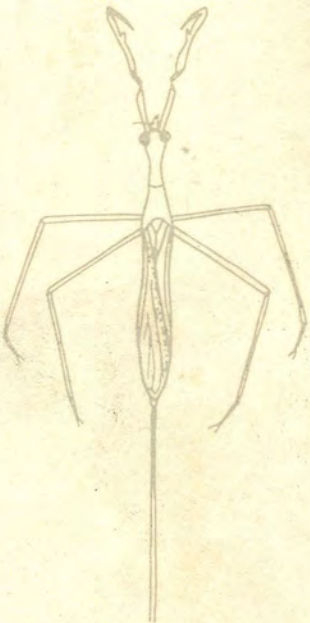
COMMON INSECTS OF FRESHWATER POND AND THEIR CONTROL

Bulletin No. 54



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Foreword

The insects which constitute an important component of the littoral fauna of aquatic ecosystems play a vital role in the trophic structure and functions of culturable water bodies. Their primary role as converters of plant materials into animal protein and consumers of organic wastes of the fish habitat is of great significance for the healthy growth of fish populations. Though the insects serve as a source of natural food for fishes, they often impair the fish productivity in the pond ecosystem by predating upon their young ones. By sharing a common trophic niche with the fish juveniles they also compete with them for food, thus retarding the growth rate of fishes. Therefore, for effective management of the faunistic resources in aquaculture it is imperative to have an insight of the biological traits of insect populations. Scattered information on several aspects of aquatic insects are available in published records. However, these are considered too inadequate to evolve any effective system for management of insect populations to the advantage of fishes.

Dr. (Mrs.) Krishna Mitra and Dr. Kuldip Kumar have succeeded in synthesizing a substantial part of the current knowledge available on the subject which, I trust, will be a valuable guide for fish culturists and entrepreneurs alike in their venture to indentify the insects. The chapter dealing with the control measures to be adopted for different insect species will come handy for the fish culturists. This bulletin attempts to fill an information gap in the management of aquaculture systems and acts as a catalyst for development of aquaculture in the country.

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INTRODUCTION

Insects constitute about four-fifth of the world fauna and considered to be the most diverse and successful group in the Animal Kingdom. Quite a large number of insects spend, for at least a part of their life cycle, in water and are commonly considered as aquatic. At present, eleven insect orders are known to have such aquatic forms. Of these, only water bugs and water beetles inhabit the water throughout their lives, although they are dependent on surface air for respiration. The rest are truly amphibious and live in water only during their immature stages.

Insects are more prevalent in shallow water bodies because of their partial adaptation to aquatic life. As a principal group in pond fauna, they constitute a significant part of the biota of aquatic community. Generally speaking, insects are desirable in pond farming as they form an important article of natural food of fishes and also serve as a reliable indicator of ecological characteristics of water. But at the same time, their prevalence in stocking ponds, especially in nurseries, is highly injurious. They, in general, act as competitors of young fishes for food and the predaceous ones among them cause heavy mortality to spawn and particularly the newly emerged hatchlings. As the aquatic insects and their immature stages have direct or indirect role on the survival and growth of young fishes in nurseries, an intimate knowledge about these insects and their proper management is deemed essential for remunerative fish culture.

CLASSIFICATION OF INSECTS

Survey of freshwater aquaculture ponds at Barrackpore shows that 42 species of insects belonging to seven orders, viz., Ephemeroptera, Odonata, Hemiptera, Coleoptera, Trichoptera, Lepidoptera and Diptera occur throughout the year, though their abundance varies depending upon the climatic conditions. To facilitate ready identification, a number of illustrations (scales denote natural size), and short descriptions of each taxa with distinguishing characters of the group to which they belong, are given below.

Order EPHEMEROPTERA

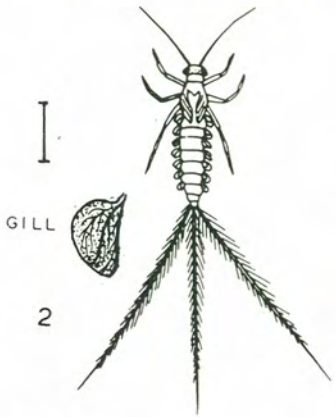
Commonly known as mayflies, the adults are terrestrial and found only near the freshwater, while the young stages are aquatic. The nymphs can be easily distinguished from the aquatic stages of other insects by the presence of three, long, tail appendages. They all posses trachial gills on the abdominal segments, the shape, size and position of which of course vary within the order. The egges are usually laid on the water surface which sink down to the bottom. The nymph passes through several moults before becoming an adult. The full grown nymph come near the surface only when they are ready to transform and crawl out of water climbing emergent vegetation of the substratum. Most species have an annual life cycle, although a few live for two to three years. The nymphs are basically herbivorous, feed on vegetable matters including the algal coatings of submerged substratum, and themselves form an important food item of fishes and other predating insects.

Family Baetidae

The nymphs are almost cylindrical in shape and eyes are dorsolateral. Antennae length more than 3 times the head width. Forelegs without fringes of hair and claws are all alike in structure and size.

***Caenis* sp.** (Fig. 1).

Nymphs 5-6 mm long with symmetrical caudal appendages evenly beset with bristles throughout. Vestigial first pair of gills is a characteristic of the species, while second pair form a hard covering which protects the remaining four pairs of gills arranged in series underneath.



***Cloeon* sp.** (Fig. 2).

Nymphs 6-7 mm long and very active. Can be easily recognised by their seven pairs of double lamillate gills with branched trachea on II-VIII abdominal segments.

Order ODONATA

The order is divided into two suborders, Anisoptera (dragonfly) and Zygoptera (damselfly). Adult members of both the suborders are terrestrial but their nymphal stages are all aquatic. The nymphs or naiads of both the flies can be distinguished mainly by the following characters.

Dragonfly nymphs :

Short and stout; head narrower than thorax and abdomen; anal opening surrounded by a number of small spine-like projections; nymphal gills internal. Usually sprawl on the bottom of the pond.

Damselfly nymphs :

Slender and delicate; head markedly wider than thorax and abdomen; anal opening not surrounded by spine-like projections; nymphal gills external, comprised of three, flattened, projections at the caudal end of abdomen. Usually cling to the water plants.

The food mainly consists of all stages of aquatic insects, molluscs, entomocrustaceans and algae. Some of them feed on mayfly nymphs and chironomus larvae which are the food of young fishes. They also eat the larvae and adults of many animals which predate upon small fishes, such as diving beetles, water boatman, cray fish and cypris. A few larger species may sometimes eat young fishes under natural conditions. The odonate nymphs themselves furnish one of the best food for carnivorous fishes.

The eggs are laid in water either in gelatinous masses on floating mats of algae or in mud along the water edge. Some can deposit inside the tissue of submarginal plants. There are about eleven to fourteen instars. Dragonfly usually takes a year to complete the life cycle, while damselfly has several generations in a year. Four dragonfly (Anisoptera) nymphs, belonging to Libellulidae and Aeshnidae and two damselfly (Zygoptera) nymphs belonging to Coenagrionidae are commonly found in ponds.

Family Libellulidae

The adults are mostly showy, medium to large size dragonflies, commonly hover over the surface of water.

