MANAGING THE MIDGE

BY ADRIAN PINDER, JENNY DAVIS AND JIM LANE

On a typical spring or summer evening, millions of small flies can be seen emerging from many of Perth's urban wetlands. They form dense swarms in swirling columns around the shores, and being attracted to lights, they are a nuisance in nearby residential areas. While they do not bite or sting, their sheer numbers prevent many outdoor activities such as jogging or entertaining. These flies, commonly known as non-biting midges and belonging to the insect family Chironomidae, are one of the more obvious environmental problems associated with urban wetlands in Perth.

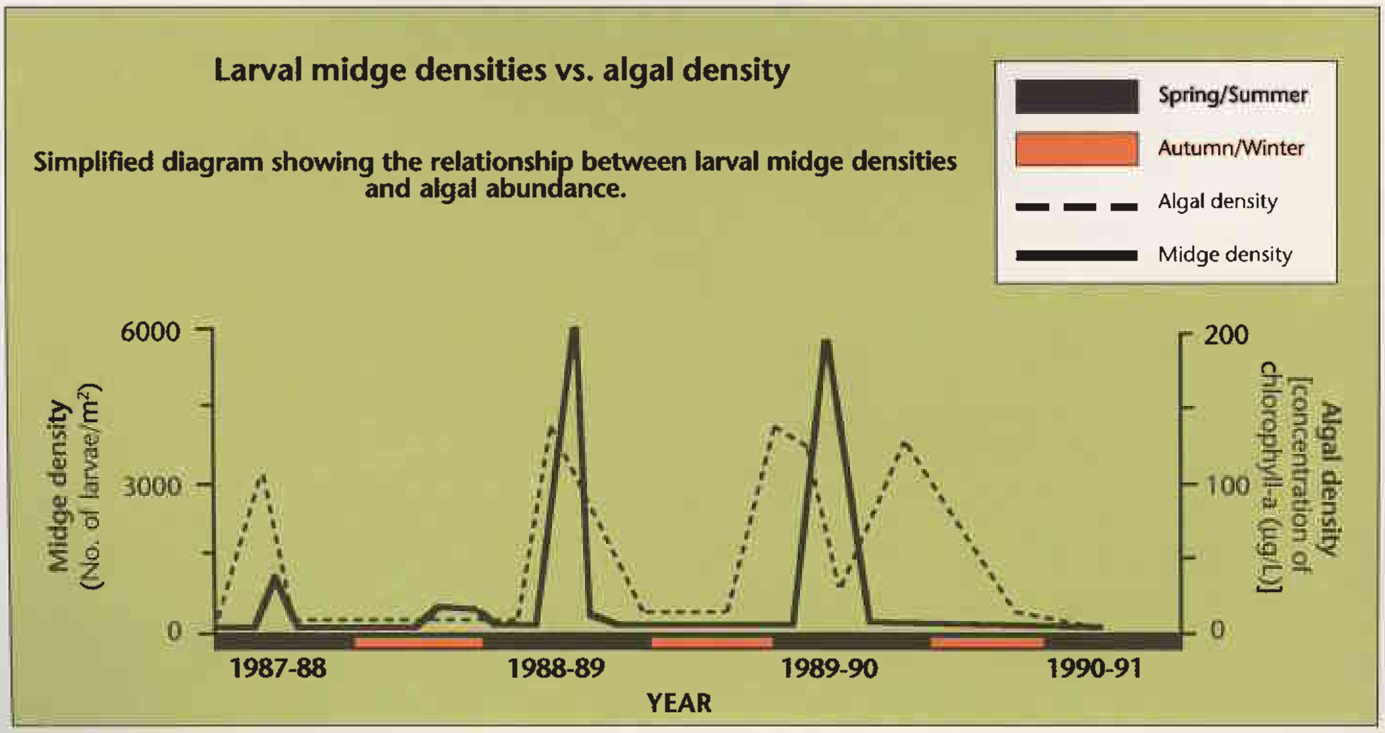
There are several types of difficulties caused by these midge swarms. As some species are small enough to pass through the holes in flyscreens, windows cannot be left open on hot summer nights. If windows are left open for ventilation, the lights must be turned off. Outdoor entertaining in the evenings becomes impossible. Dead midges are often found piled high on window sills and may also stain laundry hung out to dry. The huge number of midges provides nightly banquets for spiders, which cover patios and verandas with their webs. Walking, jogging or cycling around lakes becomes unbearable as midges get in eyes and mouths. Driving, too, may become hazardous as dead midges smear thickly on windscreens and roads.

