

Insecta: Diptera, Tipulidae

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INTRODUCTION

Tipulidae, the group to which the crane flies belong, is the largest fly family. The body plan or morphology of crane flies is rather simple. They are characterized by an elongate body, one pair of narrow wings, and long, slender legs (Fig. 1A). The body size ranges from 5 to 50 mm and can be described as mosquito-like. They are often mistaken for mosquitoes, but they belong to a group of harmless flies. Crane flies can be distinguished from all other true flies by the transverse V-shaped groove on the dorsal part of the thorax.

Some European crane fly specialists recognize four families (Tipulidae, Limoniidae, Cylindrotomidae and Pediciidae) (Oosterbroek 1998). However, here they are dealt with as one family, Tipulidae. According to the classification concept of Charles P. Alexander (as used here), the family Tipulidae includes three subfamilies: Tipulinae, Cylindrotominae, and Limoniinae. Most large crane flies belong to the Tipulinae. These are characterized by having the terminal segment of the maxillary palps slender and longer than the penultimate segment, and the antennae are normally 13-segmented. In the Limoniinae and Cylindrotominae the terminal segment of the maxillary palps is as short as the others, and the antennae usually have 14 to 16 segments.

Crane flies serve several important roles in the ecosystem. Most importantly, they are food for many animals such as birds, fish, frogs, lizards, spiders and other insects. In addition, the larvae are detritus feeders that help to break down organic matter in various habitats such as streams and forest floors, thereby modifying the microhabitat for other invertebrate species. Fishermen use larvae of some large species as bait. Several species of crane flies are important agricultural pests; their larvae feed on seedlings of field crops and if abundant can be destructive to lawns, rangelands, rice fields, and golf courses.

GENERAL BIOLOGY

Adult crane flies are often abundant near habitats where the larvae develop. The larvae can be found in a wide variety of habitats, varying from strictly aquatic to terrestrial, even relatively dry soil in deserts. Only a few genera have truly aquatic species, the larvae of which close the tracheal system completely and exchange of

oxygen takes place by diffusion through the cuticle of tracheal gills. In contrast, most larvae of crane flies are classified as semi-aquatic. Their habitats include fresh water in fast-flowing streams, marshes, springs, alpine meadows, seeps, tree holes, algal growth or mosses on rock faces near water, organic mud and decaying vegetable debris along the shores of streams and ponds, accumulated decomposed leaves and rotting wood on the forest floor, and occasionally soil in lawn and pastures. They all

