

Family Tipulidae (Insecta: Diptera) as a natural enemy of Culicidae (Diptera)

Carlos Henrique Marchiori *

Department of Biological Science, Instituto Federal Goiano, Goias, Brazil.

International Journal of Frontiers in Science and Technology Research, 2022, 03(02), 019–051

Publication history: Received on 06 October 2022; revised on 14 November 2022; accepted on 16 November 2022

Article DOI: <https://doi.org/10.53294/ijfstr.2022.3.2.0056>

Abstract

The Tipulidae serve as food for several species of birds and insects. Many fish and some waterfowl feed on the larvae. They are vulnerable to fungal infection. Some aquatic larvae are used as bait in recreational fishing. The Tipulidae are agricultural pests of economic importance because the larvae live in the upper layers of the soil, where they feed on the roots, root hairs, crown and sometimes the leaves of crops, stunting their growth or killing the plants. The aim of the manuscript is to report the importance of Tipulidae in the natural control of Culicidae. The bibliographic verification of Tipulidae was carried out from 1906 to 2022. Manuscripts published in scientific journals and digital platforms on the subject were examined. With this paper it expands the knowledge of the bioecology and bionomy of Tipulidae.

Keywords: Economic importance; Larva; Fungal; Plants; Crops

1 Introduction

Tipulidae is a family of nematoceran dipterans of the infraorder Tipulomorpha, which groups the insects known by the common name of tipules, crane flies or giant mosquitoes (although they are not true mosquitoes). In its present taxonomic circumscription, the family Tipulidae is one of the largest families of Diptera, having described at least 4256 species (Figures 1, 2, 3, 4A and 4B) [1,2].



Source: <https://www.wilder.pt/especies/que-especie-e-esta-insecto-do-genero-tipula/>

Figure 1 Specimen of Tipulidae Family

* Corresponding author: Carlos Henrique Marchiori
Department of Biological Science, Instituto Federal Goiano, Goias, Brazil.



Source: <https://www.biodiversity4all.org/taxa/51225-Tipulidae>

Figure 2 Specimen of Tipulidae Family



Source: h2omacro

Figure 3 Specimen of Tipulidae Family



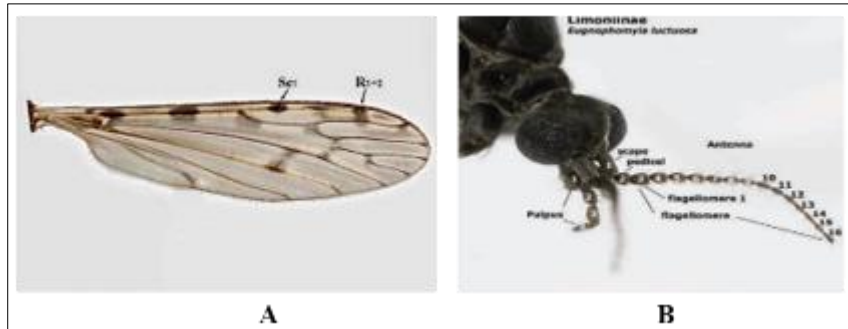
Source Miranda Engelshove, Henk Wallays and Kevin Metcal

Figure 4A Specimen of Tipulidae Family (Diversity)



Source: Cassidy FG (1985). Dictionary of American Regional English

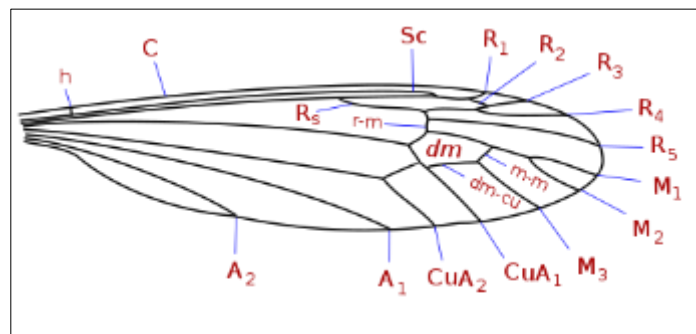
Figure 4B Specimen Tipulidae



Source: by Gayle and Jeanell Strickland and Gayle and Jeanell Strickland

Figure 7A Wing and **Figure 7B** Head Tipulidae Family

They are insects with a delicate appearance, slender, with very thin and long legs. They tend to keep their wings spread when they are at rest, which makes it easy to see the big dumbbells (or rockers). They have two large compound eyes at the end of the head. The mouthparts are elongated, giving the appearance of a long snout, but despite being pointed, they are not suitable for biting (Figure 8) [3,4,5].



Source: <https://www.wikiwand.com/pt/Tipulidae>

Figure 8 Arrangement of the venation on the wing of a specimen of the *Tipula* genus

In contrast to most dipterans, members of the Tipulidae family are not good fliers and are easy to catch in flight. When grabbed, they easily lose some of their delicate legs, which may give them some defense against predators. The Tipulidae show a great variation in size between species, with those originating from temperate regions with lengths ranging from 2 to 60 mm, but with some tipules from tropical climates reaching 100 mm in length (not considering the legs). Some of the smaller species can be confused with Culicidae, the biggest morphological difference being the V-shape of the thorax. Another differentiating feature in relation to mosquitoes is the absence of mouthparts adapted to bite and suck, since they do not feed on blood. Their wings also lack the characteristic scales of true mosquitoes (Figure 9) [3,4,5,6].

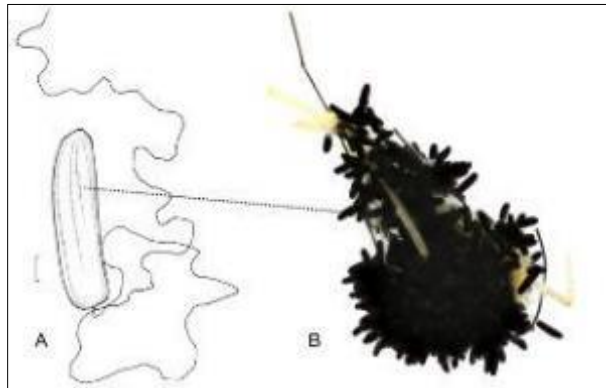


Source: Chen W. Young and James W. Fetzner Jr.

Figure 9 The flagellomeres are usually simple and unmodified but are branched in species of *Ctenophora*, *Limonia* (*Idioglochina*), and *Limonia* (*Rhipidia*)

1.2 Biology, Ecology and Habitat

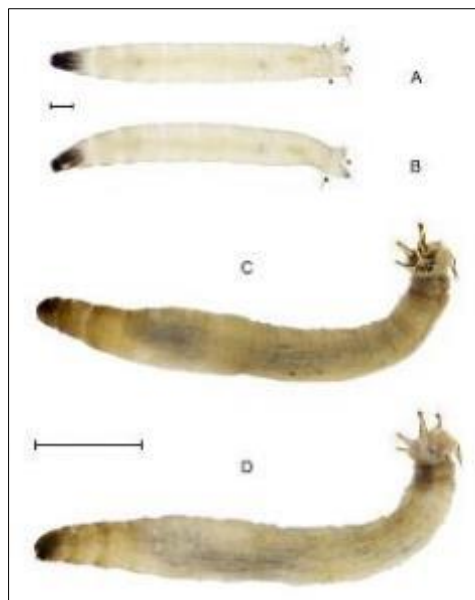
Only the larvae of about 2% of the described species are known, making specific identification very difficult. Larvae have been found in a wide variety of aquatic habitats, including hypersaline lagoons, and in multiple terrestrial habitats. Most larvae feed on decomposition products, being mostly detritivores, but some feed on other larvae (predators) and roots. The larvae of some species feed on mosquito larvae. Because they are very resistant to pesticides, the larvae of root eating species can be a pest on some crops, especially lawns (Figure 10) [7,8,9].