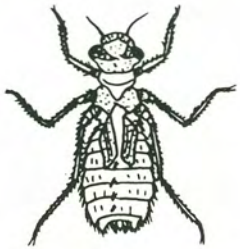
The naiads are protectively coloured, their head quadrate, labia characteristically spoon shaped, eyes projecting from anterior corners, abdomen triquatral and strongly spined both laterally and dorsally, and the legs rather long and spidery. They sprawl on the bottom in shallow water (fig. 3).

***Sympetrum* sp.**

Nymphs hairy, muddy brown in colour with long legs. Mask spoon shaped. Dorsal hook present on VIII abdominal segment. Lateral spines of VIII and IX abdominal segments short. Inferior anal appendages noticeably longer than superior anal appendages.

***Pachydiplax* sp.**

Nymphs muddy brown in colour. Dorsal abdominal hooks absent. Lateral spines on VIII abdominal segment short, while those of IX reaches up to tip of anterior anal appendage. Anal appendages long and straight.



Urothemis signata (Rambur) (Fig. 3).

Nymphs spiny, brown in colour. Lateral spines present on VIII and IX abdominal segments. Dorsal hooks present on III-VIII abdominal segments which increase in size posteriorly.

Family Aeshnidae

Adults are large, robust and strong flying dragonflies, commonly seen over the ponds.

The naiads are elongated, their head subtriangular and flattened, labia elongately pyriform, prothorax large and often armoured with projecting tubercles or spines, abdomen cylindrical and often spined laterally on the end of the segments, and the legs are short and robust.

They clamber over aquatic vegetation and bottom trash, capture and eat almost every living animal and even small fry, and are also cannibalistic (fig .4) .

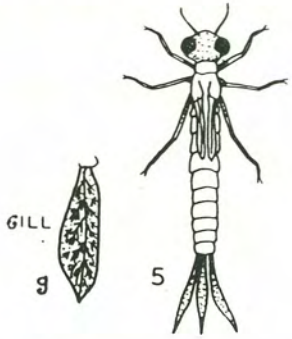
***Anax* sp** (Fig.4).

Nymphs elongated, smooth, light brown in colour. Lateral spines present on VII-IX abdominal segments. Superior anal appendages slightly shorter than inferior anal appendage, cleft at apex. These are notoriously cannibalistic, actively climb on submerged weeds.

Family Coenagrionidae

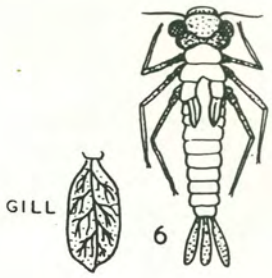
These are mostly brightly coloured damselflies with clear wings. The naiads are elongated-cylindrical, green or brown in colour,

their antennal segments nearly equal in length. Climbing forms usually live in submerged weeds.



***Enallagma* sp.** (Fig. 5).

Nymphs slender; caudal gills elongated and with numerously branched trachae.



***Agria* sp.** (Fig. 6).

Nymphs stout; caudal gills thick and triquetral with fewer and branched trachae.

Order HEMIPTERA

Commonly known as bugs, the insects of this group can be distinguished by their head modified anteriorly to form a rostrum, their prolegs for siezing and holding prey, and also by their piercing and sucking type of mouth parts. The antennae are longer than the head in surface bugs but variously reduced and concealed in true aquatics.

Nearly all aquatic bugs are predaceous and their food mainly consists of small terrestrial and aquatic insects and entomocrustacea. They generally over winter as adults, and lay eggs during spring and summer. The nymphs normally undergo five moults before becoming adults.

Thirteen taxa belonging to six different families are commonly met with almost throughout the year. These are *Gerris nitida* Mayr, *Gerris spinolae* Leth. & Sev. (Gerridae); *Anisops* sp. (Notonectidae); *Plea* sp. (Pleidae); *Ranatra filiformes* Fab., *Ranatra elongata* Fab., *Laccotrephes ruber* Linn. (Nepidae); *Lethocerus indicus* Lep. & Serv., *Diplonychus annulatum* Fab. (Belostomatidae); *Corixa hieroglyphica* Duf., *Micronecta* sp.,

Micronecta merope Dist., *Micronecta proba* Dist. (Corixidae). Though these species are found throughout the year, they form large population during March to October. The population formed by the *Gerris*, *Lethocerus* and *Laccotrephes* are, however, smaller as compared to other species.

Family Gerridae

Known as pond skaters, these are common insects of water surface. They are unique in having antennae conspicuously longer than their head, long legs with preapical claws, and a single scent gland opening at the middle of the metasternum in adults.

They are semi-aquatic; though mostly wingless, a few in the same population have wings and can fly if the ponds dry up. They feed largely on dying insects that fall on water surface but also predate on aquatic organisms which come to the surface.

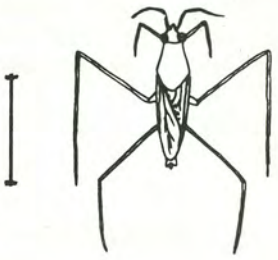
The eggs are long and cylindrical, usually laid in rows parallel to one another and are glued to floating objects which, of course, remain at approximately the level of water surface throughout the season.

***Gerris nitida* Mayr**

Adults 8-10 mm long; head and pronotum black, shining ; hemelytra with violaceous reflection ; sternum and abdomen silvery grey; head with two longitudinal lines above within eyes ; antennal segments subequal, first and fourth longer than second and third; abdominal spiracle black.

***Gerris spinolae* Leth. & Sev.** (Fig. 7).

Adults 13-15 mm long ; head, rostrum, pronotum and anterior legs black ; hemelytra pale brownish ; antennal segments unequal, first about as long as remaining segments together, third shortest, second a little shorter than fourth.



Family Notonectidae

Commonly called back swimmers because of their peculiar habit of rowing with the ventral side facing up. The body is elongated,

dorsally convex and ventrally keeled, provided with short and partially concealed antennae, short, stout and 4-segmented rostrum, and very long, oar-like hindlegs fringed with swimming haris. Also distinguished from related families by absence of posterior abdominal appendages and nymphal scent glands.

They respire by breaking the surface film with the tip of abdomen and though truely aquatic, the adults can fly for a distance. They are fiercely predaceous and feed on any invertebrate that they can overpower. The eggs are either inserted in plant tissues or glued to their surface.

***Anisops* sp.** (Fig. 8).

Adults 7-10 mmlong,with unusually large eyes; head and thorax coloured dorsally with various shades of white, grey and yellow, etc. Swim powerfully by rapid oar-like strokes of hindlegs and often come to rest at surface with tip of the abdomen in contact with air.

Nymphs mostly feed on entomocrustaceans but the food of the adults consists of living creatures sometimes much larger than themselves, e.g., tadpoles, fish fry , etc. Two different species are observed in the pond.

Family Pleidae

Known as pigmy back swimmers, these are smallest among the water bugs. They are closely related to Notonectidae but differ in having suboval body with elevated venter, hindlegs that are not oar-like, and a single dorsal abdominal scent gland in nymphs.

***Plea* sp.** (Fig. 9).

Adults 1.6-2.3 mm long; body strongly arched and greyish in colour. Cling to leaves and stems in densely tangled vegetation, swim only for a short distance and dodge from stem to stem. Food consists mainly of entomocrustaceans.