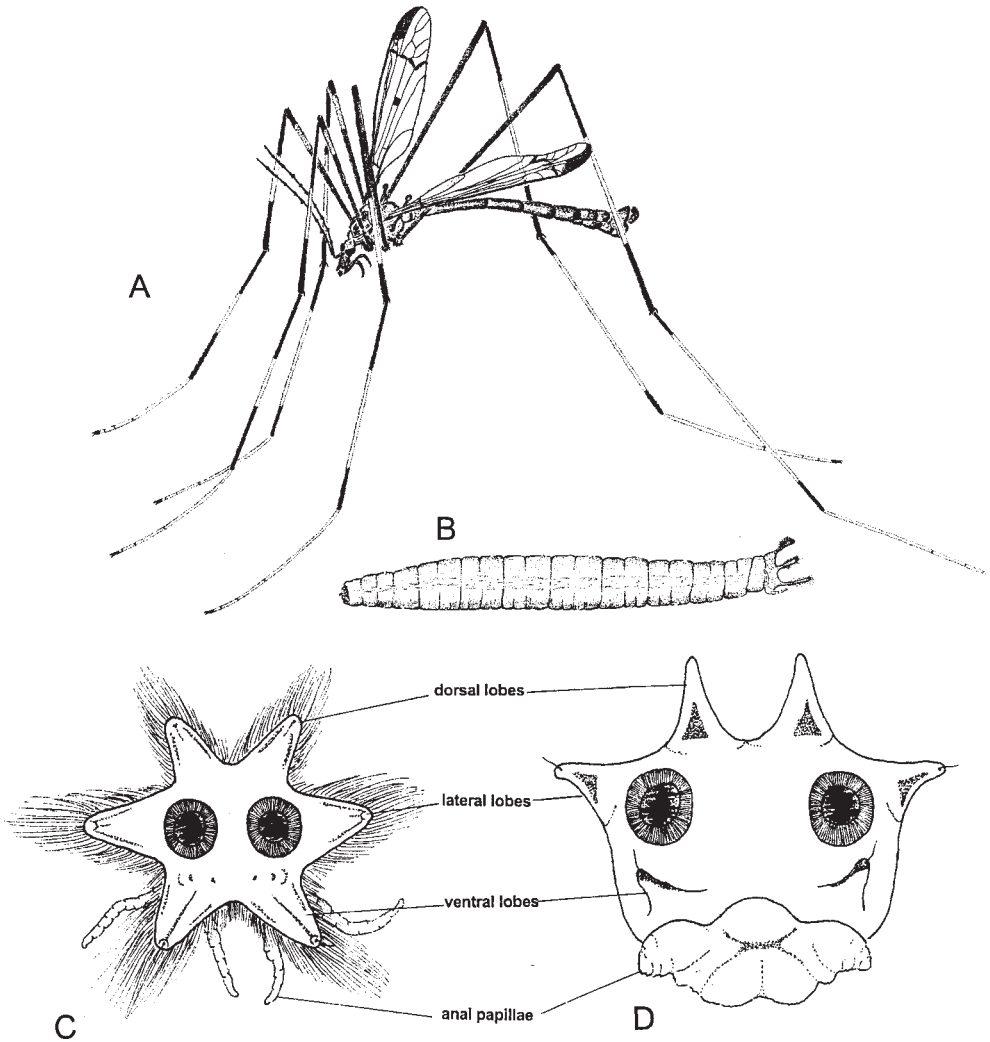


Figure 1. A, B – *Tipula (Tipulodina) nettingi* Young. A – adult, B – mature larva. C, D –

external morphology of larval spiracular area showing spiracular lobes. C – aquatic form, D – terrestrial form. (Source: C, D, modified from Gelhaus 1986)

breathe air through the posterior spiracles and some can remain submerged in water when the habitats become flooded for a limited period. The lobes surrounding the posterior spiracles often have a fringe of fine hairs that entrap a film of air when submerged.

Most adult crane fly species in the Temperate Zone emerge with the highest concentration of species and individuals in spring, tapering off through summer, reappearing in autumn, and disappearing in winter (except the species of small, wingless, spider-like crane flies of the genus *Chionea* which may be found on snow in winter). In comparison, moisture rather than temperature largely influences the emergence of the adult crane flies in the Tropical Zone. As a result of this, adults usually can be observed year-round and there is no burst of emergence and activity. Instead they are most abundant during the wet season.

Adult crane flies are most active in the cooler part of the day, usually around dusk after sunset. They are sluggish fliers and can be collected by sweeping an aerial net through their resting sites, in the air as they fly, or through their mating swarms. They can be collected early in the night by light trap, or using a white cloth sheet illuminated by light sources such as a black light or mercury vapour lamp. Malaise traps have also proved to be a successful means of collecting adult flies. For detailed methods of collecting, preservation, and preparation of crane fly larvae, see Gelhaus (1986); for adults, see Byers (1961).

The majority of crane fly larvae are scavengers feeding on decomposing plant material and the associated microorganisms. Larvae of some aquatic species are predators on other invertebrates, and several are herbivores on algae, moss or herbaceous plants.

Life cycle

Crane flies undergo complete metamorphosis in their development with a brief egg stage, a relatively long larval feeding stage, a brief pupal resting stage, and finally a short adult breeding stage.

Mature eggs are generally black, brown, or white, and elongate-ovoid in shape. The chorion is either smooth, hairy, or has a varied hexagonal pattern. Females deposit their eggs in a variety of substrates ranging from water, damp soil, and mud to decaying wood and algal mats. Oviposition takes place when the female taps the tip of the abdomen randomly on the substrate. Females of some species insert the whole or part of the abdomen into the substrate for oviposition. Eggs usually hatch without delay; some may undergo diapause in droughts or during the cold part of the year.