Source: <https://bdj.pensoft.net/article/82427/>

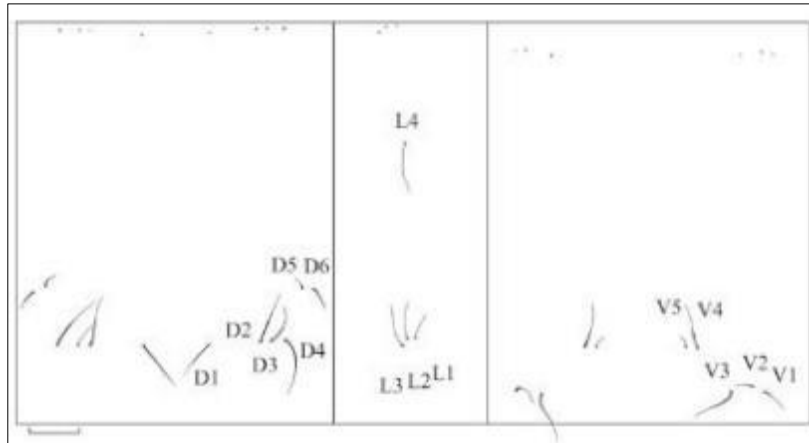
Figure 10 A Egg, ventral view; B egg mass

Although it depends on the ecology of the particular species, adults (imago) prefer wetlands with mild temperatures in winter. The larvae of some species live in saline pools in desert areas, supporting temperatures below freezing point. The imago either feed on nectar or not at all. The long legs seem to be an adaptation for landing on the cylindrical stems and blades of the leaves of reeds and grasses (Figures 11, 12 and 13) [8,9,10,11].



Source: <https://bdj.pensoft.net/article/82427/>

Figure 11 Larvae. A, B second instar, dorsal and lateral view; C, D last instar, dorsal and lateral view



Source: <https://bdj.pensoft.net/article/82427/>

Figure 12 Last instar, dorsal, lateral and ventral chaetotaxy of abdominal segment



Source: <https://bdj.pensoft.net/article/82427/>

Figure 13 Pupae, (A) (C) (E) male, lateral, ventral and dorsal view; (B) (D) (F) female, lateral, ventral and dorsal view

The Tipulidae serve as food for multiple species of birds and insects. Many fish and some waterfowl feed on the larvae. They are vulnerable to fungal infection. Some aquatic larvae are used as bait in recreational fishing. The abdomen of females is more voluminous than that of males because it contains eggs. In addition, the female's abdomen ends in a tapered ovipositor that may look like a stinger, but these insects do not bite [12,13,14].

The larvae have a characteristic cephalic capsule and the abdominal segments in them generally have fleshy processes, similar to small tentacles, which surround the spiracles or respiratory orifices (Figures 14, 15 and 16) [12,13,14].



Source: <https://bdj.pensoft.net/article/82427/>

Figure 14 A Mating; B young larvae foraging; C last instar larva; D last instar larva, stress state; E newly-pupated pupa; F Pupa shell, female and male



Source: Photo by Yang Hao-Cheng

Figure 15 Habitat of Xiaoxilong, Yunnan. Photo by Yang Qi-Cheng; B Habitat of Luxi, Yunan



Source: <https://pt.wikipedia.org/wiki/Tipulidae>

Figure 16 Larva of Tipulidae

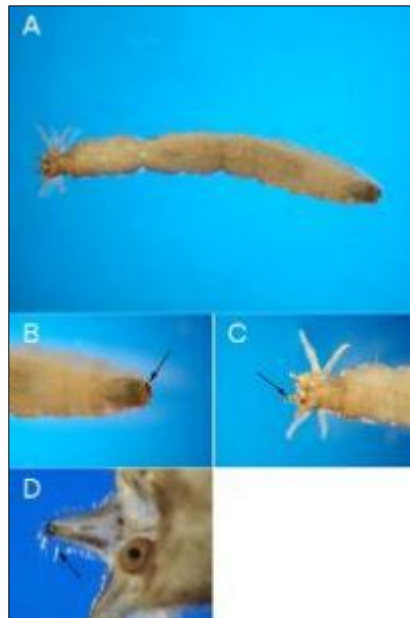
1.3 Life cycle

The female contains mature eggs as she emerges from her pupa and immediately mates with a male. Adults have a lifespan of 10 to 15 days. The female immediately lays eggs, usually in moist soil or on the surface of a body of water or in dry soils, and some simply release them in flight. Most fly eggs are black in color. They usually have a filament, which can help anchor the egg in wet or aquatic environments. Larvae have been observed in many types of habitats on land and in water, including marine, brackish and freshwater (Figures 17A and 17B) [12,13,14,15].



Source: <https://www.flickr.com/photos/72616463@N00/3173681281>

Figure 17A Copula Tipulidae Family



Source: <https://www.waterbugkey.vcsu.edu/php/familydetail.php?idnum=7&f=tipulidae&ls=larvae>

Figure 17B Distinguishing characteristics - The head of Crane fly larva is usually partially retracted into thorax (Fig. B). The most distinctive feature of the larvae is the spiracular disc found on the end of the abdomen which is surrounded by 1-3 or 5-7 variously developed lobes (Fig. C), which are often fringed with hairs (Fig. D)

1.4 Damage

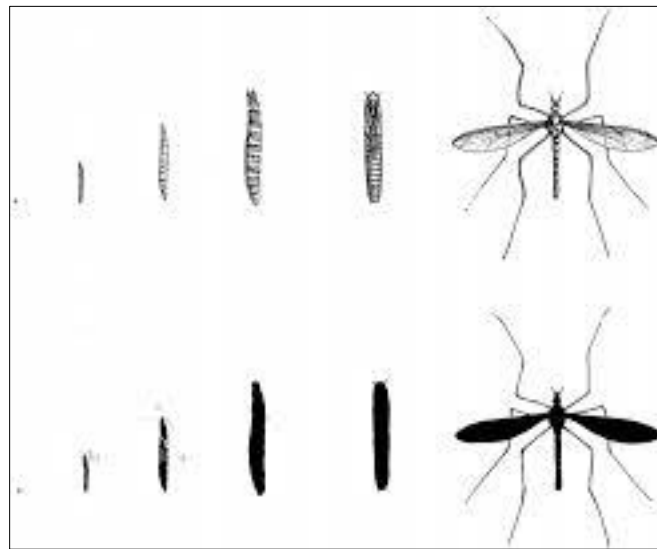
The Tipulidae serve as food for multiple species of birds and insects. Many fish and some waterfowl feed on the larvae. They are vulnerable to fungal infection. Some aquatic larvae are used as bait in recreational fishing. The abdomen of females is more voluminous than that of males because it contains eggs. In addition, the female's abdomen ends in a tapered ovipositor that may look like a stinger, but these insects do not bite.

The crane fly are agricultural pests. Crane fly larvae of economic importance live in the top layers of soil where they feed on the roots, root hairs, crown, and sometimes the leaves of crops, stunting their growth or killing the plants (Figures 18A, 18B and 18C) [15,16].



Source: <https://myloview.com.br/fotomural-crane-fly-is-a-common-name-referring-to-any-member-of-the-insect-no-C91F23A>

Figure 18A Crane fly is a common name referring to any member of the insect Family Tipulidae. Larvae of this insects are significant pest of many crops in soil



Source: (Stahnke et al. 2012; Wilkinson 1969): <https://www.degruyter.com/document/doi/10.1515/9781501747977-024/pdf>

Figure 18B Dipteran Pests: Families Tipulidae and Chloropidae: Host plants and damage. Larvae of both species of invasive crane fly feed primarily on the grasses of lawns, sod farms, golf courses, pastures, and hayfields, but strawberries, flowers, and vegetable crops have also been attacked seedlings and seed



Figure 18C Many crane larvae. is a common name referring to any member of the Tipulidae family of insects. is a significant pest in the soil of many crops

1.5 Taxonomy

Subfamily Cylindrotominae: *Cylindrotoma*, *Liogma*, *Phalacrocer* and *Triogma* (Figures 19, 20, 21, 22 and 23).