Family Nepidae

Though known as water scorpions because of their chelate forelegs, they are distinguished from the remaining water bugs primarily by their long, slender, caudal appendages.

Like Notonectids, they too have short and partially concealed antennae and short, stout, 4-segmented rostrum. But their forelegs are stout and raptorial while the remaining legs are slender and suited for movements among trash and tangled vegetation. The nymphs are also without scent glands.

They obtain air by protruding their grooved caudal appendages above water surface. They do not move actively in search of food but feed voraciously on all sorts of aquatic organisms that happen to be within their reach.

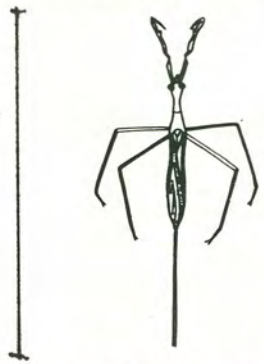
In Nepids, the eggs are oblong with two or more filaments and are inserted in plant tissues with filaments projecting out.

***Ranatra* sp.**

Slender and subcylindrical, straw-coloured, usually cling to the submerged aquatic weeds along margins of pond with tip of respiratory siphon just above the surface of water. Two non-retractile caudal filaments which, when held together, form a respiratory tube. Feed on all aquatic organisms, especially insects, and also act as predators of spawn and hatchlings.

***Ranatra filiformes* Fab.**

Adults 2.4-2.6 cm long excluding respiratory siphon which is shorter than body, dull brownish-yellow in colour, eyes prominent, posterior and middle legs prominently annulated than anterior legs.

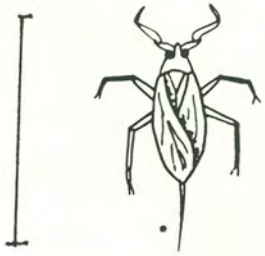


***Ranatra elongata* Fab.** (Fig.10).

Adults 4.4-4.6 cm long excluding respiratory siphon which is longer than body, greyish brown in colour.

***Laccotrephes ruber* Linn.** (Fig. 11).

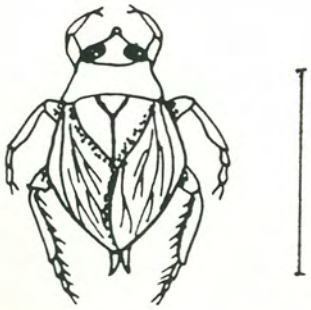
Adults about 3 cm long excluding abdominal appendages which are slightly longer than body, brown in colour. Differ from *Ranatra* sp. being more stout, broad and flat. Feed on all kinds of metazoa including insects.



Family Belostomatidae

They are large, dorsiventrally subflattened bugs with short and partially concealed antennae, and short, stout, 4-segmented rostrum. Like Nepids, they have a pair of caudal respiratory appendages, but these are very short, strap-like and retractile. Their forelegs are also chelate and raptorial but being strong swimmers the hindlegs are well developed, flattened and fringed with swimming hairs. The nymphs are also without any scent glands.

In general, Belostomatids are fiercely predaceous and feed on all kinds of aquatic organisms including larger forms such as tadpoles, small frogs and fishes. They take rest and respire by extending their body obliquely downwards with the caudal appendages in contact with air.



***Diplonychus annulatum* Fab.** (Fig. 12).

Adults 2.6-2.8 cm long, oval, brown in colour. Young nymphs usually greenish in colour, nymphal forelegs 1-clawed.

The eggs are laid in clumps on the back of male which they carry until incubated.

***Lethocerus indicus* Lep. & Serv.** (Fig. 13).

Commonly called electric light bug, because of their attraction to light at night; easily distinguished by the gigantic size. Adults 7-10 cm long, elongated, muddy brown in colour. Nymphal forelegs 2-clawed.

The eggs are laid in masses on plants above water.

Family Corixidae

Known as lesser water boatman, the members have elongated, dorsally convex and ventrally flattened body with short and partially concealed antennae, but their short rostrum is scarcely segmented and forms a broad cone shaped apex of the head.

Corixids, are however, easily distinguished by their comb-like palmer bristles of front tarsi which help in scooping up small benthic organisms - their food, and three pairs of abdominal scent glands in nymphs.

They spend more time at the bottom using oxygen from water by their extensive plastron surface and occassionally come to surface to renew air supply by breaking water film with pronotum. Like other Hemiptera, they do not suck the juice of their food but ingest the whole organism.

The eggs are suboval in shape and characteristically stalked, laid in enormous numbers on submerged objects.

***Corixa hieroglyphica* Duf.** (Fig. 14).

Adults 6 mm long, greyish brown in colour; scutellum covered by pronotum having seven or eight transverse black lines; elytra with short, transverse fragmentary markings.

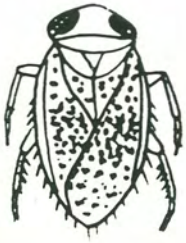
Closely resembles members of Notoncetidae but differs in having ventrally flattened body with blunter tail end and swims in normal way unlike them.

***Micronecta* sp.**

Similar to Corixids but their scutellum is exposed, and is also much smaller in size (3-4 mm long), hence the generic name. The following two species are very common in ponds.

***Micronecta proba* Dist.**

Adults more or less oblong, yellowish brown in colour; elytra with four, indistinct, longitudinal broken lines.



***Micronecta merope* Dist.** (Fig. 15).

Adults ellipsoid, yellowish brown in colour; elytra with small, scattered, black spots.

Order COLEOPTERA

The insects, commonly known as beetles, are characterised by having sclerotised forewings called elytra under which the membranous true wings remain folded. They have well developed mouth parts modified for biting and in aquatic ones somewhat flattened legs, especially the last pair, which help in swimming. Both adults and larvae are predaceous as well as herbivorous. The

eggs are deposited below the surface of water and though the larvae are aquatic, they mostly pupate on land near water.

The following species are very common in the freshwater ponds : *Canthydrus laetabillis* (Wlk.), *Canthydrus morscbachi* (Wel.), *Hydrocoptus subvittulus* Mots., *Hydrovatus bonvouloiri* Sharp, *Hydrovatus confertus* Sharp, *Eretes* sp. (Dytiscidae); *Berosus indicus* Mots., *Halochares* sp., *Regimbertia attenuata* Fab., *Sternolophus rufipes* Fab. (Hydrophilidae); *Dineutes* sp. (Gyrinidae), and *Bagous* sp. (Curculionidae).

Family Dytiscidae

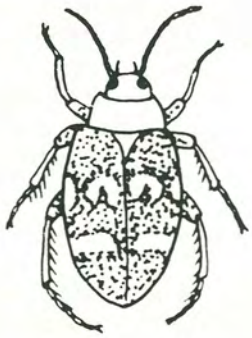
The adults are characterised by having 11-segmented, thread-like, glabrous antennae inserted close to the eyes. They have short and broad head sunk in the prothorax and 6-segmented abdomen which is visible ventrally. Adults spend most of their time under water but obtain air by breaking through surface film or from bubbles attached to aquatic plants.

The larvae are generally spindle shaped with sickle shaped jaws and there is a pair of cerci on last abdominal segment. To renew air supply, they often hang from the surface with the tip of abdomen exposed to the air.