The typical shape of mature crane fly larvae is elongate, tapering gradually toward both ends (Fig. 1B). The skin is thin, tough, and usually covered with

microscopic hairs. The head is fairly complete and can be retracted into the thorax. The posterior end (Fig. 1C,D) has a single pair of spiracles surrounded by a disc of

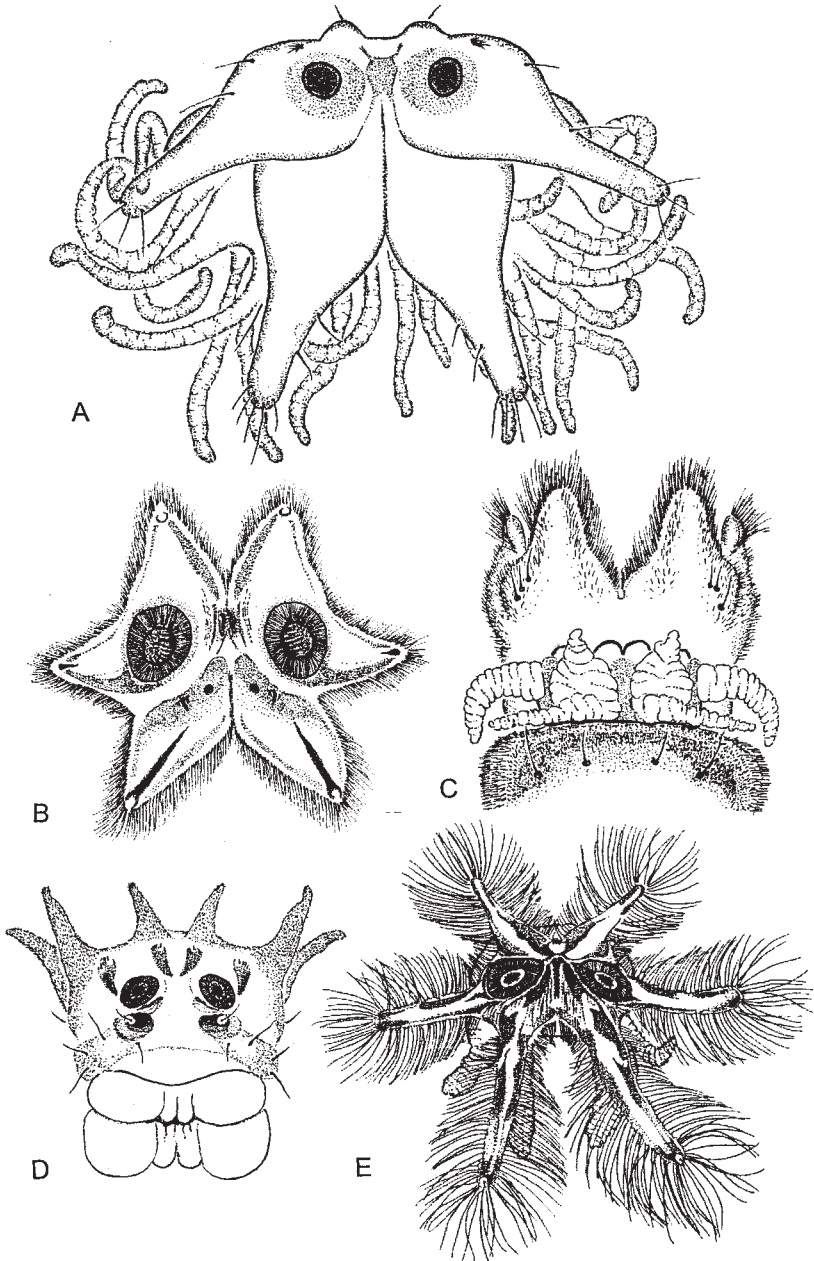


Figure 2. Spiracular area of larvae. A – *Leptotarsus (Longurio) testaceus* Loew, ventral posterior

view; B, C – *Holorusia hespera* Arnaud and Byers, B – dorsal posterior view, C – ventral posterior view showing anal papillae; D – *Dolichopeza (Oropeza) walleyi* (Alexander), dorsal posterior view; E – *Megistocera longipennis* (Macquart), dorsal posterior view. (Source: E, after Rogers 1949) fleshy lobes (spiracular lobes), and membranous lobes (anal papillae) surround the anus. The shape, length, and number of these lobes vary between species and have proved to be taxonomically important. There is probably a close correlation of structure to habitats.