Adult chironomids, unlike mosquitoes, do not have biting or piercing mouthparts and so are not vectors of disease. However, there are some reports of people being allergic to the haemoglobin in the bodies of adult midges; this has been implicated in such complaints as asthma and conjunctivitis.

Until recently, the traditional remedy to these problems was to kill the aquatic midge larvae using the insecticide Abate® (temephos). However, midges appear to be building up a resistance to this insecticide. Partly in response to this, a research steering committee was established in Perth in 1987 to guide research into more effective, economic and environmentally acceptable methods of midge control - the aim is not to eliminate the midges, but to control them, as midge larvae are an essential part of aquatic ecosystems. Some of the wetlands where midge problems occur are nature reserves (for example, Forrestdale Lake) and so it is especially important that the food chains of these ecosystems are not overly disrupted by pesticides. After four years of research carried out by a Murdoch University study team, new methods of control are being proposed.

Jackadder Lake - the original fringing vegetation has been replaced by steep banks and lawns, resulting in low densities of midge predators.
Photo - A. Pinder

Previous page
Inset: An adult midge, *Kiefferulus intertinctus*. Large numbers can occur around Perth wetlands.
Photo - K. Trayler
Main: Food for midge larvae - an algal bloom at North Lake.
Photo - S. Rolls



MIDGES AND WETLANDS ECOLOGY

Nutrient enrichment and the degradation of wetlands is believed to be a major factor in the high densities of midge larvae in lakes. Generally, the most nutrient-enriched lakes have the worst midge problems.

Undisturbed wetlands on the Swan Coastal Plain are characterised by complex food webs. The growth of algae is limited by low nutrient concentrations, grazing by zooplankton, and by naturally occurring coloured compounds (resulting from the decomposition of plant material, such as leaves from fringing vegetation) which limit the availability of light. The algae that is not eaten eventually sinks to the bottom of the wetland, where it contributes to the organic debris (known as detritus) and is consumed by a variety of microbes and invertebrates, including midge larvae. Those midges that feed on decaying plant and animal matter help to recycle such material and so help to keep the food chains flowing, effectively acting as nature's vacuum cleaners in wetlands. The zooplankton and the detritivores in turn either fall prey to the predatory invertebrates (such as dragonfly larvae and beetles) and vertebrates (such as tortoises and birds) or themselves add to the detritus. Nutrients, released from the detritus and from excretion by the animals, return to the water column to fuel algal growth, so continuing the cycle.

Disturbed wetlands are often excessively enriched with nutrients and have most of their natural fringing rushes and woodland removed. The high availability of nutrients encourages growth of a type of algae (blue-green) that is not readily digested by the zooplankton. These algae, fuelled by the excessive nutrients, form blooms that collapse and become the basis of a rich food source for midge larvae.

Many animals that would ordinarily prey on the midge larvae rely on catching their prey by sight. During a dense algal bloom they are no longer able to see their prey. This effect, combined with low oxygen concentrations caused by decaying algae, the effects of other pollutants and the reduced habitat diversity associated with the loss of aquatic vegetation, results in low densities of predators and favourable conditions for midges.

Nymphs of the dragonfly *Hemianax papuensis* which occur in the urban wetlands are natural predators of midge larvae.
Photo - S. Rolls

The larval midge *(Chironomus occidentalis)* can occur in very large numbers in Perth wetlands. The larvae inhabit the sediments where they feed, and pass through four stages (instars) before pupating.
Photo - S. Rolls

Decomposing algae at the edge of North Lake - an abundant source of food for larval midges.
Photo - S. Rolls

CONTROL BY CHEMICALS

Chemical control of midges was initiated in the 1950s when organochlorine pesticides were applied to wetlands to kill larvae. Use of these chemicals ceased in the late 1960s and the organophosphate insecticide Abate® was used instead. This chemical is still the only registered insecticide for midge control in WA.

In recent years Abate® has declined in effectiveness at some Perth lakes, most likely because of genetic resistance in midge populations and the increased abundance of algal blooms in the water. One aim of research at Murdoch University has been to find an alternative chemical for use in short-term control programs.

Several different pesticides have been assessed. However, most were considered unacceptable from an environmental viewpoint or were not effective in controlling midges.