Both adults and larvae of all the Dytiscids are predaceous and feed on larvae and adults of other aquatic insects, shrimps, worms, leeches, snails, tadpoles and even small fry. Mature larvae crawl up to the margin of pond and pupate in damp soil. The female oviposit normally on or in plants under water, sometimes within the tissues of aquatic plants with the specialised ovipositor. Usually univoltine, overwinters either in adult or larval stage. Adults hibernate in debris or burrow themselves in mud.

***Canthydrus laetabilis* (Wlk.)** (Fig. 16).

Adults about 2.5 mm long, ellipsoid and somewhat attenuated posteriorly; head and antenna testaceous; elytra black with yellow spots.



***Canthydrus morscbachi* (Wel.)**

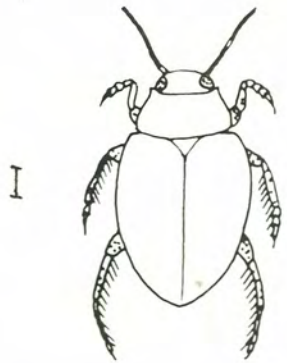
Adults about 3.5 mm long, ovoid, reddish brown in colour. Found associated with weeds.

***Hydrocoptus subvittulus* Mots.**

Adults about 2 mm long, ovoid and moderately convex; head and pronotum rusty red; antenna pale yellow; elytra reddish brown. Found associated with floating weeds.

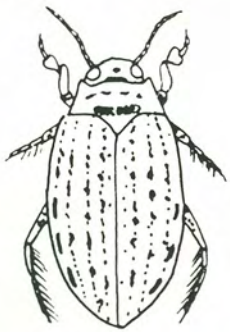
***Hydrovatus bonvouloiri* Sharp** (Fig. 17).

Adults 3-3.5 mm long, moderately convex, brown in colour; punctation on elytra fine and dense; legs and coaxae brilliant yellow with distinct but remote punctures.



***Hydrovatus confertus* Sharp**

Adults about 2.5 mm long, more or less ellipsoid; head, pronotum and elytra ferruginous; punctation on elytra very fine and moderate.



***Eretes* sp.** (Fig. 18).

Adults about 14 mm long, dull yellowish in colour; elytra marked with dark spots and three short bands along lateral margin giving a spotted appearance.

Family Hydrophilidae

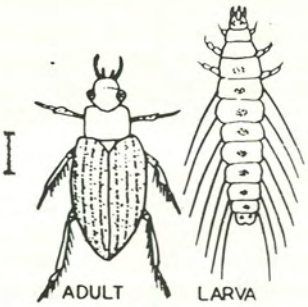
In these beetles the antennae are short, club shaped, 6-9-segmented, and inserted before the eyes. The maxillary palpi are

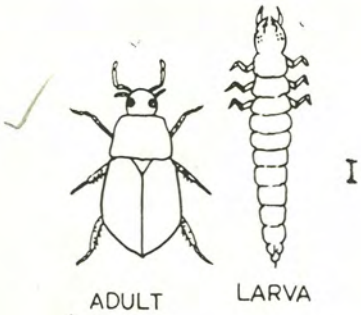
usually much longer than antennae and their abdomens are with (4-) 5 (-7) visible ventral segments. Nearly all are omnivorous and, being poor swimmers, spent much of their time crawling among the aquatic plants. The beetles project their head to the surface and not the tail unlike Dytiscidae when they come to the surface for air.

The eggs are laid usually in spring, but some oviposit even throughout summer, and these are carried in transparent bags attached to the abdomen of females until hatched. The larvae are heterogeneous, usually pupate in damp soil near water.

***Berosus indicus* Mots.** (Fig. 19).

Adults about 5.5 mm long, yellowish grey in colour ; elytra evenly and densely punctate with deep brown colour; antenna light yellow; second and third legs with swimming hairs. Larvae cylindrical, abdominal segments with long lateral filaments (tracheal gills) except the last one.



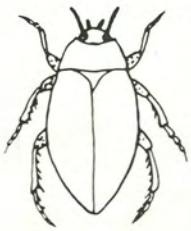


***Halochares* sp.** (Fig. 20).

Adults about 1 mm long, head black, pronotum and elytra yellow. Found associated with weeds.

***Regimbertia attenuata* Fab.** (Fig. 21).

Adults about 11 mm long, ellipsoid, moderately convex; head, pronotum and elytra black; antenna reddish brown.



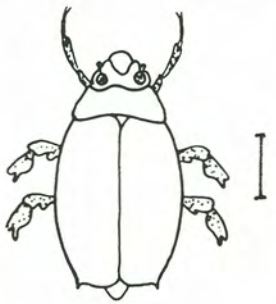
***Sternolophus rufipes* Fab.**
(Fig. 22).

Adults about 6.5 mm long, ellipsoid, slightly convex, greyish black in colour.

Family Gyrinidae

Commonly called whirligig beetle, they are found usually in groups on the surface of water and are characterised by having short, thick, 11- segmented antennae inserted (latero-ventrally) behind the base of the mandible. Their eyes are divided into two widely separated submerged and non-submerged parts enabling them to have aerial as well as aquatic vision when they swim, and the abdomen with 7 visible ventral segments.

The larvae are long and slender, have a pair of tracheal gills on each of the first eight abdominal segments and two pairs on the ninth segment. These are predaceous and cannibalistic, feed on blood worms, odonate nymphs and even small fry. The larvae emerge out of water crawling on aquatic plants, spin a cocoon and pupate inside it. The adults are good fliers, hibernate during cold months in mud or trash at the bottom or edge of the pond. The eggs are laid on the submerged plants during spring.



***Dineutes* sp.** (Fig. 23).

Adults 7-9 mm long, shiny black; abdomen protruded beyond elytra; middle and hindlegs greatly flattened and bladder-like, help in swimming.

Family Curculionidae

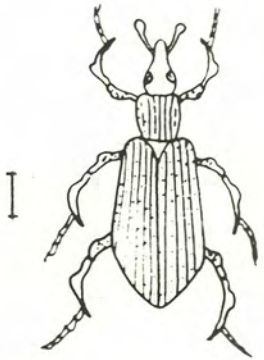
Popularly known as weevils, the head in these insect is either globular and well-set in the prothoracic cavity or prolonged behind the eyes into a short neck, and produced infront characteristically into a long snout at the end of which the mouth parts are arranged. The antennae are situated anywhere between the base and apex of the rostrum, geniculate in insects having

globular head and straight in those having a short neck.

The larvae are rather stout, distinctly curved and somewhat narrowed at the posterior end. Mature larvae construct a cocoon attached to the food plants.

***Bagous* sp.** (Fig. 24).

Adults 4-5 mm long, dirty brown in colour. All stages are semiaquatic, live and feed on a variety of floating or emergent weeds. They are not able to swim but merely drift through water if they lose their hold on the food plant.



Order TRICHOPTERA

The adults are known as Caddisfly, look like moths, and being poor fliers, usually found resting near the ponds, while their immature stages are all aquatic.

The eggs are laid on or underside of the submerged leaves and are covered with mucilage. The larvae (caddis worm) form tubular cases around themselves with an opening at each end. They have a longitudinal cuticular fold beset with hairs on each side of abdomen, and a hook-like appendage at the extreme posterior end with which they anchor the case. There are about 6-7 larval instars. The full grown larvae spin cocoon while inside the case and pupate. Before pupation, the mature larva attaches itself firmly to a support out of water when the fly emerges out. These are usually omnivorous insects.

