Chapter XIII —Family Chironomidae

(Non-biting or true midges)

- (Williams & Feltmate, 1992)
  - Superphylum Arthropoda
    - (jointed-legged metazoan animals [Gr, *arthron* = joint; *pous* = foot])
  - Phylum Entoma
  - Subphylum Uniramia
    - (L, *unus* = one; *ramus* = branch, referring to the unbranched nature of the appendages)
  - Superclass Hexapoda
    - (Gr, *hex* = six, *pous* = foot)
  - Class Insecta
    - (L, *insectum* meaning cut into sections)
  - Subclass Ptilota
  - Infraclass Neopterygota
  - Order Diptera

The midges (order Diptera, family Chironomidae) account for most of the macroinvertebrates in freshwater environments. In many aquatic habitats this group constitutes more than half of the total number of macroinvertebrate species present. The family is also the most widely distributed group of insects, having adapted to nearly every type of aquatic or semiaquatic environment. The larvae, which are recognized because they usually have **anterior and posterior pairs of prolegs**, are diverse in form and size. Larvae are often the dominant insect in the profundal and sublittoral zones of lakes, and consequently adults are sometimes called “lake flies”. Species in larger lakes may emerge in such tremendous numbers that they create nuisance problems. The short-lived adults cause allergies in some people, invade factories, spot the paint on houses, and accumulate in large, odorous piles. Larvae are an extremely important part of aquatic food chains, serving as prey for many other insects and food for most species of fish.

The subfamilies Chironominae, Orthocladiinae, and Tanypodinae contain the great majority of the species in the family in North America. Of these, the Tanypodinae and Chironominae are generally most common in lentic warm-water habitats, while the Orthocladiinae are found mostly in lotic and cold-water habitats.

The Chironomidae, commonly known as non-biting midges, is a large, cosmopolitan family of nematocerans whose adults are small and delicate and superficially resemble mosquitoes.

The separation of the Diptera, as potential or actual inhabitants of deep water, from the other orders of immature aquatic insects is justified by the fact that an elaborate classification of lake types has been built upon the ecology of the deep-water Chironomidae (true midges) and their associated organisms. The question as to why, among all the aquatic insects with gills, this family of Diptera has alone significantly exploited the depths of lakes is of considerable interest. The generally small size, at least in the lacustrine Diptera, is doubtless important in this invasion.

The midge larvae found on the shelf and in the deep water of a lake differ in appearance to their smaller pale coloured cousins found in the shallow water. These are generally large larvae (>1/2 inch) that are red coloured, hence the term **“blood worm”.** The red colour is due to the presence of hemoglobin that stores oxygen. This allows them to live in areas that have limited oxygen conditions such as lake bottoms or areas of high organic pollution. The oxygen is exchanged across the cuticle and some forms have tubular gills extending ventrally near the caudal end. These tube makers create a current in their tubes by undulating the body so that water passes through the tube. Lakes that have higher oxygen levels in the hypolimnion (oligotrophic-meso-trophic lakes) often contain large populations of midge larvae.

- The benthos of the deep water (= hypolimnion) is dictated by the presence and duration of oxygen. The bottom fauna will be reduced or absent in lakes where the deep water looses oxygen for the duration of summer stagnation, or in winter.
- A mesotrophic system with a stable thermocline in the summer months looses most of its oxygen for a time during stagnation but not for the entire period. The bottom fauna may be limited to a few non-biting midge larvae (*Chironomus* sp.), a biting midge (*Palpomyia* sp.) and a phantom midge (*Chaoboruss punctipennis*).

Life History

Like other dipterans, chironomids have four life stages; egg, larva, pupa, and adult.
The larvae are long (2 to 30 mm, depending on species) and slender and often assume a slightly curved posture, particularly when preserved. Larvae pass through 4 instars before pupating. The duration of the larval stage may be from two weeks to several years; it seems to depend mostly on temperature. The pupal stage lasts no more than a few days.
Adult chironomids are minute (e.g. wing length 0.8 mm in *Orthosmittia reyei*) to medium-sized (wing length 7.5 mm in *Chironomus alternans*) insects. The mouthparts are generally reduced, as few adults live for more than a few days. Adults often emerge, simultaneously, in huge numbers, and proceed to form vast mating clouds. They are especially attracted to lights.

In temperate regions, many chironomid species are uni- or bivoltine, but up to four generations in a year are not uncommon. Species living in the cold, profundal zones of deep lakes may take more than one year to complete their life cycles, and circumpolar species require at least two years, and occasionally, as many as seven. In such long-lived species, the larvae coil up in co-coons and overwinter under freezing conditions. In highly transient, tropical habitats such as rainpools, life cycles may be as short as a few weeks.

Habitat and Distribution

The distribution of chironomids extends to both the northern and southern limits of land, and they are the dominant group in the Arctic. As well as occurring in all the “usual” types of freshwater habitat (streams, rivers, lakes and ponds), many are terrestrial or semi-terrestrial. Others live in pitcherplants, leaf axils or tree holes, and some are marine. living in tidepools or even on tropical coral-heads to a depth of 30m. Two species are known from Antarctica and these represent the southernmost, free-living, holometabolous insects.