The larvae pass through four moults. Growth rates fluctuate with environmental temperature, humidity, photoperiod, and availability of food in the substrate. The larval stage varies from six weeks to several years (2–4 years for species in high altitude habitats). Pupation takes place in the same microhabitat in which the larvae develop. The duration of the pupal stage varies from 6 to 15 days. Adult males are more abundant at the beginning of the emergence while females are more numerous toward the end. Although individual adults have a relatively short life span of 5 to 7 days, the flight period for each species can last from 15 to 20 days. The main functions of the adult stage are mating and egg-laying. Feeding is less important, and probably water is the most pressing need.

In the Temperate Zone, there are many species that have single, short, clear-cut adult seasons while some species complete two or more generations per year and have two or more flight periods (bi- or multivoltine). Temporal disjunction between generations is either total or partial. Very few studies have been done on the life cycles of tropical crane flies and it is very likely that the seasonality of tropical species is less exact due to a lesser degree of environmental fluctuations.

REGIONAL TAXA

Crane flies are cosmopolitan in distribution, with about 15,000 described species in all zoogeographical regions. There are about 3200 species described from the Oriental Region (Alexander and Alexander 1973), and about 2100 species in the Australian-Oceanian Region (Oosterbroek 1989). Since the geographical distributions of most tipulid species are inadequately documented in the Oriental Region, the crane fly fauna of Malaysia is poorly understood. The recent study by Oosterbroek (1998) listed 1054 species for the Malay Archipelago that includes Borneo, Indonesia, and the eastern part of the island of New Guinea, but not Peninsular Malaysia.

In Peninsular Malaysia and Borneo, only 400 species in 45 genera have been reported in the catalogue, the most recent taxon having been recorded in 1967, and no up-to-date faunistic studies have been conducted since. This number probably represents only about one quarter of the estimated actual number for the country, and much more precise taxonomic studies are needed in the region. The composition of the Malaysian crane fly fauna has four distinct components. Peninsular Malaysia

has its share of species of Indo-Chinese origin; Borneo has its Australian and New Guinean invaders; and both regions have widespread Oriental, and regional Sundanian elements.

KEY TO MATURE LARVAE

Study of immature stages of Tipulidae in general is still incomplete and this is especially true for crane flies in the Southern Hemisphere. Practically nothing is known about the larval forms of Malaysian crane flies. The following key is based mainly on previous research (Alexander 1920; Alexander and Byers 1981; Savchenko 1961; Gelhaus 1986; Gelhaus and Byers 1994; Young 1999; Young and Hynes 2003) on genera in other geographic regions, but which also occur in Malaysia. In certain genera, no included species have been reared and consequently these are absent from the key. Several additional taxa are included in the key, though they have not yet been recorded in Malaysia. Their distribution patterns suggest that they are likely to be present either in Peninsular Malaysia or Borneo and may be discovered as the regional fauna is further investigated. The following key is modified from Alexander and Byers (1981), and Gelhaus and Byers (1994). This simplified preliminary key includes only the crane fly larvae belonging to the subfamily Tipulinae. Several larvae of terrestrial forms have also been included for comparison. Keys for other subfamilies will be in a forthcoming paper.

1. Body with rows of dorsal and lateral elongate fleshy projections on both thoracic and abdominal segments *Cylindrotominae*
- Body with short, blunt projections on abdominal segments only 2
2. Spiracular disc bordered by five or fewer lobes; lobes variable in shape, with one dorsomedially, two laterally, and two below spiracles *Limoniinae*
- Spiracular disc bordered by six subconical lobes, with two dorsally (dorsal lobes), two dorsolaterally (lateral lobes), and two below spiracles (ventral lobes) *Tipulinae* .3
3. Anal papillae pinnately branched. Dorsal spiracular lobes short, inconspicuous; lateral and ventral lobes large (Fig. 2A). Larvae aquatic or semiaquatic *Leptotarsus (Longurio)*
- Anal papillae not pinnately branched. 4
4. Lateral and medial anal papillae curved dorsad (Fig. 2B); spiracles large, spiracular lobes evenly elongate; less than twice as long as their basal width (Fig. 2C). Larvae aquatic *Holorusia*
- Anal papillae directed laterad or ventrad; spiracular lobes variable. Larvae in a variety of aquatic and terrestrial habitats 5
5. Abdominal segment VIII bearing a subconical lobe at each side below lateral spiracular lobes (Fig. 2D). Larvae found in terrestrial mosses and liverworts *Dolichopeza (Oropeza)*
- Abdominal segment VIII without subconical lobes 6
6. All spiracular lobes elongate; longest ones three or four times as long as their basal width, with numerous long hairs bordering each spiracular lobe (Figs. 2E, 3A) 7
- Some spiracular lobes elongate; longest ones rarely more than twice their basal width, with medium, short to no hairs bordering each spiracular lobe (Figs. 3B,3D-F, 4A-C, 5A-C) 8

