



Brisbane City

Mosquitoes in Brisbane



*MOSQUITO & PEST SERVICES
PROTECTING BRISBANE'S HEALTH AND LIVEABILITY*

General Notes

Mosquitoes in Brisbane can be highly irritating biting pests of man and animals. They can also carry viruses, such as Ross River Virus and Barmah Forest Virus, which can cause debilitating disease in an unfortunate small proportion of those who are infected. Because of their pest status and their importance as disease carriers, mosquitoes are a major concern for the Brisbane City Council's Mosquito and Pest Services, a Small Business Unit in the City's Business Division. This section operates a year-round mosquito control program throughout the city. Following are some notes about the life cycles of these insects, with a few details on the more frequently encountered species, and information on the Council's control program.

Mosquitoes lay their eggs on the surface of water, or damp ground or vegetation at the edge of a water hole, or on the damp edges of a container such as a treehole cavity or a man-made container such as a tyre or rainwater tank. Eggs hatch to produce larvae (wigglers) which grow through four "size" steps (called instars) before becoming pupae (tumbler). The larvae feed on micro-organisms in the water and breathe through a tube in the tail which opens to the air as the larvae come to the surface of the water. The pupae do not feed, and breathe through a pair of tubes on the top of the body as they rest at the water surface. In the warm temperatures of summer, the larval stage may be as short as 4-6 days, but in cooler weather this stage will be much longer. The pupal stage is shorter than the larval stage, and may be only 2-3 days in summer. The adult emerges from the pupal case as it rests at the surface of the water. A generalised diagram of the life cycle of a mosquito is shown on the last page of these notes.

Those mosquito eggs which are laid on damp surfaces are usually drought resistant, so that there is a resting stage where the eggs remain viable until the pool, container or cavity is flooded by rainfall or irrigation or tidal water. This is why there are often outbreaks of savage mosquitoes within a week or two of rain after a long dry spell or after a peak high tide - many larvae hatch from eggs simultaneously and, if unchecked, produce swarms of hungry females which are eager to feed in time to lay their eggs in the receding pools where the eggs lie dormant till they are flooded by the next lot of water. A plague of this type of mosquito associated with fresh water inundation generally fades away after a couple of weeks, if there is no more rain. In the case of saltmarsh mosquitoes which hatch with tidal inundation, when there is no influence from rain there are usually cycles of adult abundance which coincide with the tidal pattern.

Eggs which are laid on the surface of free water are usually deposited in the form of a raft and hatch within 24 - 48 hours. These mosquitoes have no resting stage in their life cycle. They often become very abundant after heavy rains by utilising floodwater pools, especially where there are grassy margins.

From the information above, it may be already apparent that temporary pools generally provide more opportunities for mosquito breeding. In permanent water such as dams and creeks, there are often substantial numbers of natural predators of mosquitoes, such as fish, dragon flies and other insects. In these situations an equilibrium has been reached over time. But in temporary pools which form after rain or tidal inundation, mosquitoes establish and complete their development rapidly before the numbers of predators rise to the level where they can provide any significant control.



Only female mosquitoes feed on blood. However both male and female mosquitoes can survive on plant nectars and secretions. The adult lifespan may be from 2 - 4 weeks in summer, but this may be much longer in cooler weather.

Mosquitoes feed on the host for a short period, with usually 1-2 minutes required to complete engorgement. As the mosquito feeds it injects saliva. This helps to prevent blood clotting around its mouthparts and may also initially reduce the sensation of being bitten in the host. However after the mosquito has left there may be a reaction to this foreign substance which causes the familiar irritation at the site of the bite. After feeding on blood the insect will rest, preferably in a damp, dark sheltered site while the blood is digested and eggs developed. In summer, the eggs can be ready for laying 2-3 days after a blood meal. After laying her eggs, the female will be ready for a further blood meal and the cycle may be repeated 4-5 times in her lifetime.