Family Leptoceriodae

Larvae are common in standing waters. Antennae of the larvae at least 7 times as long as wide, and arising at the base of the mandibles. Case is portable, conical or cylindrical, curved or straight and made of sand grains, vegetable matters or silk.

***Leptocerus* sp.** (Fig. 25).

The only trichoptera larvae found in the pond, easily recognised by their off white protective conical cases made of sand, which are straight at the beginning and slightly curved afterwards.

Larvae 7-8 mm long, slender and cylindrical. These are bottom dwellers and exclusively herbivorous.

Order LEPIDOPTERA

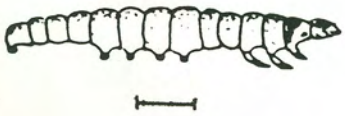
Comprises moths and butterflies, which are primarily terrestrial. Severl species of Microlepidoptera, belonging to family Pyralidae, commonly known as China mark moth, have aquatic forms. The adults are small and dull-coloured, found near the ponds.

They lay eggs on the side of submerged leaves. Pupation takes place in air-filled cocoons attached to the submerged plants. The caterpillars have three pairs of well developed thoracic legs and five pairs of pseudopods on II-VI and XI abdominal segments. They protect themselves by making a case out of bitten off pieces of leaves and stems. The caterpillars feed on variety of submerged or floating plants.

Family Pyralidae

Larval head darker than the body, external gills when present in larvae are branched ranging up to 400 gill filaments. Spiracle present on I-IV and VIII-XI abdominal segments which are reduced.The following two species are very common in ponds.

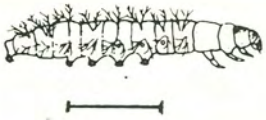
***Nymphula* sp.** (Fig. 26).



Larvae about 7 mm long, slender; head and thorax heavily sclerotised; external gills absent.

***Nymphula* sp.** (Fig. 27).

Larvae about 12 mm long, stout, head and thorax moderately sclerotised; all except thoracic segments with number of branched, paired, gills on dorsal, lateral and ventral side.



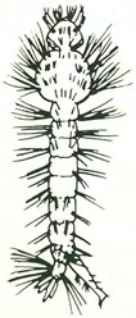
Order DIPTERA

The adults are highly specialised two-winged flies. Though mostly terrestrial, members of many families have minute aquatic stages which are found in every type of freshwater habitats. Their eggs are usually deposited in regular or irregular masses on submerged vegetation or stringed at or below the surface of water.

The larvae are elongated, soft, flexible and worm-like, their mouth parts being variously modified from vestigial to scraping type. By complex fans present on their mouth, they usually strain minute organisms from water, but are also known to feed on other plant materials, small animals and their debris.

Family Culicidae

It includes mosquitoes and phantom midges. Easily distinguished from other dipteran larvae by their thoracic segments being fused, enlarged and distinctly thicker than rest of the body. The larvae usually lie quietly at the surface of water but when disturbed they wriggle downward.



***Culex* sp.** (Fig. 28).

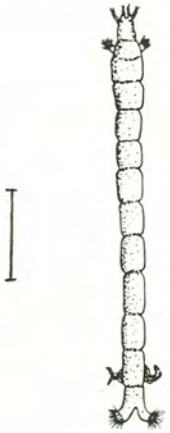
Larvae 6-7 mm long, usually remain hanging at an angle with only the tip of the respiratory tube at the surface. Eggs are laid in masses or rafts on the surface. Feed on protozoa, algae and organic debris.

Family Tendipedidae

The midges are most abundant in shallow water and are characterised by having a complete head capsule which is not retractable within the thorax and a pair of well developed anterior and posterior forelegs on the thorax and last abdominal segment. They do not have spiracle but some times anal gills are present on lateroventral surface of penultimate abdominal segments. Many species form fragile tubes composed of algae. Feed mainly on algae, plankton and detritus.

***Tendipes* sp.** (Fig. 29).

Pink to red coloured midges, commonly known as blood worm. Larvae 10-12 mm long. Usually bottom dwellers, live inside fragile tubes open at both ends and made up of sand grains cemented together by salivary scretion. Food mainly consists of organic particles obtained from detritus of the bottom.

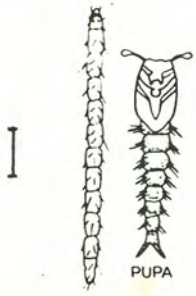


Family Heleidae

The biting midges, often called sand flies. Most of the genera are predaceous on the small and soft-bodied insects. Immature stages are mostly aquatic. Larvae elongate, eel-like and legless, abundant in floating masses of algae along the margin of water. The pupae are typically conical with spinose abdomen bearing a pair of apical lateral processes. They are herbivorous as well as carnivorous.

***Probezzia* sp.** (Fig. 30).

Larvae 5-6 mm long, 9-segmented; first eight segments each with three pairs of lateral spines of unequal size while the last segment ends into a blunt projection. Live on the surface of water and swim in an undulating manner; feed on algae.

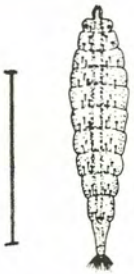


Family Stratiomyidae

The aquatic larvae can be easily identified by the opaque deposits of calcium carbonate in their integuments. These are spindle shaped and flattened, have a circlet of hairs or bristles around a pair of spiracular openings at the extreme posterior end. Food includes organic debris, algae and small metazoa.

***Stratiomys* sp.** (Fig. 31).

Larvae 20-23 mm long; body flattened, having leathery skin, impregnated with calcarious matter, blackish brown in colour; head small, teleoscopic. Pupae remain enclosed in the last larval skin.



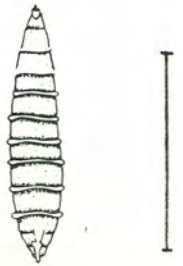
Somewhat sluggish and apparently look lifeless; mostly remain hanging from the surface of water by means of a tuft of stellate filaments present at the extreme posterior end which act as float.

Family Tabanidae

The aquatic larvae are cylindrical, tapering at both ends. They have a pair of fused dorsal, lateral and ventral prolegs on each of the first seven abdominal segments, and a short siphon at the extreme posterior end. They are all predaceous on soft bodied invertebrates.

The eggs are spindle shaped and deposited in compact masses on submerged leaves and stems.

***Tabanus* sp.** (Fig. 32).



Larvae about 26 mm long; body divided into a minute, retractile head, three thoracic and eight abdominal segments. The girdles of abdominal prolegs help in locomotion. Found in muddy bottom in shallow waters, feed on snails, oligocheates and insect larvae.

Pupae elongated, cylindrical, the terminal segment armed with six stout, pointed projections ; also found in mud along the edges of water.

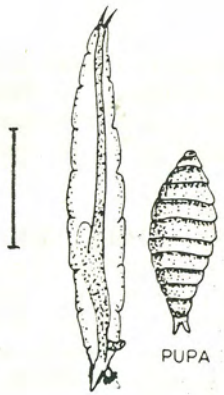
Family Muscidae

This includes houseflies and large number of agricultural pests. In those having aquatic immature stages, the larvae are distinguished by their more tapering front end and pointed (not rounded or truncate) hind end with the posterior spiracles lying at its tip.