One chemical, Sumilarv® (pyriproxyfen), was effective in field and laboratory tests. Sumilarv® is known as a juvenile hormone analogue - a synthetic chemical which mimics the effects of a naturally occurring insect growth hormone. When mature midge larvae are exposed to this artificial hormone their natural hormone balance is upset and they are unable to develop into pupae and adults. However, some adverse side effects, such as changes in invertebrate community structure, cannot be ruled out and these aspects are still under investigation.

Because resistance to this chemical is likely to develop with persistent use, Sumilarv® will only be useful as a short-term control option. It will not provide a permanent solution to Perth's midge problems.

AN INTEGRATED APPROACH

Chemical control is only one of a variety of modern pest control techniques. Others include biological control (such as predation and parasitism), light traps, in-lake modifications (such as nutrient binding), public education, and improved environmental management and land-use planning.

Light traps exploit the natural attraction of midges to bright lights. These can be placed close to the lakes and away from residential areas to reduce the number of midges in the suburbs. Such light traps have been installed at Lake Monger by the City of Perth, with the dual purpose of midge control and footpath lighting, and preliminary studies indicate that these may form an effective component of an integrated approach.

Many attempts have been made overseas to control chironomids by using insect diseases, parasites or predators, i.e. by biological control. These attempts, however, have generally been unsuccessful or have had deleterious effects upon the environment. The dangers of introducing exotic species to control pest populations have been exemplified by the case of the infamous cane toad (*Bufo marinus*) of Queensland. The introduced mosquitofish (*Gambusia affinis*), which has been used (largely unsuccessfully) in attempts to control mosquitoes, is present in high numbers in many wetlands where midge problems occur. But it does not appear to feed on the sediment-dwelling midge larvae unless there is nothing more accessible to eat.

Preventing further nutrient enrichment of wetlands and rehabilitating those that are already degraded must form an integral part of midge control in the long term. In essence, this will involve improved management of wetland catchments, possibly with some in-lake work for the worst-affected sites.

Above left:
A light trap installed on the edge of Lake Monger to attract and collect adult midges.
Photo - A. Pinder

Above right:
Aerial photograph of Lake Monger and Herdsman Lake. The greeness of Lake Monger is a result of the presence of a large algal bloom.
Photo - from the Perth Road Guide Services

Below:
The lack of fringe vegetation at Bibra Lake means that swarms of midges move easily to nearby well-lit residential areas.
Photo - A. Pinder

MANAGEMENT

Sources of nutrients to wetlands include agricultural and urban runoff, leakage from septic tanks, and abandoned tip sites, which were often located in or near wetlands in the past. Nutrients from these sources enter wetlands either through the groundwater or via surface runoff, for example stormwater drains. Many of these sources can be reduced by appropriate land management practices.

In urban areas, much of the nutrient matter that enters wetlands is derived from fertilisers and detergents, which are either washed into drains or seep into the groundwater. Slow-release fertilisers or, even better, gardens that require minimum fertilisation, are ways to reduce this source. Phosphorus-free detergents are also preferable.

Sometimes it may be desirable to divert urban or agricultural drains away from wetlands. In other situations, nutrients can be chemically stripped from the drainage water before it enters the wetland. Where septic tank leachate is a source of nutrients, connection to deep sewage networks should be considered.

Fringing vegetation, such as rushes, sedges and paperbark woodlands, is important for natural wetland functioning. Its removal leads to loss of habitat diversity and thus a reduced diversity of invertebrate and vertebrate fauna. This type of vegetation can also absorb much of the nutrients entering a wetland via the groundwater and some of the nutrients from lake sediments.

A wide buffer zone of vegetation

hides the lights associated with residential areas that are so attractive to midge swarms and presents a physical barrier to the movement of swarms from the wetland. Large trees (for example, the swamp paperbark *Melaleuca rhaphiophylla*) growing at the edges of wetlands also shade the shallow littoral zone, resulting in lower water temperatures, and this helps to reduce the growth of both algae and midge larvae. In addition, the brown colouration caused by the tannins which leach from the resulting leaf litter can help reduce algal growth. Thus the replanting of native vegetation is an essential aspect of wetland restoration from a midge control perspective.

Biological manipulation has the potential to reduce the amount of algal growth in nutrient-enriched wetlands and may be achieved by altering the balance between various components of the biota, especially the fish, zooplankton and phytoplankton.