Disease Transmission

The fact that mosquitoes inject saliva as they feed leads to their ability to transmit viruses such as Ross River virus (RR). In some species of mosquitoes, if RR is taken into the mosquito gut with a blood meal, the virus can pass through the gut wall and infect tissues of the mosquito, where it can multiply sometimes as much as 1,000-fold. If a mosquito's salivary glands are infected by the virus, it may be possible for infective virus to be transmitted by the insect as it feeds. Not all mosquito species are susceptible to infection with a virus, and not all infected mosquitoes will go on to transmit virus when feeding. Usually only a very small proportion of mosquitoes in nature will transmit. There is now evidence that RR can be passed on by mosquitoes through their eggs to their offspring, but once again this probably occurs at a very low rate. Susceptibility of mosquitoes to infection with viruses is controlled both by genetic inheritance and by environmental factors such as temperature and larval nutrition. Infection and transmission rates can be derived in laboratory studies to determine which mosquito species are important carriers of viruses such as RR.

Mosquito Control in Brisbane

The Brisbane City Council's mosquito control group, Mosquito and Pest Services, is based at 145 Sydney Street, New Farm. It has a staff of approximately 40, with trucks, 4WD bikes and airboats fitted with pumps and sprays for mosquito control. The unit has an annual budget of approximately \$3.5 million. Staff make regular checks throughout the city, monitoring potential breeding sites such as swamps and roadside drains for the presence of mosquito larvae. If necessary, breeding sites can be treated as soon as mosquito activity is found.

In the summer, there is an aerial program to control mosquitoes which breed in the salt marshes on the Boondall and Pine River Wetlands, around the Airport and Pinkenba, on Fisherman and Whyte Islands at the mouth of the Brisbane River, around Wynnum and Hemmant, and along Tingalpa Creek. Up to 3,000 hectares may have to be treated as often as 12-16 times during the season. Treatments are usually made approximately every 16 days because the mosquito breeding cycle is controlled by the monthly tide cycles. In general, tides higher than 2.4 m at the Brisbane Bar will flood the breeding areas and trigger an aerial treatment. However, heavy rainfall can change this timing.



The targets of the control program are the mosquito larvae while they are still concentrated in their breeding sites and before they emerge and disperse as adults looking for blood. The products used are an insecticide called "Bti", which is a protein produced in a fermentation process by the bacteria *Bacillus thuringiensis israelensis*, and an insect growth regulator called "Methoprene". These chemicals are friendly to the environment because they specifically target mosquitoes - they affect very few other insects, and no wildlife or people. Bti is a stomach poison which breaks down the lining of the gut of the mosquito larva and kills it. Bti does not contain live bacteria. The growth regulator methoprene interferes with the normal development of the mosquito larvae into pupae and adults, and usually causes high mortality in the pupal stage.

The aerial treatments use methoprene which is coated onto sand granules applied from a hopper carried under a helicopter, at a rate of 3 kg of sand per hectare, or Bti in water applied at a total volume of 3 litres per hectare. The aircraft use a Differential Global Positioning System (DGPS) to achieve accurate tracking over the salt marshes. During and after the treatment, computer files can be downloaded from the DGPS console in the helicopters and flight paths can be plotted onto a computerised mapping system, to provide a record which shows that all appropriate areas have been treated. When the helicopters are working with sand, the Mosquito and Pest Services Field Monitoring Team sets up an array of large funnels on the ground to check that the sand granules are being applied evenly and at the correct rate. When liquid is being used, the application is monitored using small dye cards which retain a permanent mark from each spray droplet. These cards can be assessed by a video image-capture system to check the number and volume of drops. There have been occasions in the past and there will be in the future when bad weather or mechanical problems will mean that an aerial treatment will not be completed in the narrow time-frame during which the mosquito larvae are susceptible to the control products. Unfortunately this may lead to a short period of mosquito activity which will cause problems.

Larvae and pupae are sampled before and after treatments, to make sure the applications are effective. Larvae are also brought into the laboratory during the season to test them and make sure that they are not developing resistance to the chemicals used in control.