The eggs are usually cylindrical-ovoid in outline, plano-convex and flanged on the ventral surface. The first and even the second larval stages are sometimes completed in the egg and the third instar is usually predaceous and feeds mainly on other Diptera. They obtain air by keeping their pointed hind end in contact with the surface.

***Limnophora* sp.** (Fig. 33).

Larvae 15-16 mm long, cylindrical, offwhite, very much similar to housefly maggot but with much tapered anterior and posterior segments. Head totally retractile except for the pair of black mouth hooks. Vestigial psuedopods present on ventral side of each abdominal segment, the last pair being the largest. Of the two pairs of spiracles, the one on prothorax is comparitively smaller than the other on the posterior end of the body. The pupa is reddish brown with eleven visible segments. The larvae found among the mats of algae.



CONTROL

It is seen that a large number of insects of diverse taxonomic groups occur in fresh water ponds. They multiply very rapidly during favourable conditions and many of them in adult stages fly from pond to pond. As pointed out earlier, insects in general are not only undesirable in nursery ponds but a majority of them, especially those belonging to Hemiptera, Coleoptera and Odonata, are extremely harmful to young fry till these are at least 3-4 weeks old. Yet, in view of their easy mode of dispersal, it is not practicable to keep the nursery pond completely free of these insects. However, by judicious application of some of the prevailing control measures discussed below it may be possible to keep the insect population well within control.

Aquatic weeds and marginal vegetation play important role in harbouring aquatic insects. It is, therefore, essential to keep the ponds cleared of such weeds and marginal vegetation.

Netting nurseries with fine-meshed nets before releasing the spawn is reported to be not very effective in controlling insect population. The reason may be that the bottom dwellers are not at all affected while a considerable number of other insects are likely to be left out during the operation.

In the past, chlorinated hydrocarbons (DDT, BHC, etc.), also called organochlorine insecticides, were recommended for eradication of aquatic insects in nurseries. This group of insecticides is persistant in nature and is now considered very dreaded one because of its high incidence of residual level in the end consumers of food chain. The other major group of insecticides now in use are the organophosphorus compounds. These are generally prefered not only because of their lesser toxicity but also because they decompose rapidly in water into non-toxic compounds. But these organophosphorus compounds are also reported to act on the nervous system of fishes inhibiting transmission of nerve impulses. Hence, some of the less toxic organophosphorus compounds and carbamates can be effectively used in nurseries before release of the spawn.

The use of oil films to eradicate the air-breathing aquatic insects by causing asphyxia is an age old practice. To make the oil readily spreadable, an oil in water emulsion is prepared by addition of

surface active chemicals known as detergents or surfactants. In nursery practice, both vegetable and mineral oils are used and likewise the emulsifying agents used are either any cheap washing soap or some synthetic detergent. Among vegetable oils both mustard and linseed oil are considered effective. But linseed oil being toxic to young fry and zooplankton, mustard oil is preferred in combination with any cheap soap at the rate of 1:3 ratio. Of the mineral oils, low speed diesel is reportedly used with soaps or synthetic surfactants.

It is well known that oil loses its volatile and water soluble constituents as it spreads. A part of the oil also sinks down to the bottom in the process. Mineral oils and the solvent part of the synthetic surfactants in general are rich in soluble hydrocarbons and aromatics and, therefore, easily leach out in water. These chemicals, like mineral oils, are not easily degradable and their repeated use will tend to pollute the nursery pond. Further, even in low concentrations, dissolved hydrocarbons and aromatics in particular are reported to cause irritation to delicate fish skin, such as that covering the gills, stimulating copious secretion of mucous. Mustard oil and soap on the other hand are free of such chemicals and, being easily degradable in nature, are to be preferred. After operation, the remaining oil is to be recovered from water by some mechanical process and should not be left out or allowed to be dispersed by agitation of water surface. By agitation, droplets break down further making them invisible to unaided eye and a part of these also sink getting adsorbed to suspended silts.

The control of aquatic insects is a very difficult problem as the method employed should be economically viable and effective to a wide variety of insects and at the same time it should not endanger the useful organisms like phyto and zooplanktons, and the delicate fish fry present therein. Therefore, attempts to evolve suitable measures for control of aquatic insects should precede basic studies on their life history and behavioral ecology.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. A. G. Jhingran, Director, Central Inland Capture Fisheries Research Institute, Barrackpore, for providing necessary facilities and kindly going through the manuscript; to Dr. A. V. Natarajan, Ex-Director, under whose guidance the work was initiated. Thanks are also due to the Director, Zoological Survey of India, Calcutta, for assistance in indentification of some insect species.

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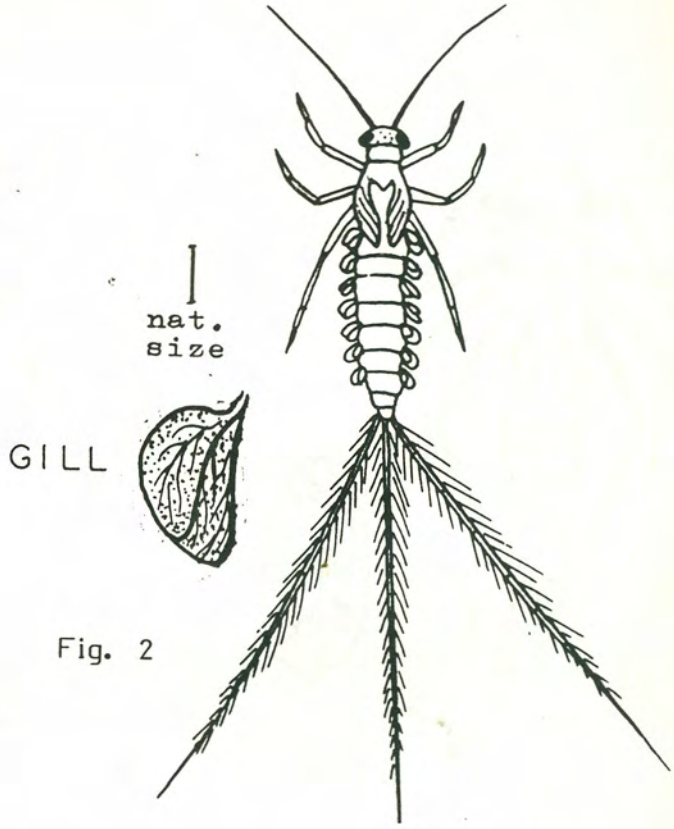
Fig. 1



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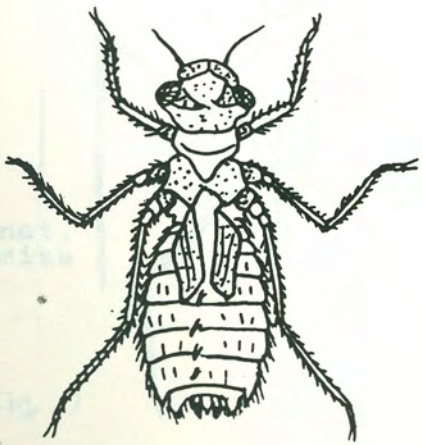

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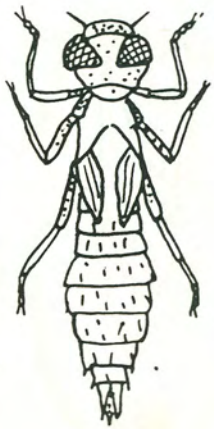