Source: <https://en.wikipedia.org/wiki/Cylindrotomidae>

Figure 19 Subfamily Cylindrotominae



Source: <http://insecta.pro/taxonomy/876129>

Figure 20 Genus *Cylindrotoma*



Source: https://en.wikipedia.org/wiki/Liogma_nodicornis

Figure 21 Genus *Liogma*



Source: http://v3.boldsystems.org/index.php/Taxbrowser_Taxonpage?taxid=178001

Figure 22 Genus *Phalacrocera*



Source: http://v3.boldsystems.org/index.php/Taxbrowser_Taxonpage?taxid=400385

Figure 23 Genus *Phalacrocera*

Subfamily Limoniinae: Tribo Eriopterini (27 Genus), Tribo Hexatomini (15 Genus), Tribo Limoniini (7 Genus) and Tribo Pediciini (5 Genus).

Subfamily Tipulinae: *Brachypremna*, *Ctenophora*, *Dolichozepea*, *Holorusia*, *Leptotarsus*, *Megistocera*, *Nephrotoma*, *Prionocera* and *Tipula* (Figures 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34 and 35) [17,18,19,20].



Source: <https://bugguide.net/node/view/157078>

Figure 24 Genus *Brachypremna*



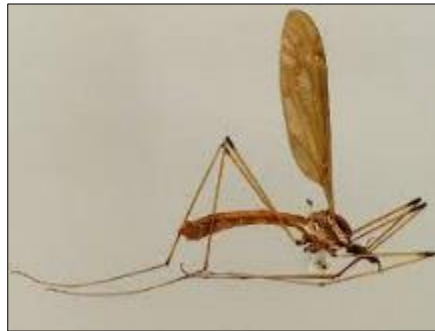
Source: https://www.wikiwand.com/en/Ctenophora_ornata

Figure 25 Genus *Ctenophora*



Source: <https://www.biodiversity4all.org/taxa/60414-Dolichocheza>

Figure 26 Genus *Dolichocheza*



Source: http://v3.boldsystems.org/index.php/Taxbrowser_Taxonpage?taxid=179428

Figure 27 Genus *Holorusia*



Source: https://www.brisbaneinsects.com/brisbane_mosquitoes/OrangeFatCraneFly.htm

Figure 28 Genus *Leptotarsus*



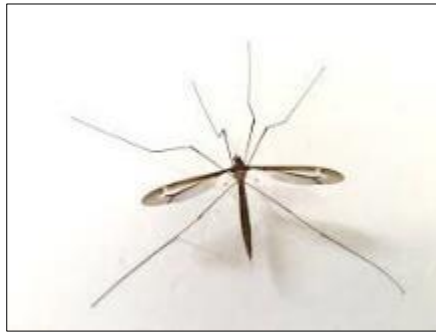
Source: <https://www.projectnoah.org/spottings/1383162418>

Figure 29 Genus *Megistocera*



Source: <https://fnaturesearch.org/nephrotoma-alterna/>

Figure 30 Genus *Nephrotoma*



Source: <https://www.istockphoto.com/br/foto/crane-fly-prionocera-gm1001123998-270645924>

Figure 31 Genus *Nephrotoma*



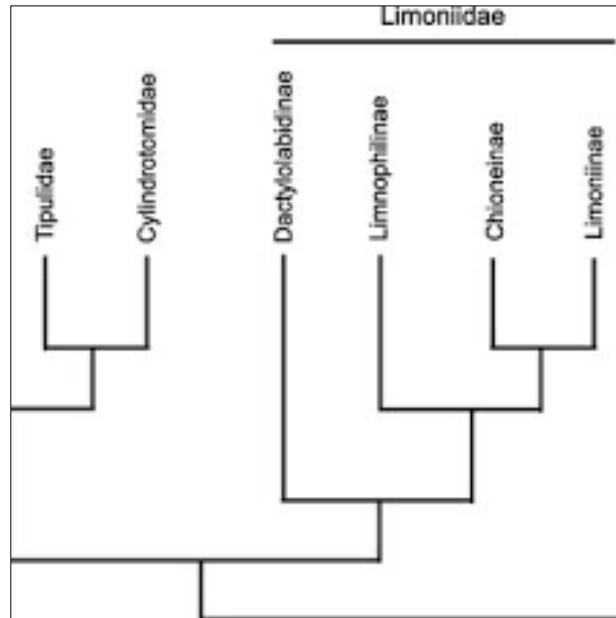
Source: <https://www.biodiversity4all.org/taxa/60393-Tipula>

Figure 32 Genus *Tipula*



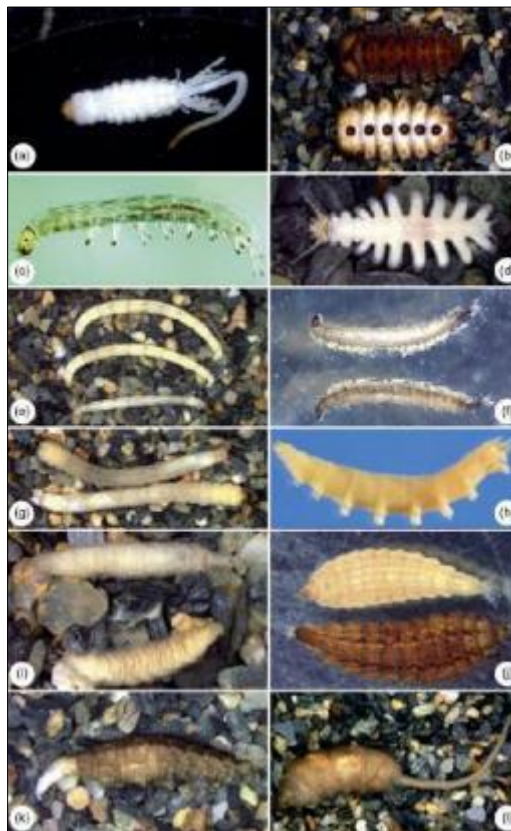
Source: <https://www.fossils-uk.com/new-in-c40/baltic-amber-with-a-crane-fly-tipulidae-from-poland-europe-sku-of1040-tipulidae-sp-p3977>

Figure 33 Baltic amber with a crane fly (Tipulidae) from Poland, Europe (SKU OF1040): Tipulidae sp.



Source: According to Starý (1992) file:///C:/Users/User/Downloads/Ribeiro2008PhylogenyofLimnophilinae%20(1).pdf

Figure 34 Phylogeny of the Tipulomorpha



Source: Photographs by G. Courtney (a-g, i-l) and R. Merritt (h). <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/tipulidae>

Figure 35 Larval Diptera. (a): Axymyiidae; (b): Blephariceridae; (c): Nymphomyiidae; (d): Deuterophlebiidae; (e): Chironomidae; (f): Psychodidae; (g): Tipulidae; (h): Empididae; (i): Ephydriidae; (j): Stratiomyiidae; (k): Sciomyzidae; (l): Syrphidae

Objective

The aim of the manuscript is to report the importance of Tipulidae in the natural control of Culicidae.