If there are mosquito complaints from ratepayers, an overnight light trap is often run at the site to identify the mosquito species. That provides clues to the breeding sites and possible source of the pest. One species which can often produce telephone complaints with its biting activity is the container-breeding mosquito *Aedes notoscriptus* (see notes below). This species invariably breeds around private houses in sites such as tyres, tins or buckets in back yards, in gutters which hold water and even in the leaf axils of bromeliads. Because these mosquitoes breed in isolated, small containers on private property, Council Officers are unable to carry out control measures. It is up to householders to ensure that potential breeding sites are eliminated. This can be done by activities such as disposing of any containers in the yard which will hold water, by keeping gutters clean and dry, and by emptying water from pot plant saucers at least once a week (are saucers necessary outdoors at all?). If possible, bromeliads should be removed, or alternatively some can be cleared by using a high pressure jet from a garden hose.

On some occasions in the past, adult mosquitoes have been controlled by fogging from the back of a truck in suburban streets. However this type of control can be very damaging to the environment, as it indiscriminately kills all insects, not just mosquitoes. At present fogging will only be considered under exceptional circumstances, such as in association with major

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flooding, or where there is a major concentration of mosquitoes adjacent to a breeding area posing a threat to residents.

Common Mosquito Species of Brisbane

Mosquitoes have many minute bristles and scales all over the body and wings, and it is the presence or absence of some of the bristles and the colours and distribution of the scales which are used to identify the different species. The normal method of preparation and storage for mosquitoes is to mount specimens on ultra fine steel pins for microscopic examination. Believe it or not, the fine structural details, colours and patterns of mosquitoes under the microscope can be quite fascinating.

Aedes vigilax: This is the major pest mosquito of Brisbane, especially in the eastern suburbs. It breeds in the salt marshes and swamps such as those at Pine River and Boondall Wetland Reserves, around the Airport, Pinkenba, Whyte and Fisherman Islands, and areas at Tingalpa Creek, Wynnum and Hemmant. It is renowned for its capacity to disperse over many kilometres and can reach pest numbers in suburbs well away from the breeding sites. It will feed readily on people and a broad range of hosts. It is one of the most important carriers of Ross River and Barmah Forest viruses in coastal Australia, and can also carry dog heartworm.

Aedes funereus: This species breeds in coastal swamps which are often brackish as they are usually near tidal areas. There is frequently an association with tea-tree or paperbark swamps. One recognised breeding area in Brisbane is Indooroopilly Island. Any host which disturbs this species resting in the vegetation around breeding sites will be attacked fiercely. Fortunately, it does not usually disperse far from its breeding areas. Ross River virus has been isolated from this species in Brisbane.

Aedes notoscriptus: This is probably the most frequently encountered species around houses across Brisbane. It occurs in an unusually wide range of sizes from very small to medium. It is a black mosquito with white markings on the legs and body. Under the microscope it is very attractive, with a lyre-shaped pattern on its thorax. It breeds in natural and man-made containers such as tree cavities, gutters which do not drain, discarded tyres and containers, bird baths and pot plant trays, especially where these contain leaf litter. As many as 400 larvae have been found in one small container holding about a cup of water. It is the species which is most likely to be found biting in the winter, and in summer it can be abundant within 7-10 days after rain has filled containers and eggs hatch. Ross River and Barmah Forest viruses have been isolated from this species in Brisbane, and recent tests have shown that it is also capable of transmitting both viruses. It will carry dog heartworm.

Aedes alternans: This is a very large ginger coloured mosquito with a "shaggy" appearance due to a covering of scales which stand out from its body. It is sometimes called the "Scotch Grey" or "Hexham Grey". It breeds in both brackish and fresh water and the larvae are predators of other mosquito larvae. It is often found in the saltmarshes in association with *Ae. vigilax* and *Culex sitiens*. Adults will bite a wide range of hosts, but they are rarely abundant enough in Brisbane to be a pest.