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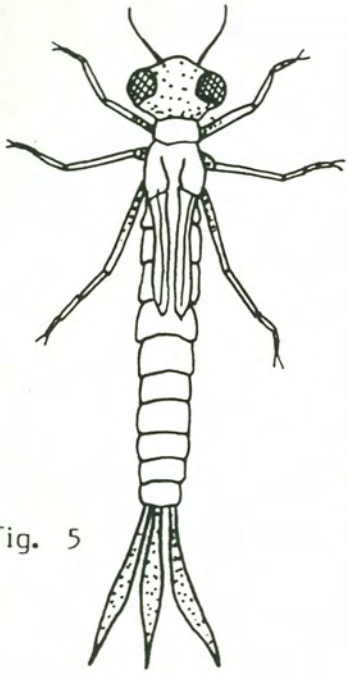

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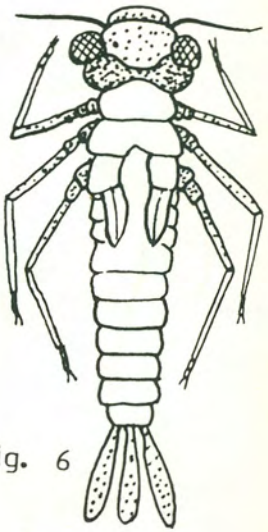

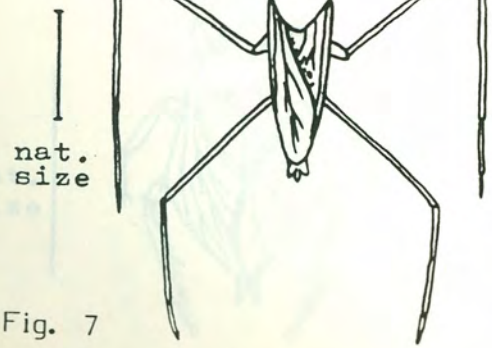

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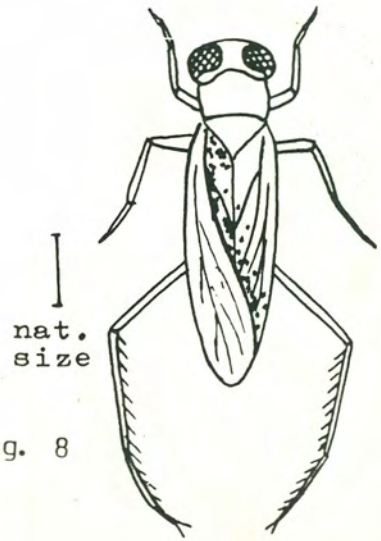

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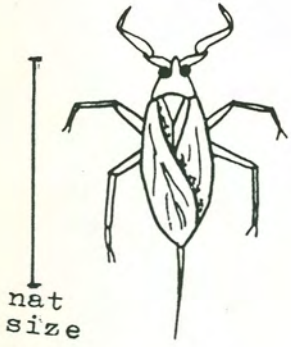

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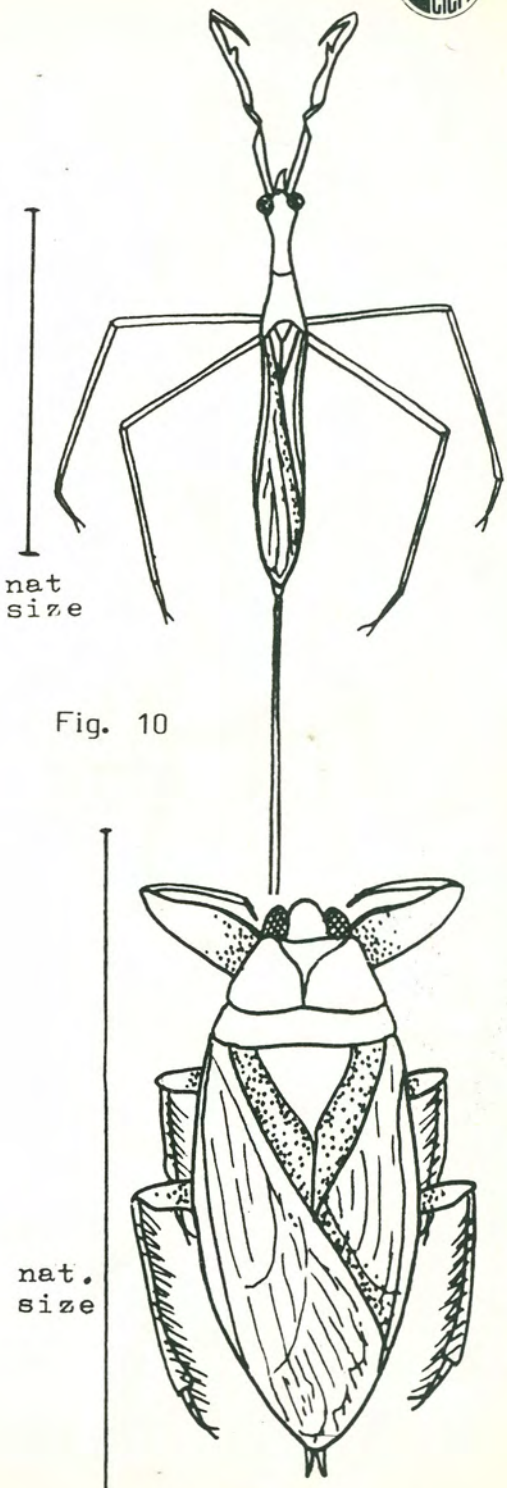

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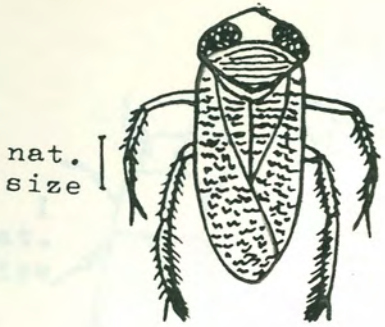

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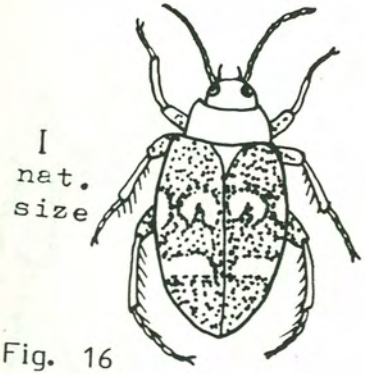

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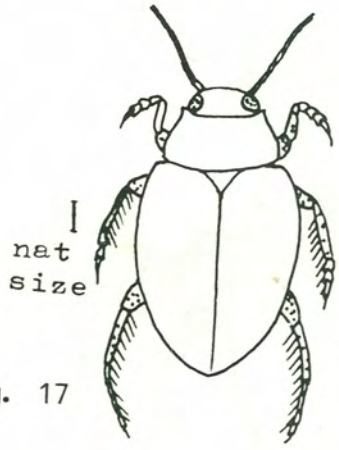