However, this is only likely to be successful if carried out with appropriate wetland restoration strategies. Such techniques have had some success overseas. Physical and chemical modifications - such as deepening of wetlands, the addition of tannins to darken lake water, or the addition of chemicals such as aluminium sulphate to bind nutrients - may also be considered.

WHICH WAY NOW?

Clearly, the use of chemical insecticides alone to control midges is only a stopgap measure aimed at the symptom and not the root causes of the problem. In the longer term, wetland restoration using the above strategies will be required. Such strategies have the potential to enhance other values associated with wetlands, including conservation, recreation and education.

In the past, inappropriate land use has led to conditions highly favourable to midges, and the huge numbers which emerge from lakes during summer cause significant nuisance problems for nearby residents. The use of chemical control agents is undesirable from certain perspectives, but with measures such as light traps it is currently the only effective means of controlling the number of midges which reach residential areas. Long-term midge control requires that the water quality of wetlands be considerably improved. Hopefully, this process will hopefully be accelerated by fundamental changes in our perceptions of the value of those wetlands and just how far we are prepared to go to preserve them. ◘

Fringing vegetation at the northern end of Loch McNess.
Photo - S. Rolls

Paperbarks at Star Swamp. Wetlands that are not excessively nutrient-enriched and still support fringing vegetation do not usually experience midge problems.
Photo - C. Pinder

Inset:
The dragonfly - a natural predator of midges.
Photo - K. Trayler

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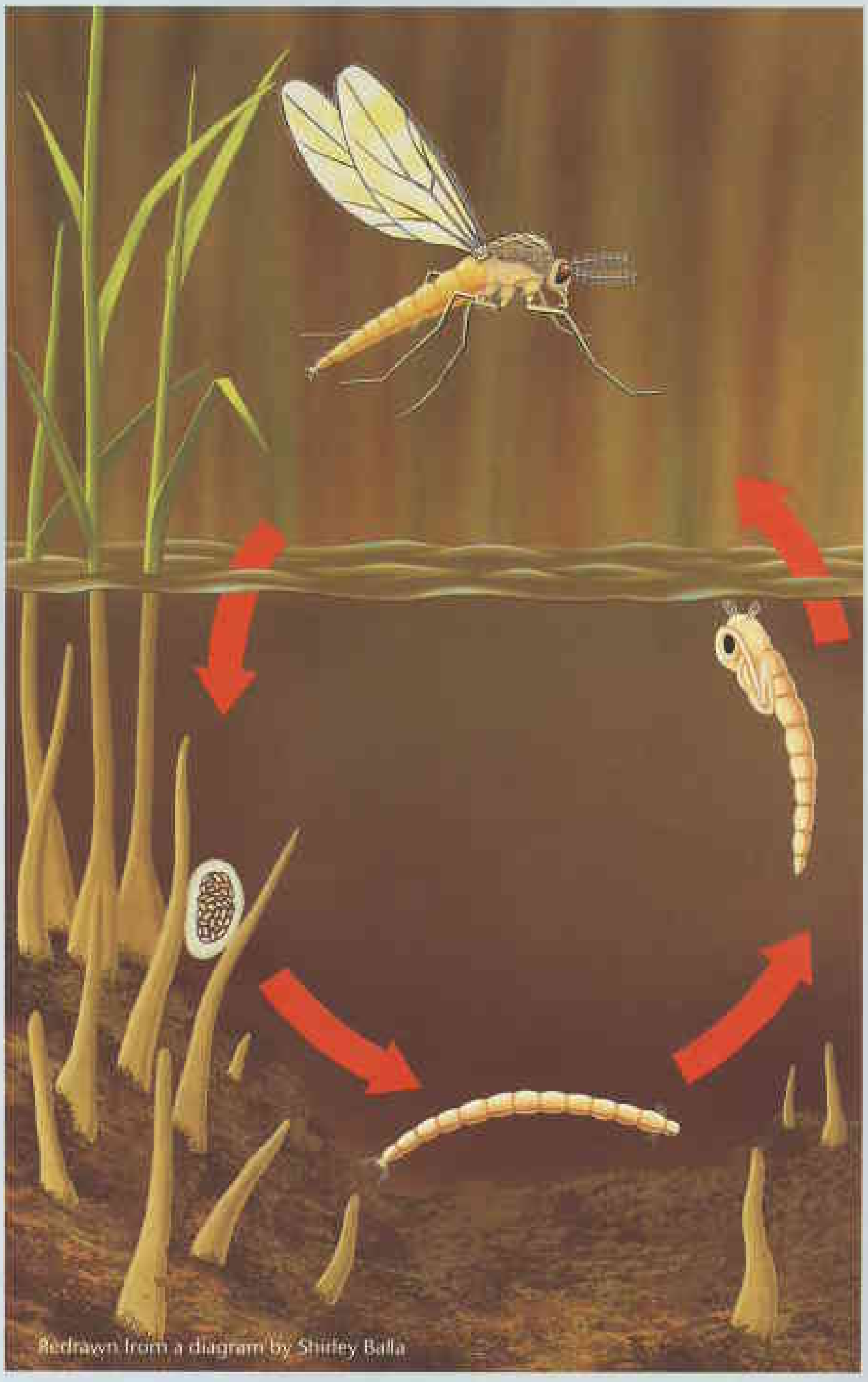
THE LIFE OF MIDGES