Aedes vittiger: This is a large pale coloured mosquito which is sometimes mistakenly called the "Scotch Grey". It is smaller than *Ae. alternans* and has four obvious dark stripes on its thorax. This is a broad spectrum feeder which can occur in troublesome waves after rain fills



shallow grassy depressions where the eggs are laid and hatch after flooding. It is a vicious and persistent mosquito which will bite through clothes.

Aedes procax: This is a small to medium sized species which breeds in temporary ground pools. It is increasingly being recognised as a significant occasional pest, and recent research has shown that it can be a very efficient carrier of Ross River virus.

Aedes alboannulatus: A medium to large black mosquito with white markings on the legs and body. It breeds in temporary ground pools, occasionally in very muddy water, and also in artificial containers. It can be a minor pest but is usually present for only short periods.

Culex annulirostris: This is probably the most common and widespread mosquito across Australia. It is a medium sized brown mosquito with a pale ring around its proboscis. It is most commonly found in freshwater swamps. Its numbers can increase rapidly to pest status after flooding rains, when it will breed in temporary grassy pools such as roadside drains. It is a broad spectrum mammal feeder which will also feed on birds. It is the most important carrier of Ross River virus in inland Australia, and is now recognised as an important carrier of this virus in Brisbane. It is generally more abundant later in the summer season, but this will depend on rainfall. It carries many other viruses in Australia, most of which have no disease associations. It will also carry dog heartworm.

Culex sitiens: This species is very similar in appearance to *Cx. annulirostris*, but it is mainly coastal in distribution where it breeds in brackish tidal pools, especially after salinity is diluted by rainfall. In Brisbane, they can be very abundant as larvae later in the season. They are known to bite avidly in some situations, but in general they do not disperse very far from their breeding sites and are not considered to be a significant pest.

Culex quinquefasciatus: A medium sized brown mosquito which is found around the world. Its breeding site is usually associated with heavy organic pollution, such as sewage or meatworks pollution. It will breed readily in septic tanks if they are not mosquito-proof. It regularly feeds on birds, but will bite people, often around the middle of the night.

Culex australicus: This species is very similar in appearance to *Cx. quinquefasciatus* and it is widespread in Australia. It breeds in freshwater ground pools and swamps, and is often more abundant than other species during the cooler part of the year. It is found regularly as larvae and adults in Brisbane, and while it is often found resting indoors it is not a problem species because it does not bite people.

Culex halifaxii: This is a large brown mosquito and individuals are often found resting indoors. However it is not known to bite people. The larvae of this species are taken regularly around Brisbane in a wide range of pools and containers. They are predators of other mosquito larvae.

Anopheles annulipes: This is the common *Anopheles* species taken regularly in larval surveys and light traps around Brisbane. However it bites people rarely and is not a significant pest in this area. It is widespread in Australia and feeds on a broad spectrum of mammals other than man. It is probably the most important vector of myxomatosis virus in rabbits in Australia, particularly as it often rests in burrows and will also feed there. It has been experimentally infected with human malaria but is highly unlikely to support establishment of this disease in Australia.

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Mansonia uniformis: This is a medium sized mottled brown mosquito which is an occasional biting pest in Brisbane. It is unusual in that the larvae have hard, sharp breathing tubes (siphons) which they use to attach to plants underwater and breathe from air cavities in the plants.