2 Methods

According to Marchiori 2022

3 Studies conducted and selected

3.1 Study 1

3.1.1 *Meet the Tipulidae, the “giant ticks” that help control Aedes This slow-flying giant with very long and fragile legs does not harm humans.*

These insects feed on sap or nectar and are beneficial to humans, as they control species such as *Aedes*, for example. The larval stage of Tipulidae occurs in water and in this environment its larvae are predators, feeding on other insects, including those of the Culicidae group, which are mosquitoes, such as *Aedes*. In other words, Tipulidae larvae are predators of *Aedes* larvae, which ends up acting as a natural control (Figure 36).



Source: <https://www.macroinvertebrates.org/taxa-info/diptera-larva/tipulidae/tipula/dorsal>

Figure 36 Larva of Tipulidae

Other studies report that Tipulidae can act even in pollination. But it is not so common to find these giants in urban environments. They are associated with mild temperatures and humid environments, where their larvae develop, so we don't see them much, compared to common mosquitoes, already more accustomed and adapted to urban environments (Figure 37) [22].



Source: https://commons.wikimedia.org/wiki/File:Tipulidae_indet._%28Tipulidae%29_%28Unidentified_Crane%28fly%29_-_%28larva%29,_Elst_%28Gld%29,_the_Netherlands_-_2.jpg

Figure 37 Larva of Tipulidae

3.2 Study 2

Despite the physical resemblance to mosquitoes, these insects belong to the Tipulidae family and are not blood-sucking, that is, they do not feed on blood, whereas mosquitoes belong to the Culicidae family and are blood-sucking. “The Tipulidae have mouthparts developed as a 'snout' or 'snout', which does not have the function of biting, so it is technically wrong to call them mosquitoes.

Tipulidae are also known as tipules and crane flies despite their size and the fear they cause, the tipules are harmless animals. “These insects feed on sap or nectar and are beneficial to humans, as they control species such as *Aedes*, for example. The larval stage of Tipulidae occurs in water and in this environment their larvae are predators, feeding on

other insects, among these those of the Culicidae group, which are mosquitoes, such as *Aedes*. In other words, Tipulidae larvae are predators of *Aedes* larvae, which ends up acting as a natural control”, he says (Figure 38).



Source: All figures © G.W. Courtney

Figure 38 Diptera life cycle *Phalacrocer tipulina* Osten Sacken, 1865 (Tipuloidea: Tipulidae): (a) Final stage (4th instar) larva (aquatic larva) (; (b) Pupa; (c) Adult male

Other studies report that Tipulidae can act even in pollination. But it is not so common to find these giants in urban environments. “They are associated with mild temperatures and humid environments, where their larvae develop, so we don't see them much, compared to common mosquitoes, which are already more accustomed and adapted to urban environments”, the explains (Figure 39) [23].



Source: <https://stock.adobe.com/br/search?k=tipulidae>

Figure 39 Tipulidae can act even in pollination

3.3 Study 3

Tipulidae comprises one of the most diversified into species in the order Diptera. The larvae of these insects are found in any type of aquatic environment, from sludge even streams. They can reach up to 3 cm in length. The species of this family have varied diet, including from raw dead organic even small animals.

Adults are a lot like mosquitoes, differing from them by not bite the human species. Some species are found in illuminated bathroom walls and can be recognized for their large size in relation to a common mosquito (Figure 40).



Source: <https://pt.wikipedia.org/wiki/Tipula>

Figure 40 Specimen of Tipulidae Family

The present study aimed to record the occurrence of immatures of the Diptera order in the Inhamum Environmental Protection Area (APA), Caxias-MA 2011, during the dry season, for five consecutive days, in five streams of 1st and 2nd order: Inhamum, Soledade, Father I Sink, Padre II Sink and Areia Branca. A total of 3,820 specimens of Diptera larvae were collected, distributed in five families: Tabanidae (2.20%), Tipulidae (1.62%), Simuliidae (10.49%), Ceratopogonidae (7%) and Hironomidae (78.74%). Areia Branca stream had the highest number of specimens and Sumidouro do Padre II had the lowest number (Figure 41).



Source: <https://caxias.ma.gov.br/2018/06/11/colaboradores-do-saae-caxias-visitam-a-reserva-do-inhamum/>

Figure 41 Inhamum Environmental Protection Area (APA), Caxias-MA, located at 04° 53' 30" S/43° 24' 53" W

The diversity of the Chironomidae family may be related with the great ability to adapt to lentic and lotic environments or the intensity of the vegetation cover producing litter that serve as a support point for these larvae in the streams collected and used as shelter, protection and food (Figure 42).



Source: SILVA, (2016)

Figure 42 Ecological trails of the APA do Inhamum, with the physiognomic aspects of vegetation. A- House 2 trail; B Trail of stills; C- House 1 trail; D- Track dos Coités 1; E-Trail of Cacimbas; F - Trail of Coités 2.

The families Tabanidae and Tipulidae had low representation assuming it is being influenced by the collection method, as these can live buried, in roots or under stones. In the present study, it was possible to verify that the Chironomidae family has a wide range in relation to the families Tabanidae and Tipulidae, this may be related to the adaptive capacity that the Chironomidae family has, as it can support changes in the physical and chemical variables of the water [24,25].

3.4 Study 4

The study of the entomofauna of areas that undergo changes due to anthropic action is necessary due to the importance of this group as an ecological indicator of changes in the environment.

The use of traps is easier and less expensive to survey insects. The yellow water tray is used as an attractive trap that collects insects attracted by the color and that land in the liquid medium. The color yellow for Diptera.

The survey was carried out in the Chapada do Araripe Environmental Protection Area, in Barbalha-CE, in the ecosystems of the Araripe National Forest (FLONA), Forest Fragment, Agricultural Area and Tourist Area (Arajara Park), on September 3, 2010 to February 22, 2011. Two yellow plastic water trays were installed per ecosystem, placed on the ground in the central area. Collections were made weekly (Figure 43).



Source: <https://www.portalmorada.com.br/noticias/turismo/62270/as-belezas-e-encantos-da-chapada-do-araripe>

Figure 43 Chapada do Araripe environmental protection area

In Arajara Park, 1,221 insects belonging to 44 families were collected, containing pollinators, parasitoids, predators and phytophagous. The order Diptera was once again the most represented with 16 families, followed by the orders Coleoptera (9), Hemiptera (8), Hymenoptera (5), Orthoptera (3), Blattodea, Isoptera and Neuroptera (1) (Figure 44).



Source: https://www.researchgate.net/figure/Vegetation-physiognomies-in-the-Araripe-National-Forest-CE-Brazil-A-Carrasco-B_fig2_305466896

Figure 44 Vegetation physiognomies in the Araripe National Forest, CE, Brazil. A) Carrasco; B) Cerradão; C) Cerrado sensu stricto; D) Semideciduous seasonal forest (Archives of Araripe-PBBI Project)

The Tipulidae family was the most abundant with 18.18% of the total Insects, these insects live in forests and around water where their larvae normally. In Arajara Park, the Tipulidae were more abundant because they lived in forests and around water, since this ecosystem is a seaside resort close to FLONA (Figure 45) [26].



Source: <https://www.flickr.com/photos/swissprot20/84797888>

Figure 45 Arajara Park

3.5 Study 5

Ctenophora ornata Meigen, 1818

3.5.1 Swedish occurrence: Resident and reproducing

Swedish immigration history: *Spontaneous*

Very colorful, medium size, thorax and abdomen chestnut brown, 4th and 5th abdominal segments dull yellow. Yellow collar. Lateral yellow spot on the front of the forewings. Hind tibiae not darkened and without dark distal ring. Yellowish wings, large dark spot towards the apex. Male antennae well pectinated, teeth longer than antennal segments, but flagellum tip bare. The species is attracted to artificial lights at night (Figure 46).