- 7. Two pairs of elongate anal papillae present (Fig. 2E). Larvae aquatic *Megistocera*
- Three pairs of elongate anal papillae present (Fig. 3A). Larvae aquatic to semiaquatic
 *Tipula (Angarotipula)*

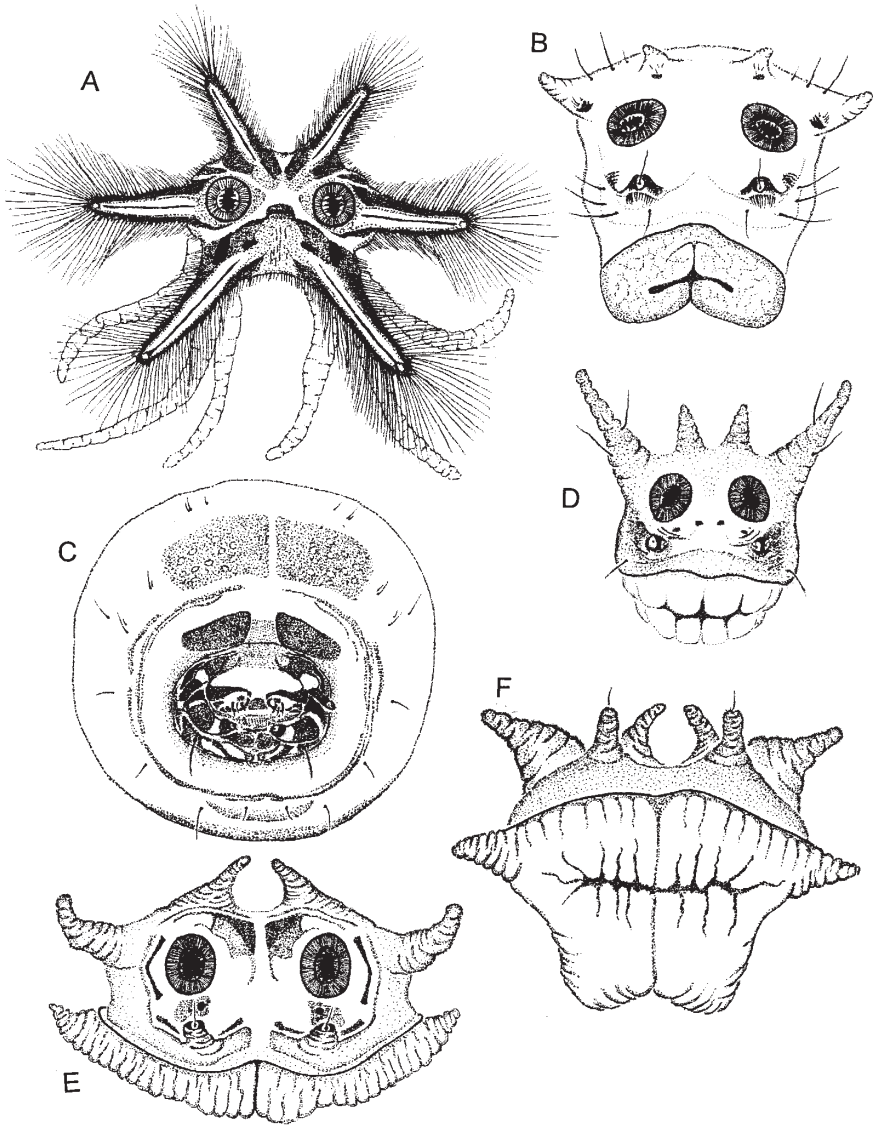


Figure 3. A – spiracular area of *Tipula (Angarotipula) illustris* Doane, dorsal posterior view; B – spiracular area of *Ctenophora (Phoroctenia) vittata angustipennis* Loew, dorsal posterior view; C, D – *Nephrotoma virescens* (Loew), C – head capsule and pro-thoracic segment, dorsal anterior