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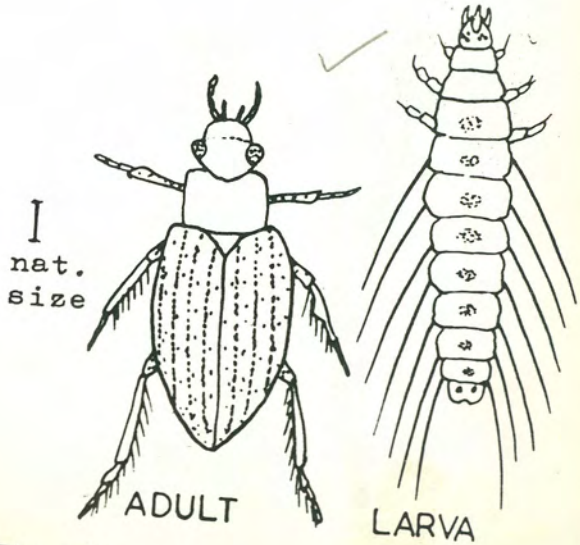

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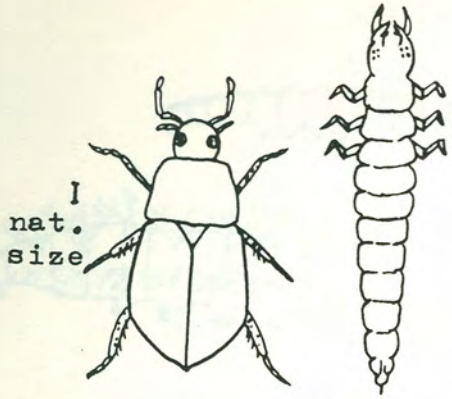
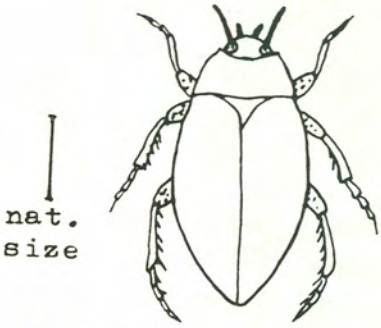


Fig. 20 ADULT LARVA



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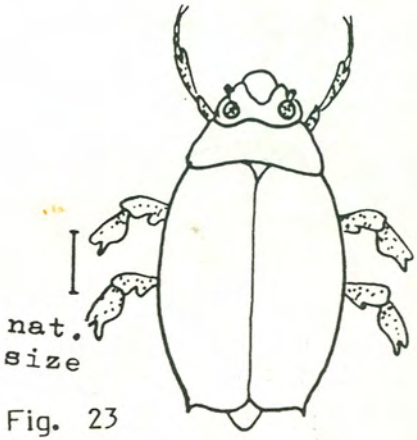

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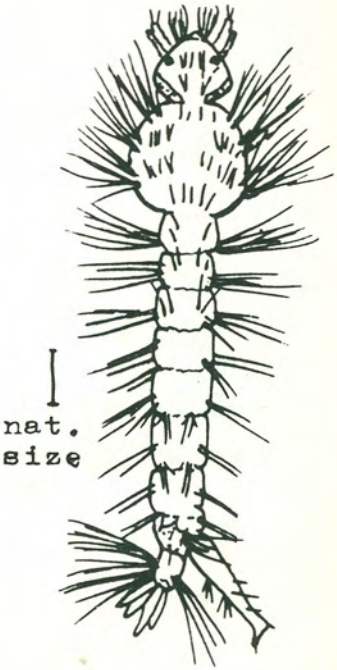

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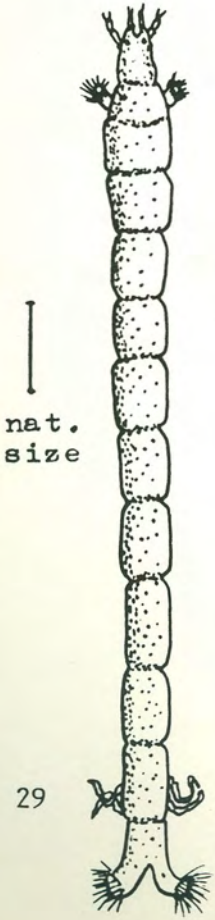

Fig. 29

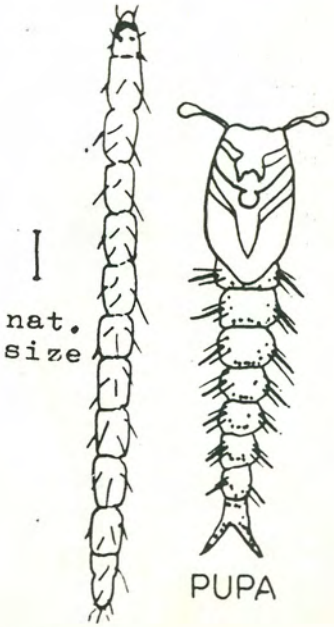

Fig. 30

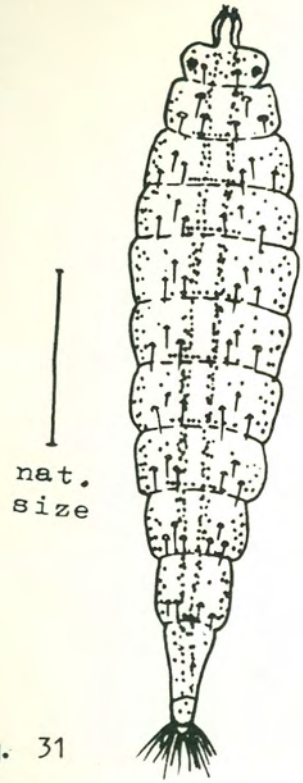

Fig. 31

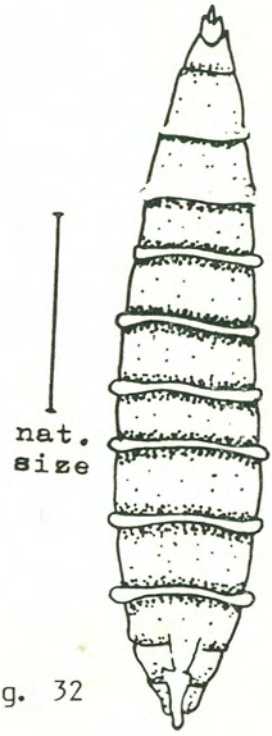

Fig. 32

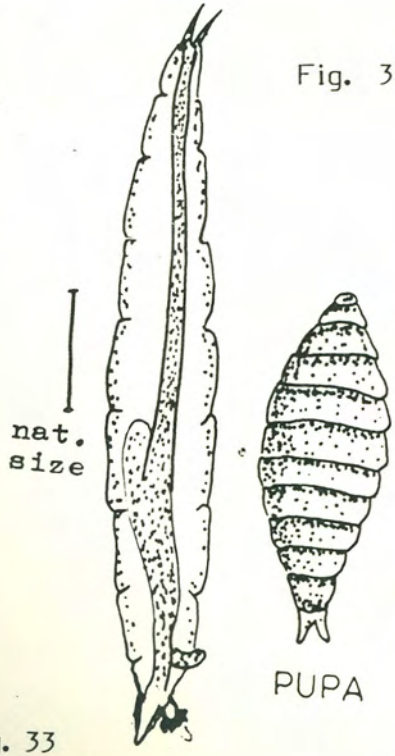

Fig. 33