Source: Guide to Flies and Mosquitoes - J. and H. Haupt

Figure 46 *Ctenophora ornata* Meigen, 1818

Not to be confused with its cousins *Ctenophora festiva* Meigen, 1804., which has a small wing patch, and *Flabellifera* Meigen, 1800: (Diptera: Tipulidae), which has a dark distal ring on the hind tibiae (Figure 47).



Source: <https://de.wikipedia.org/wiki/Datei:Ctenophora-festiva-20110508.jpg>

Figure 47 *Ctenophora festiva* Meigen, 1804

This species has recently been identified in Sweden, partly from a find in Skåne and partly from finds in Blekinge. It is also known from Denmark with a find in the Copenhagen area (1992). The species has its northernmost distribution in southern Scandinavia (Figure 48).



Source: Denis Bourgeois

Figure 48 *Ctenophora ornata* Meigen, 1818

It is rarely found in most of Europe. The species has probably been resident in Sweden for a long time. Hawthorns that live in hollow trees in deciduous forests have been poorly researched. Increased interest in hardwood forest in combination with new trapping methods has recently given us a better picture of the fauna in hollow trees [27,28,29].

Tipula cava Riedel, 1913

Mark: The gnats are mainly brown in color. There is a white vertical line on the transparent wings. In the males (see picture above and picture 2) the abdomen is thickened and blunted at the end, while in the females it is extended to form a pointed ovipositor. Body length: 15 - 22mm (Figure 49).



Source: Photo: Hanover - Grob-Buchholz (NS) June 2011 © H. Leunig

Figure 49 *Tipula cava* Riedel, 1913

Habitat: forest edges.

Development: The crane flies can be found from May to September.

Nutrition: The crane flies live on meadow chervil and meadow hogweed.

Distribution: Western Europe, Central Europe, Southern Scandinavia [30,31,32].

3.6 Study 6

The first comprehensive study on tipulids from the Iberian Peninsula, which includes all the quotes included in previous works as well as some of its own data. Subsequently, other authors point out new contributions.

During the last four years we have carried out numerous samplings throughout the Galician geography and nearby areas, with the aim of knowing its tipulid fauna; and consequently we capture specimens of some interesting species from the point of view of their distribution, since they constitute new contributions for our fauna.

Below we list them, also pointing out the data on their geographical distribution. In the “Material studied” section, the data is presented in alphabetical order by province, then the toponym of the locality, the UTM coordinates, the number

of males and females captured and, finally, the sampling date are indicated. The catches have been always made by the author of the work.

3.6.1 *Tipula (Yamatotipula) marginella* Theowald, 1980

Material studied: Pontevedra: Nerga

This species is distributed in central and northern Europe, on the Balkan Peninsula, in northern Italy and in Corsica. Specify that it does not appear in the Iberian Peninsula. Our captures, therefore, significantly expand the distribution of *T. marginella* in southern Europe, and constitute the first in the Iberian Peninsula (Figures 50, 51, 52, 53 and 54).



Source: *Tipula marginella* 23.6.2013 Nummi-Pusula Kärkölä

Figure 50 *Tipula (Yamatotipula) marginella* Theowald, 1980



Source: Nummi-Pusula Kärkölä 19.9.2013

Figure 51 Habitat of Tipulidae Family



Source: Done 10.3.2014

Figure 52 Wing of Tipulidae Family



Source: Done 10.3.2014

Figure 53 Male of Tipulidae Family



Source: Done 10.3.2014

Figure 54 Male head of Tipulidae Family

3.6.2 *Tipula (Savtshenkia) jeekeli* Mannheims and Theowald, 1959

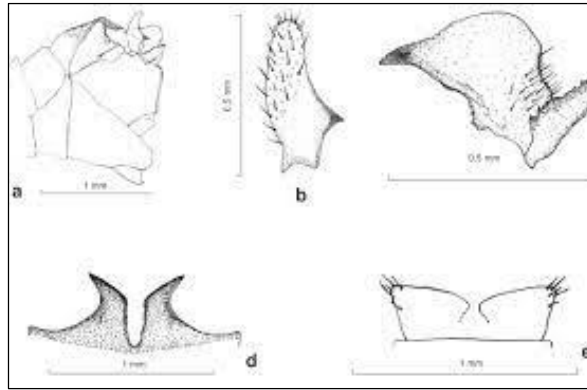
Material studied. Orense: *Entoma* (Figures 55 and 56).



Source: <https://en.wikipedia.org/wiki/Tipula>

Figure 55 *Tipula (Savtshenkia) jeekeli* Mannheims and Theowald, 1959

This species was described from Greece and Sardinia, and its presence was later reported in southern France, Corsica and Majorca. Its distribution is expanded with our captures, which represent the first in the Iberian Peninsula.



Source: https://www.researchgate.net/figure/Tipula-Savtshenka-jeekeli-Mannheims-and-Theowald-a-hypopyg-lateral-view-b-outer_fig1_280559279

Figure 56 *Tipula (Savtshenka) jeekeli* Mannheims and Theowald, 1059; a, hypopyg, lateral view; b, outer gonostylus, view lateral; c, inner gonostylus, lateral view; d, tergite 9, dorsal view; e, hind margin of sternite 8, ventral view

As can be seen, the distribution of *T. jeekeli* is typically Mediterranean; we have only captured it in the Sil valley (southeast of Galicia), phytoclimatically belonging to the Mediterranean region

3.6.3 *Tipula (Savtshenka) subvariety* Lackschewitz, 1936 (Figures 57, 58 and 59).



Source: <https://www.naturbasen.dk/art/14108/tipula-subvafra>

Figure 57 *Tipula (Savtshenka) subvariety* Lackschewitz, 1936



Source: Photo: Henrik Stenholt

Figure 58 Wing of Tipulidae Family



Source: Henrik Stenholt

Figure 59 Male of Tipulidae Family

3.6.4 *Tipula subvafra* was described from the French Pyrenees

Points out that it is probably present in all countries from the Netherlands to the Pyrenees, but that it has been overlooked as an autumn species. For this same reason, think that it should be found in the Iberian Peninsula, a hypothesis that is confirmed by our captures.

3.6.5 *Tipula (Savtshenkia) pagana* Meigen, 1818

Tipula pagana is distributed in Western and Northern Europe, including the Faroe Islands. Until now it was not known from the Iberian Peninsula, being our catches the first (Figure 60).



Source: Patrick Le Mao: France: Bain-de-Bretagne: 35470: 05/11/2015 Altitude: 61 m - Taille: 15-20 mm Réf.: 152602

Figure 60 *Tipula (Savtshenkia) pagana* Meigen, 1818

This species presents the posterior margin of the eighth sternites of males straight, and with bristles on its edge. Point out the existence of variability regarding the number of bristles present in said margin, indicating between 5-7 and 5-8 bristles, respectively; This variability also appears in our specimens, although we have only found specimens with a lower number of bristles, varying between 3 and 5 (Figure 61).



Source: <https://www.commanster.eu/Commanster/Insects/Flies/Tipulidae3c.html>

Figure 61 *Tipula (Savtshenkia) pagana* Meigen, 1818. Wing

3.6.6 *Tipula (Savtshenkia) holoptera* Edwards, 1939

Until now, this species was only known from the south of England, so our captures are the first in the Iberian Peninsula. *Tipula holoptera* is very close to *T. pagana*, the males only differ in the shape of the posterior edge of the eighth sternites, which is notched in holoptera, and may or may not carry a bristle that comes out of a median basal tubercle, according to the original description (Figure 62).



Source: Réf.: 154 017 - Photo: The Ghost Nightjar (France [56400] 15/11/2015) - Taille: env. 13 mm

Figure 62 *Tipula (Savtshenkia) holoptera* Edwards, 1939

Our specimens have been assigned to Holoptera, as they present the edge of the eighth sternum notched. However, with respect to the other trait, it shows considerable variability, with the number of bristles ranging between 0 and 3.