view, D – spiracular area, dorsal posterior view; E, F – spiracular area of *Pilogyne (Plusiomyia) herroni* (Alexander), E – dorsal posterior view, F – ventral posterior view showing anal papillae. (Sources: A, modified from Gelhaus 1986; E, F, after Young and Hynes 2003)

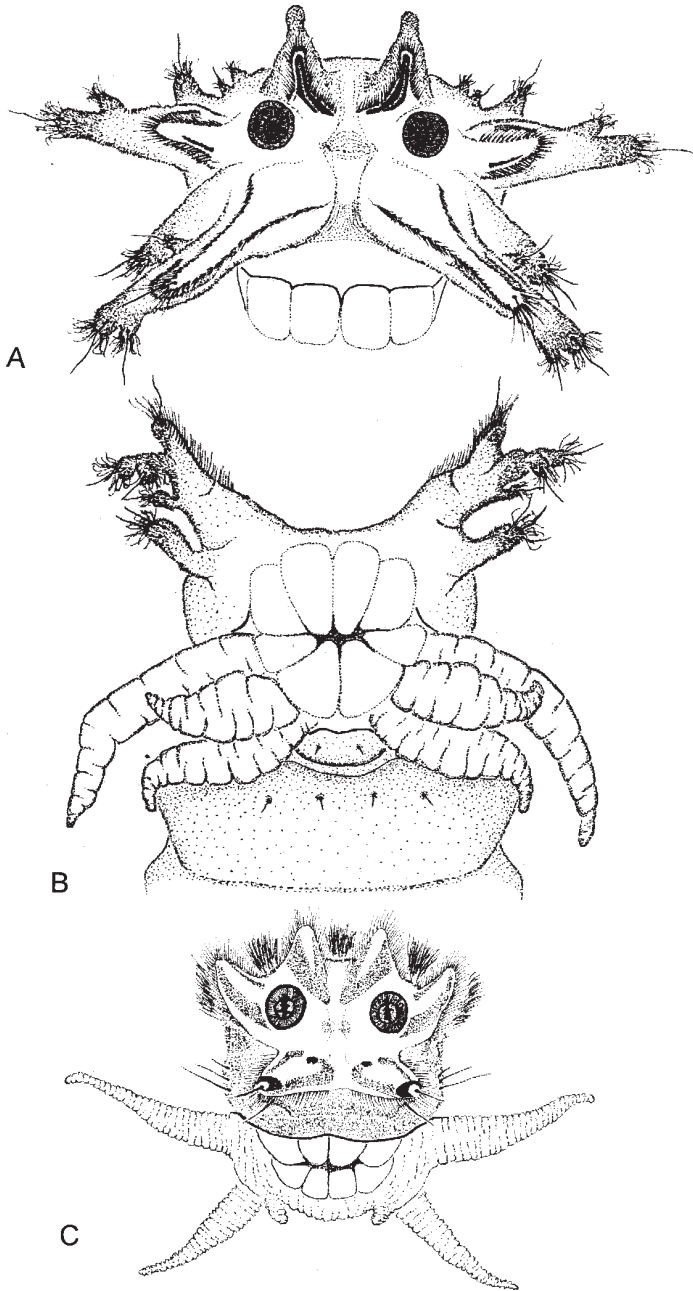


Figure 4. Spiracular area of larvae. A, B – *Tipula (Nippotipula) abdominalis* (Say), A – dorsal posterior view; B – ventral posterior view showing anal papillae; C – *Tipula (Yamatotipula) sayi* Alexander, dorsal posterior view.