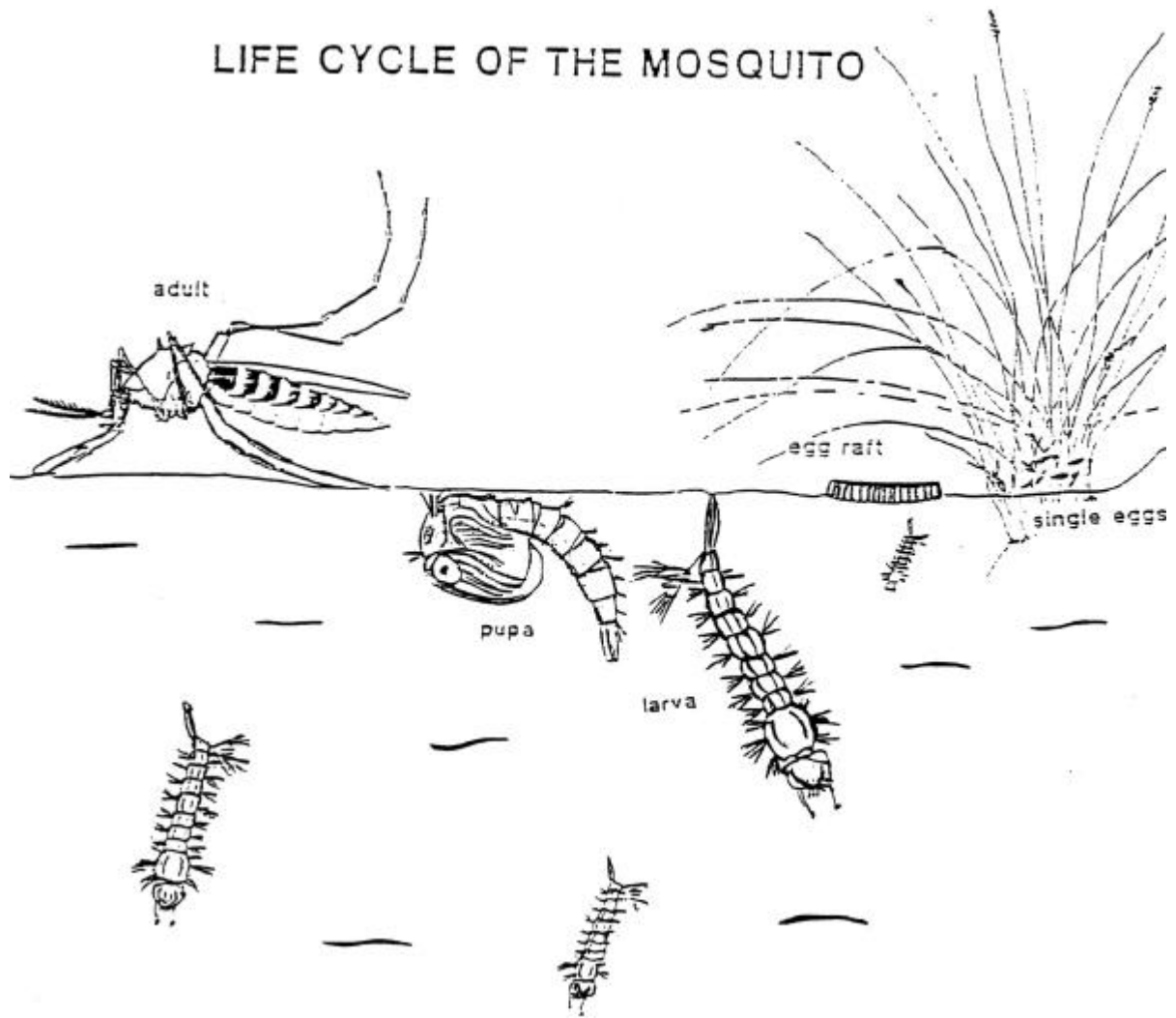
Coquillettidia xanthogaster: This species is easy to recognise because of its golden colour. It is occasionally taken in light traps in Brisbane, and while it can be a pest in northern Australia it is never abundant enough to be a problem in Brisbane. The larvae of this species also breathe by attaching to plants underwater.

Coquillettidia linealis: This species is becoming more common in collections in Brisbane and is increasingly being recognised as a pest. The larvae breathe from plants in permanent waterholes. The species can be a pest in coastal and inland areas elsewhere. Ross River virus has been isolated from this species on a number of occasions in NSW.

Toxorhynchites speciosus: This is a very large and unusual mosquito. It is a metallic blue/black colour with white markings, and the proboscis is curved sharply back under the body. Adults are occasionally found indoors but do not feed on blood. They survive on plant nectar and secretions. The larvae are a burgundy colour and are predators of other mosquito larvae. They are found naturally in treehole cavities, but are also collected regularly in artificial containers such as tyres and pot plant trays.

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