3.6.7 *Tipula (Platytipula) melanoceros* Schummel, 1833

Tipula melanoceros is distributed in Europe, except Italy and the Balkan Peninsula. It is also marked from Siberia. did not include it in their catalog of the Iberian Peninsula; subsequently, indicate it from the north of the same without specifying any locality, they only mention that this species, in the southwest of Europe, reaches the Pyrenees; therefore, with our captures its distribution is extended and its presence in the Iberian Peninsula is confirmed (Figure 63).



Source: Photo 5728296, (c) Fyn Kynd

Figure 63 *Tipula (Platytipula) melanoceros* Schummel, 1833

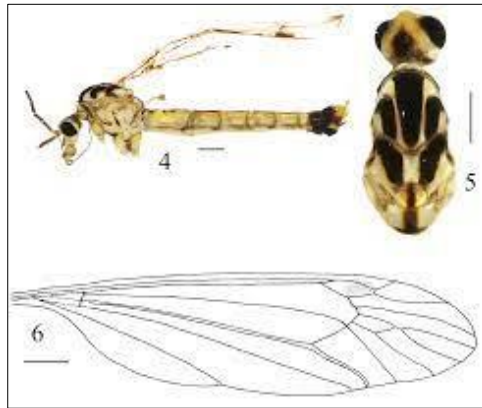
3.6.8 *Nephrotoma analis* Schummel, 1833 (Figure 64).



Source: <https://www.flickr.com/photos/15908940@N07/25377154842/>

Figure 64 *Nephrotoma analis* Schummel, 1833

This species is reported from northern and central Europe, the Caucasus, Iran, and a few isolated records in central and eastern Asia (Figures 65 and 66) [33,34,35,36,37,38,39].



Source: <https://doi.org/10.11646/zootaxa.4353.3.9>

Figure 65 *Nephrotoma analis* (Schummel, 1833) 4: Male habitus, lateral view; 5: Head and thorax, dorsal view; 6: Right wing. Scale bar: 4–6 = 1.0 mm

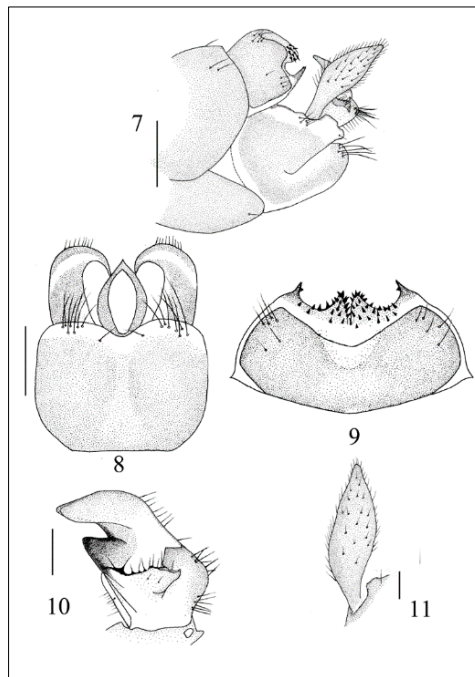


Figure 66 *Nephrotoma analis* (Schummel, 1833) 7: Hypopygium, lateral view; 8: Hypopygium, ventral view; 9: Tergite nine, dorsal view; 10: Clasper of gonostylus, lateral external view; 11: Lobe of gonostylus, lateral external view. Scale bar: 7–9 = 0.5 mm, 10–11 = 0.1 mm

3.7 Study 7

Genus *Tipula* (family Tipulidae) it is only possible to determine the species by studying the specimen with a magnifying glass, since there are very similar species.

Two of them have spots on their wings, remaining the *Tipula paludosa* Meigen, 1818 and the endemic *Tipula atlantica* Mannheims, 1962. Regarding the first, adults are usually active in summer and autumn in Europe, and this could indicate that it is *T. atlantica*, but I don't know if the phenology will be different in Madeira. I have never seen specimens of *T. atlantica*, so I don't know exactly what this species looks like, I just know that it belongs to the same subgenus as *Tipula* (*Tipula*) *paludosa* Meigen, 1818, so they are very close species (Figure 67).



Source: https://stringfixer.com/pt/Tipula_paludosa

Figure 67 *Tipula (Tipula) paludosa* Meigen, 1818

Insects of the genus *Tipula* are often confused with mosquitoes (family Culicidae), but they belong to a different family, the Tipulidae. Both families belong to the order Diptera, which includes mosquitoes and flies. But unlike female mosquitoes, *Tipula* do not ingest blood and are harmless to people. They can be easily separated from mosquitoes due to their larger size and lack of the long proboscis characteristic of mosquitoes. *Tipula* larvae live in the soil where they feed on roots and other plant parts (Figure 68) [40].



Source: Tomasz #209403206

Figure 68 Crane fly is a common name referring to any member of the insect Family Tipulidae. larvae of this insects are significant pest of many crops in soil

3.8 Study 8

Tipula (Tipula) paludosa Meigen, 1818, is a species of true cranes, family Tipulidae. It is also known as European crane fly or swamp crane fly. It is a pest in the grasslands of northwestern Europe and was accidentally introduced to North America (Figure 69).



Source: https://stringfixer.com/pt/Tipula_paludosa

Figure 69 *Tipula (Tipula) paludosa* Meigen, 1818. Female

3.8.1 Distribution

Tipula paludosa is common throughout the Western Palearctic and Nearctic. For identification, see Insect Keys of the European Part of the USSR and the Diptera: Tipulidae. *Tipula paludosa* is a very common species that flies from May and July to October with a peak in August and September (Figure 70).



Source: https://stringfixer.com/pt/Tipula_paludosa

Figure 70 *Tipula (Tipula) paludosa* Meigen, 1818. Male

3.8.2 Biological interactions

Tipula paludosa larvae live in the upper layers of the soil and are the main insect pest in the grasslands of northwestern Europe (Figure 71).



Source: <https://pnwhandbooks.org/insect/legume-grass-field-seed/grass-seed/grass-seed-crane-fly>

Figure 71 *Tipula (Tipula) paludosa* Meigen, 1818 larvae live in the upper layers of the soil

Tipula paludosa is a species of true cranes, family Tipulidae. It is also known as European crane fly or swamp crane fly. It is a pest in the grasslands of northwestern Europe and was accidentally introduced to North America (Figure 72) [41,42,43,44,45,46].



Source: Photo: Rob Golembiewski, Ph.D., Bayer

Figure 72 Crane fly larvae (*Tipula (Tipula) paludosa* Meigen, 1818) at 1st, 2nd and 3rd instar stages

3.9 Study 9

This flying insect belongs to the family of the tipulidos (Tipulidae) which is one of the largest in terms of number of species of the order of Diptera. The females of this species usually exceed 2 centimeters in length. They are distinguished from males by the pointed termination of the abdomen. It is an ovipositor device to deposit eggs on the ground. In the male, on the other hand, the end of the abdomen ends in a protuberance. In photo number 4 you can see two male specimens (Figure 73).



Source: C. Prairie 11-2012

Figure 73 Female of *Tipula oleracea* Linnaeus, 1758

This *Tipula* has very long legs, ideal for walking through long grass. The female can produce up to 1,000 eggs during the summer. These are deposited on the ground in areas with ground covered with vegetation. The larva feeds on roots, stems and leaves. During the day it is buried in the ground and feeds on the roots. At nightfall, it goes outside to eat the aerial parts of the plants. This larva is grayish in color and needs 4 molts to become an adult insect (Figures 74, 75, 76, 77 and 78).