Chironomids are a major component of the invertebrate community in many aquatic habitats. About 5 000 species worldwide and 461 species in the Oceania region, including Australia, have been described, and at least 35 of these have been recorded in or near wetlands in the Perth region.

Midges pass through several stages in their life cycles. The terrestrial adults lay eggs in such diverse aquatic habitats as water-filled tree holes, waterfalls, hot springs, lakes and streams. The aquatic larvae grow and eventually develop into pupae. At emergence, the pupae rise to the water surface and the adult breaks free from the pupal case. Millions of midges emerge nightly during summer and emergence rates of over 1 500 midges per square metre per night have been recorded in Perth wetlands. After emerging, the midges form mating swarms, commonly seen as the tall, swirling columns around local wetlands. The females leave the swarm after mating, each to lay one jelly-like egg mass containing thousands of eggs. These sink to the bottom of the wetland or become attached to plants and other submerged objects. The high number of eggs laid by each female means that the abundance of larvae can increase from low to very high densities in a matter of weeks under favourable conditions.

The length of the life cycle, and thus the rate of population growth, is highly dependent upon temperature and food availability. During warm summer months the entire life cycle can be completed in a few weeks. In colder climes, up to seven years are required to complete larval development.


Redrawn from a diagram by Shirley Balla

The larvae, also known as bloodworms, are usually red or brown and range from 0.5-3 cm in length when mature. Species that inhabit lakes are generally sediment dwellers. Some inhabit tubes, which they construct from fine particles. They are usually filter feeders, eating debris, bacteria and algae, which may be sucked into the tube by the rhythmic movements of the larvae. Other species are more mobile and are either grazers of algae or are predatory, feeding upon other animals. The larvae pass through four juvenile stages before pupating and emerging as adults. Up to 100 000 larvae per square metre of sediment have been found in Perth wetlands.

The larval chironomids are important food sources for a variety of animals, including invertebrates, birds and tortoises. This is recognised by managers of waterfowl breeding habitats. In some areas of North America, wetland managers actively encourage high numbers of midges to provide a food source for waterfowl.

You don't have to go far from Perth to enjoy the peace and quiet of the bush. The forest is right on our doorstep. See page 10.

The increase of births in captivity for cockatoos seemed promising, but was it related to the upsurge in 'birdnapping' in the wild? To Catch a Thief explains how forensic experts unravelled the mystery. See page 28.

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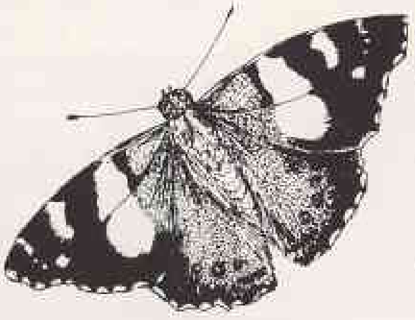

Painted ladies, northern admirals, southern admirals and Western Australian skippers - not the stuff of a sailor's dream, but all members of the butterfly family. See page 23.

Our native animals are prey to introduced species. While baiting gives them a fighting chance, scientists are looking for more long-term, humane solutions. See page 16.

The bilby has many names, including ninu and dalgyte. Ninu Magic tells the story of this shy animal and its remarkable survival skills. See page 43.

FEATURES

REGULARS

COVER

The red-tailed black cockatoo (*Calyptorhynchus magnificus*) is one of several cockatoos native to Western Australia. These spectacular birds nest in tree hollows and can be found in the woodlands and grasslands of the south-west of Western Australia.

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