- 8. Spiracular lobes not bordered with hairs. Larvae found in terrestrial habitats 9
- Spiracular lobes bordered with medium to short hairs. Larvae found in aquatic to semiaquatic habitats 11
- 9. Prothoracic dorsum with two transverse welts behind line of attachment to head capsule, readily visible when head extended (Fig. 3C). Spiracular lobes elongate (Fig. 3D). Larvae found in soil near surface in woodland *Nephrotoma*
- Prothoracic dorsum without transverse welts. Spiracular lobes variable 10
- 10. All spiracular lobes well-developed; posterior surface of ventral lobes slightly sclerotized (Fig. 3E); four short anal papillae (Fig. 3F). Larvae found inside decaying wood *Ptilogyne (Plusiomyia)*
- Dorsal and ventral spiracular lobes not well-developed; anal papillae reduced (Fig. 3B). Larvae found in dead but still fairly sound wood *Ctenophora (Phoroctenia)*
- 11. Hairs around spiracular lobes reduced; both lateral and ventral lobes long, with bifurcate apices (Fig. 4A); six anal papillae (Fig. 4B). Larvae found in streams among dead leaves
..... *Tipula (Nippotipula)*
- Hairs around spiracular lobes not reduced; lobes similar in shape and usually in size; anal papillae variable 12

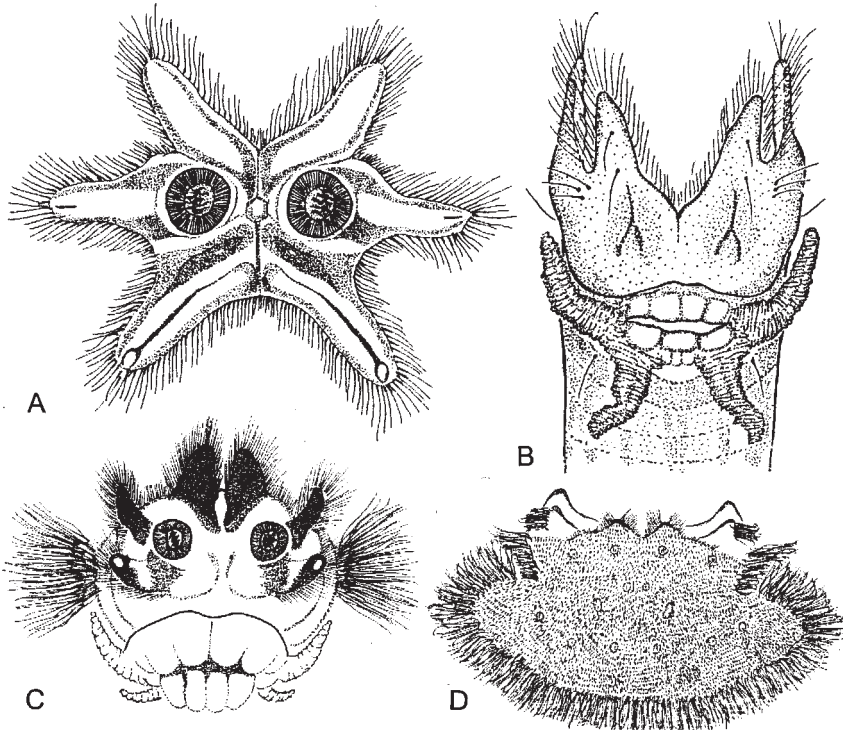


Figure 5. Spiracular area of larvae. A, B – *Tipula (Tipulodina) nettingi* Young, A – dorsal posterior view, B – ventral posterior view showing anal papillae; C, D – *Tipula (Schummelia) synchroa* Alexander; C – dorsal posterior view, D – dorsal view of terminal abdominal segment. (Sources: A,B, after Young 1999; D, modified from Gelhaus 1986)

12. Three pairs of anal papillae (Fig. 4C). Larvae found in wide variety of aquatic and semiaquatic habitats *Tipula (Yamatotipula)*
- Two pairs of anal papillae (Fig. 5B,C) 13
13. Spiracular lobes similar in shape and size (Fig. 5A). Larvae found in water in tree holes, or wet decaying palm stumps *Tipula (Tipulodina)*
- Dorsal spiracular lobes larger than lateral and ventral lobes (Fig. 5C). Abdominal segment VIII with dorsal row of macroscopic hairs surrounding semicircular pilose area (Fig. 5D). Larvae found in seepage area or along streams *Tipula (Schummelia)*

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