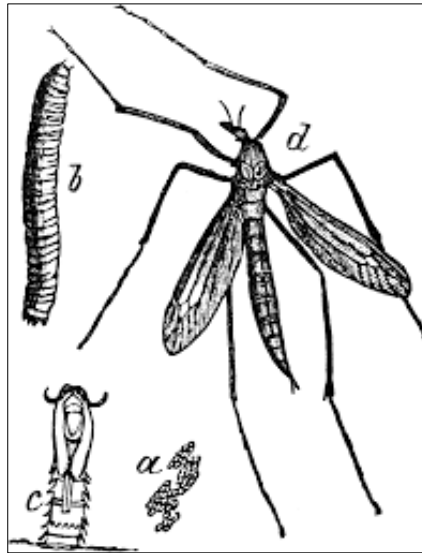
Source: C. Pradera 11-2012

Figure 74 Detail of *Tipula oleracea* Linnaeus, 1758, with binocular magnifying glass



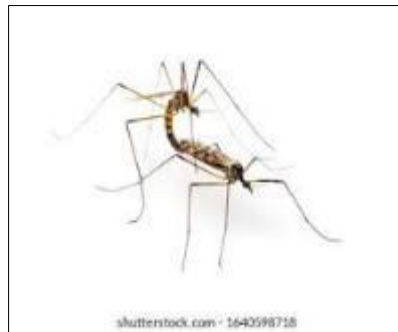
Source: <https://www.bioimages.org.uk/image.php?id=111311>

Figure 75 Larvae of *Tipula oleracea* Linnaeus, 1758



Source: Chambers' Encyclopedia, 1875

Figure 76 Crane-fly *Tipula oleracea* Linnaeus, 1758: a, eggs; b, larva; c, pupa case as left by the insect, sticking out of the eath; d, perfect insect



Source: <https://www.shutterstock.com/pt/image-photo/two-crane-fly-daddylonglegs-mating-isolated-1640598718>

Figure 77 Copula: *Tipula oleracea* Linnaeus, 1758



Source: Photo 102343896, (c) Troi_Olivares, some rights reserved (CC BY-NC), uploaded by Troi_Olivares

Figure 78 *Tipula oleracea* Linnaeus, 1758

Tipula oleracea has two annual generations. The second generation of larvae forms during the fall. These can develop during the winter to give adult specimens in spring. If the conditions are not good, the cabbage tipula can overwinter in any phase. In the humid areas of our country it can become a problem for crops and gardens. In photo number 3 you can see a lateral image of the tipula. Like all dipterans, it has only one pair of wings (Figure 79).



Source: C. Prairie 11-2012

Figure 79 Image of two males of *Tipula oleracea* Linnaeus, 1758

The other pair of wings that other insects have, has been reduced to rocker arms. If we look at its head we will see that it does not have a trunk. The adults of the family of the tipúlidos do not usually feed. They live off the reserves accumulated during their larval stages. In the event that a species feeds as an adult, it does so with nectar. From the appearance of the cabbage tipula, the long legs and the elongated and narrow abdomen stand out. This títupula is the most abundant in our country (Figure 80) [47].

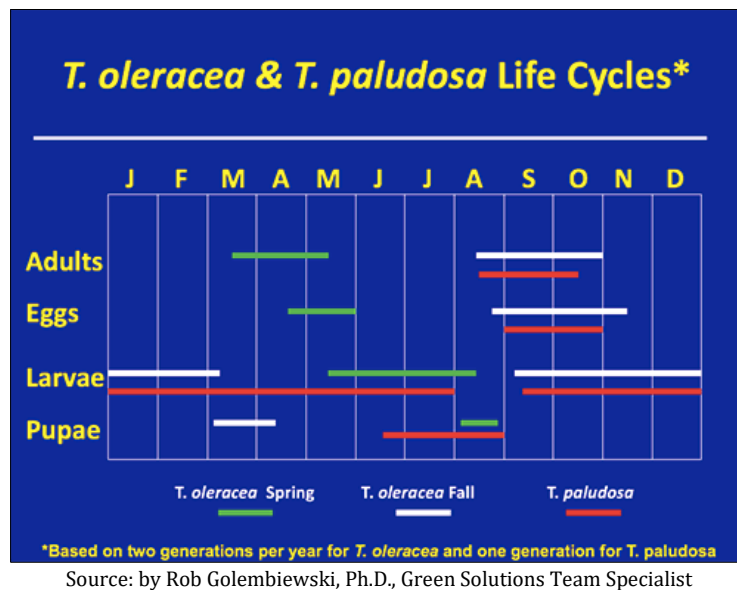


Figure 80 Life cycles of common crane fly *Tipula oleracea* Linnaeus, 1758 and European crane fly *Tipula (Tipula) paludosa* Meigen, 1818

4 Conclusion

The Tipulidae serve as food for several species of birds and insects. Many fish and some waterfowl feed on the larvae. They are vulnerable to fungal infection. Some aquatic larvae are used as bait in recreational fishing. The Tipulidae are agricultural pests of economic importance because the larvae live in the upper layers of the soil, where they feed on the roots, root hairs, crown and sometimes the leaves of crops, stunting their growth or killing the plants.

References

- [1] Crane flies of Kentucky [Internet]. Lexington: University of Kentucky Entomology; © 2021 [cited 2022 Aug 10]. Available from <https://www.nku.edu/about.html>.
- [2] Alexander CP, Byers GW. Tipulidae. in: McAlpine JF, et al., eds. Manual of Nearctic Diptera. 1th ed. Ottawa: Agriculture Canada; 1981. p. 153–1902.
- [3] Ward A. Cricket's strangest matches. 1th ed. London: Robson Books. 1998.