Table XIII-1: The major subdivisions of the Chironomidae together with the typical habitats in which they are found (Williams & Feltmate, 1992)

Subfamily	Tribe	Habitat
Tanypodinae	Coelotanypodini	littoral zone of ponds & lakes (lentic)
	Macropelopiini	streams & rivers (lotic); some lentic littoral & profundal
	Natarsiini	fast-flowing waters
	Pentaneurini	fast-flowing waters; lentic littoral; a few hygropetric
	Tanypodini	lentic littoral
Podonominae	Boreochlini	fast-flowing waters; lentic littoral; esp. cold waters
	Podonomini	fast-flowing, cold waters
Telmatogetoninae		saltmarshes & tidepools, estuaries
Buchonomiinae		unknown, but probably in rivers in Oriental & Palaearctic regions
Diamesinae	Boreoheptagyini	cold, fast streams
	Diamesini	fast-flowing, cold waters; springs
	Protanypini	profundal zone of lakes
Prodiamesinae		fast-flowing waters, often in detritus
Orthocladiinae	Clunionini	marine, rocky shores
	Corynoneurini	lotic fast & slow water; lentic littoral
	Metriocnemini	wide range of lentic & lotic habitats, including springs, pitcherplants, dung, interstitial, marine intertidal & semi-terrestrial
	Orthocladiini	wide range of lentic & lotic habitats, including marine intertidal
Chironominae	Chironomini	lentic, littoral/profundal; slow lotic; especially on sandy substrates & associated with aquatic macrophytes
	Tanytarsini	lotic fast & slow water; lentic littoral; occasionally in brackish water
Chilenomyiinae		unknown; restricted to Chile
Aphroteniinae		lentic & lotic in S. Hemisphere; esp. in sandy areas overlain with FPOM; also swift mountain streams

Classification of lakes based on the Profundal Chironomid Fauna (Resh & Rosenberg, 1984; Williams & Feltmate, 1992)

The most common components of the profundal benthos are chironomid larvae, and the abundance of certain species, or species groups, is often characteristic of a particular lake type. Deep lakes, for example, may have only small populations of these midges, or none at all. This believed to be more a reflection of the weak internal circulation found in many deep lakes rather than of any strict biological limitation of the insects. Thienemann (1925), working on European lakes, and Deevey (1941), working on lakes in Connecticut, U.S.A., recognized several types, for example:

- Ultraoligotrophic (Lake Type I): *Heterotrissocladius oliveri* lakes in North America, and *Heterotrissocladius subpilosus* lakes in Europe.
- Oligotrophic (Lake Type II): *Tanytarsus* sp. (Chironominae: Tanytarsini) lakes (with *Monodiamesa tuberculata* and *Heterotrissocladius changi*) in North America, and *Tanytarsus lugens lakes* (with *Heterotrissocladius grimshawi* or *H. scutellatus*) in Europe- these are usually deep lakes which never lack oxygen in deep water. *Chaoborus* tends to be absent.
- Mesotrophic (Lake Type II/III): *Chironomus* lakes- these have oxygen curves typical of lakes of intermediate nutrient content, and characteristically support species of *Chironomus* that lack ventral abdominal gills. *Chironomus atritibia* and *Sergentia coracina* lakes In North America, and *Stictochironomus rosenschoeldi* and *Sergentia coracina* lakes in Europe.
- Eutrophic (Lake Type III): *Chironomus* lakes- these are usually shallow and turbid, and have, in general, oxygen curves characteristic of eutrophic (nutrient-rich) lakes. They are dominated by species of *Chironomus* (Chironominae: Chironomini) in which the larvae typically have two pairs of ventral abdominal gills. The culicid *Chaoborus* is often present in open water.
    - Moderately eutrophic: *Chironomus decorus* lakes in North America, and *C. anthracinus* lakes in Europe.
    - Strongly eutrophic: *Chironomus plumosus* in North America as well as in Europe.
- Dystrophic (Lake Type IV):- these also have variable amounts of nutrients, but they are always high in humic compounds which colour the water brown. They tend to be shallow but can experience oxygen deficiencies in deeper parts. *Chironomus* sp. lakes (with *Zalutschia zalutschicola*) in North America, and *Chironomus tenuistylus* lakes (with *Zalutschia zalutschicola)* in Europe. *Chaoborus* are often present but their densities are low.
- *Trissocladius* lakes (Orthocladiinae)- these become stratified, but are of inconsistent trophic status.
- Unstratified, faunistically and limnologically diverse lakes.

Such distinctions have proved useful in comparing lakes within the Holarctic, but in a country like New Zealand, where the chironomid fauna is particularly depauperate, they have little or no value as biological indicators. The same tends to be true of the littoral fauna, in general. For example Saether (1975) showed that although lists of littoral dipterans from lakes in both Europe and North America identified some species restricted to oligotrophic systems, those found in eutrophic lakes tended to be more widely distributed and therefore less useful. Further, seasonal differences in littoral species from a given lake are greater than those seen in profundal species. **Shallow lakes therefore fit existing classification schemes less well than deep lakes.**

Ecological preference

The predictable responses of populations of certain species to different levels of a variety of pollutants has resulted in the use of larval chironomids as biological indicators of water quality. Additionally, chironomid larvae are essential components in the efficient biological processing that takes place in the oxidation ponds of sewage treatment plants.

Water quality also determines chironomid distribution, and within the family a wide range of tolerance is displayed. Some Tanypodinae and Chironominae are very tolerant of low levels of dissolved oxygen. *Chironomus plumosus* larvae are able to withstand a pH value of 2.3. *Cricotopus bicinctus* is known for its tolerance for many substances, including electroplating wastes and crude oil. Other members of the family are known for their intolerance for poor water quality.

Feeding

The majority appear to be opportunistic omnivores, feeding on diatoms, detritus, and other small plants and animals. Chironomid larvae exhibit a variety of feeding habits. Most adults do not feed.

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