- [4] McAlpine JF, Petersen BV, Shewell GE, Teskey HJ, Vockeroth JR, Wood. DM. Manual of Nearctic Diptera. 1th ed. Alberta: Research Branch Agriculture Canada. 1987.
- [5] Coeb RL, Freeman P, Mattingly PF. Nematocera: families Tipulidae to Chironomidae (Tipulidae). 9th ed. St Albans: Handbooks for the Identification of British Insects.1958.
- [6] Pritchard G. Biology of Tipulidae. Annual Review of Entomology. 1983; 28(1): 1–22.
- [7] Jackson DM, Campbell RL. Biology of the European crane fly, Meigen, in western Washington (Tipulidae: Diptera). 1th ed. Washington: Washington State University Technical Bulletin. 1975.
- [8] Blackshaw RP, Coll C. Economically important leatherjackets of grassland and cereals: biology, impact and control. Integrated Pest Management Reviews. 1999; 4(2): 145–162.
- [9] Mertz L. Mosquito Hawk? Skeeter Eater? Giant Mosquito? No, No, and No. Entomology Today. Entomological Society of America. 2015.
- [10] Ward A. Cricket's strangest matches. 1th ed. London: Robson Books. 1999.
- [11] Rohdendorf B. The Historical Development of Diptera. 1th ed. Edmonton: University of Alberta. 1974.
- [12] Cassidy FG. Dictionary of american regional English. 1th ed. Cambridge: Belknap Press. 1985.
- [13] Gullan PJ, Cranston PS. The insects: an outline of Entomology. 5th ed. West Sussex: Wiley Blackwell. 2014.
- [14] Oosterbroek P. Superfamily Tipuloidea, Family Tipulidae. In: Evenhuis NL, eds. Catalog of the Diptera of the Australasian and Oceanian Regions Museum Special Publication. Apollo Press; 1989. p. 1-86.
- [15] Moon L. World's biggest' mosquito with 11cm wing span found in southwest China. 1th ed. Beijing: South China Morning Post. 2018.
- [16] Savchenko EN. Phylogeny and systematics of the Tipulidae. Fauna Ukraini. 1966; 14: 63–88.
- [17] Petersen MJ, Bertone MA, Wiegmann BM, Courtney GW. Phylogenetic synthesis of morphological and molecular data reveals new insights into the higher-level classification of Tipuloidea (Diptera). Systematic Entomology. 2010; 35(3): 526–545.
- [18] Ribeiro GC, Lukashevich ED. New *Leptotarsus* from the early Cretaceous of Brazil and Spain: the oldest members of the family Tipulidae (Diptera). Zootaxa. 2014; 3753(4): 347–363.
- [19] Herman j, Oosterbroek P, Gelhaus J, Reusch H, Young C. Global diversity of crane flies (Insecta, Diptera: Tipulidea or Tipulidae sensu lato) in freshwater. Hydrobiologia. 2008; 595(1): 457–467.
- [20] Rao SLA, Cramptonb L, Takeyasu J. Dentification of larvae of exotic *Tipula paludosa* (Diptera: Tipulidae) and *T. oleracea* in North America using mitochondrial cytB sequences. Annals of the Entomological Society of America. 2006; 99(1): 33–40.
- [21] Marchiori CH. Biology and feeding behavior of ceratopogonid adult (Diptera: Ceratopogonidae). International Journal of Frontiers in Science and Technology. 2021; 1(2): 007–024.
- [22] Amazon Portal [Internet]. Manaus: Federal Rural University of the Amazon; © 2022 [cited 2022 Aug 10]. Available from <https://portalamazonia.com/noticias/meio-ambiente/connheca-os-tipulidaes-os-carapanas-gigantes-que-ajudam-no-controle-do-aedes>.
- [23] Monteiro V, Silva AG. Tipulidaes, the “giant carapanãs” that help control Aedes [Internet]. Manaus: Federal University of the Amazon; © 2022 [cited 2022 Aug 10]. Available from https://novo.ufra.edu.br/index.php?option=com_content&view=article&id=2719&catid=17&Itemid=12.
- [24] Bond-Buckup G. Biodiversidade dos campos de Cima da Serra. 1th ed. Porto Alegre: Libretos. 2010.
- [25] Saraiva CCS, Gracyone S, et al. Levantamento de Imaturos Aquáticos da Ordem Díptera na Área de Proteção Ambiental do Inhamum, Caxias-MA. Curitiba [Internet]. Curitiba: XXIV Congresso Brasileiro de Entomologia; © 2012 [cited 2022 Aug 11]. Available from https://seb.org.br/anais2012/trabalhos/562/562_1.pdf.
- [26] Nere DR, Mariano CA, Moura ES, Azevedo FR. Captura de insetos de voo baixo em bandejas amarelas em ecossistemas do Cariri Cearense [Internet]. Cariri: Universidade Federal do Ceará © 2011 [cited 2022 Aug 11]. Available from <https://conferencias.ufca.edu.br/index.php/encontros-universitarios/eu-2011/paper/viewFile/352/44>.

- [27] Oosterbroek P, Bygebjerg R, Munk T. The west palaeartic species of Ctenophorinae (Diptera: Tipulidae); key, distribution and references. *Entomological Messages*. 2006; 6: 138-149.
- [28] Warren MS, Key RS. Woodlands: Past, present and potential. In: Collins NM, Thomas JA eds. *The Conservation of Insects and their Habitats*. 1th ed: New York; Academic Press; 1991. p. 155-211.
- [29] Sandström J, Brodin Y, Bygebjerg R, Östrand, F. Red list expert committee for dippers. *Species facts*. 1th ed: Stockholm: SLU Species data bank. 2020.
- [30] *Tipula cava* [Internet]. Berlin: insect box; © 2022 [cited 2022 Sep 12]. Available from <https://www.google.com/search?q=Tipula+cava&oq=Tipula+cava&aqs=chrome.0.69i59j46>.
- [31] Eiroa E. New data on the distribution of tipulids in the Iberian Peninsula (Diptera, Tipulidae). *East-Telling*. 1989; 965(1): 25–29.
- [32] Eiroa E, Novoa F. Interesting citations of Iberian Tipulidae (Diptera). *Bulletin of the Portuguese Society of Entomology*. 1985; 1(2): 135-140.
- [33] Edwards F. Additions to the list of British Crane-Flies. *Entomologist's Monthly Magazine*. 1939; 75: 241-249.
- [34] Strobl G. Spanische Dipteren II. 1906; 3: 271-422.
- [35] Oosterbroek P. The western palaeartic species of *Nephrotoma* Meigen, 1803 (Diptera, Tipulidae) Part 4, including a key to the species. *Beaufortia*. 1979; 29(354): 129-197.
- [36] Andreu J. Tipúlidos and Limonidos of Spain. *Bulletin of the Aragonese Society of Natural Sciences*. 1912; 11: 72-77.
- [37] Theischinger G. New taxa of *Lunatipula* Edwards from the Mediterranean subregion of the Palaeartic (Diptera, Tipulidae, *Tipula* Linnaeus). *Beaufortia*. 1982; 32(5): 79-96.
- [38] Theowald B, Oosterbroek P. On the zoogeography of the West Palaeartic Tipulids. The Tipulids of the Iberian Peninsula. *Beaufortia*. 1981; 31(2): 31-50.
- [39] Theowald B, Oosterbroek P. On the zoogeography of the West Palaeartic Tipulids. III. The tipulides of the European Plains (Diptera, Tipulidae). *Bonner Zoological Contributions*. 1983; 34(1-3): 371-394.
- [40] Correia MN. What species is this? [Internet]. Campbell County: Wilder's Nature Journalism; © 2021 [cited 2022 Aug 10]. Available from <https://www.wilder.pt/especies/que-especie-e-esta-insecto-do-genero-tipula/>.
- [41] Oosterbroek P. *Tipula (Tipula) paludosa* Meigen, 1830. *Catalog of craneflies of the world*. 1th ed. Leiden: Naturalis. 2009.
- [42] Bei-Bienko GY. Keys to the insects of the European part of the USSR. Diptera and Siphonaptera, Parts I, II. 5th ed. New Delhi: Amerind Publishing Co. 1988.
- [43] Dawson LA, Grayston SJ, Murray PJ, Pratt SM. Feeding behavior of roots of *Tipula paludosa* (Meig.) (Diptera: Tipulidae) in *Lolium perenne* (L.) and *Trifolium repens* (L.). *Soil Biology and Biochemistry*. 2002; 34 (5): 609–615.
- [44] Oestergaard J, Belau C, Strauch O, Ester A, van Rozen K, Ehlers Ralf-Udo. Biological control of *Tipula paludosa* (Diptera: Nematocera) using entomopathogenic nematodes (*Steinernema* spp.) and *Bacillus thuringiensis* subsp. Israeli. *Biological control*. 2006; 39(3): 525–531.
- [45] Webster JM, Lam ABQ. Morphology and biology of *Panagrolaimus tipulae* n. sp. (Panagrolaimidae) and *Rhabditis (Rhabditella) tipulae* n. sp. (Rhabditidae), from leather jacket larvae, *Tipula paludosa* (Diptera: Tipulidae). *Nematologica*. 1971; 17(2): 201–212.
- [46] Pierre C. Diptera: Tipulidae. 8th ed. Virtual Digital Library. 1924.
- [47] Meadow C. On the cabbage *Typula*, *Tipula oleracea* (Diptera, Tipulidae) [Internet]. Barcelona: The Disinsector and Deratizer; @ © 2012 [cited 2022 Aug 10]. Available from <https://desinsectador.com/2012/11/14/sobre-la-tipula-de-la-col-tipula-oleracea-diptera-tipulidae/>.