Department of **Agriculture, Fisheries and Forestry**

Mosquito management in tidal wetlands

Why is saltmarsh mosquito management important?

The principal problem species associated with tidal wetlands is the saltmarsh mosquito (*Ochlerotatus vigilax*), which uses tidal wetland habitat to breed. Adults of this mosquito species are a major pest in coastal residential areas, are aggressive and will bite day and night. It can carry Ross River virus, Barrah Forest virus and dog heartworm.

Where do saltmarsh mosquitoes breed?

In well-drained tidal wetlands, saltmarsh mosquitoes are principally found behind the mangrove communities in the 'high' marsh, where pools of water in saltmarsh areas are left by spring tides or are filled by runoff and rainfall, and are flushed by the daily tide movement.

In tidal wetlands that are not well drained, saltmarsh mosquitoes are also able to exploit impounded 'stagnant' pools retained within stands of mangroves and some saltmarsh vegetation on the 'low' marsh, caused by siltation or other blockage of the normal tidal channels and not subject to the normal daily flushing.

The female saltmarsh mosquito lays her eggs on drying soil and at the base of vegetation on the edge of depressions on the high marsh, and at the edge of impounded pools in the mangroves. These eggs dry and become dormant. They hatch weeks to months later when submerged by tide or rain water that refill the depressions.

This typically occurs when the higher spring tides each month flood the 'high' marsh. As the tide recedes, depressions are left filled with water, and eggs hatch to mosquito larvae. The larvae hatch in relatively isolated pools that are protected from predators and tidal flushing. These pools may evaporate naturally or persist as brackish pools after heavy rainfall, usually in summer.

The mosquito larvae develop into adults, usually over a period of six days, if the pools persist.

Who is involved in mosquito management?

Control of mosquitoes involves integrated management by governments and researchers. Including:

- Local Governments - Mosquito control activities are important to public health, and the lead responsibility for carrying out mosquito management lies with local governments.
- Department of Agriculture, Fisheries and Forestry (DAFF) – DAFF has an important role in the management of tidal wetlands to support commercial, recreational and traditional fisheries.
- Queensland Health – public health and communicable diseases, research and training.
- Research organisations e.g. Queensland Institute of Medical Research, Mosquito and Arbovirus Research Committee Inc., Australian School of Environmental Studies, Griffith University.

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How are saltmarsh mosquitoes managed?

Chemical control

Local governments administer aerial and backpack spraying programs in known saltmarsh mosquito breeding areas. Controlled application of registered pesticides to the upper limits of the intertidal zone involves use of recommended dilutions of effective agents which specifically target the early stages of saltmarsh mosquito larvae (mosquito wrigglers). Products used include pesticides, biocides or insect growth regulators. Local governments monitor the effectiveness of each application on resident mosquito populations and relate the required level of control to the reported pest and health problems in the area.

The use of pesticides, to control aquatic stages of the mosquito life cycle, has limitations in terms of requiring favourable conditions for aerial application, the costs of agent supply and application, the possibility of inducing pesticide resistance in mosquito populations, and potential for effects on non-target organisms.

Biological control

The availability of biological agents for control of saltmarsh mosquitoes in shallow transient pools is limited. One successful agent is *Bacillus thuringiensis var. israelensis* (Bti), a bacterium producing active protein crystals, selectively toxic to mosquito larvae. When ingested, the crystals rupture the digestive tract resulting in rapid mortality of the larvae. Increased specificity of products used for mosquito control reduces the likelihood of deleterious impacts on non-target organisms.

Several fish species are effective in controlling mosquito populations. These fish eat mosquito larvae and control the algae that provide protection to the larvae. In saltmarshes, fish such as Pacific blue-eye (*Pseudomugil signifier*) and gobies help control mosquito larvae. However, it is unlikely that these fish could be effective as the sole strategy for mosquito control in saltmarshes, due to the difficulties in stocking and retaining fish in the harsh saltmarsh habitat, and the seasonal nature of the tidal saltmarsh pools.

Fish stocking for mosquito control is a useful strategy in **freshwater** ecosystems. Choosing the right fish is important. Fish that are native to local waterways ensure that local ecosystems are not disturbed. Information on fish stocking for mosquito control in freshwaters is available from DAFF.

Habitat modification – runnelling

A number of programs are presently in place that involve minor landform modifications to saltmarsh areas with minimal disturbance to associated vegetation. Approvals have been granted by DAFF to create shallow, spoon shaped drains or ‘runnels’ to enhance tidal flushing of ponds isolated from main tributaries. Runnels also provide increased access to mosquito habitat for fish that prey on mosquito larvae.

Suitability of a site for runnelling is determined by the general topography including the tidal profile, the proximity of natural waterways, and the density of intertidal vegetation. Wetlands vegetation may restrict the ease of construction of runnels. For example the occurrence of mangrove pneumatophores (shallow root systems at the base of mangroves) may influence the chosen path of disturbance. Post runnel construction may also be affected through regrowth of pneumatophores or colonisation by mangrove seedlings can restrict tidal flushing of the runnel.

Specifications for the construction of runnels within saltmarsh zones include:

- runnels may be hand-dug or constructed using specialised mechanical equipment where impacts on the surrounding vegetation or terrain are minimised
- runnels should be less than 30 cm deep with a width to depth ratio of 3:1
- runnels should follow and be confluent with existing natural drainage lines
- spoil from runnel excavation may be used as fill for very deep depressions or for isolated pools
- spoil must not be placed in such a position as to form a levee
- spoil may be broadcast if dispersed to an undetectable level.

The effectiveness of runnelling in the control of saltmarsh mosquito larvae has been demonstrated through programs such as that of Coomera Island in Moreton Bay. Increased tidal flushing of saltmarsh zones allows greater movement of larvivorous fish resulting in a reduction of mosquito larvae through both predation and downstream displacement. Runnelling programs, undertaken in Queensland have been monitored by researchers of Griffith University, to determine long term effects on vegetation patterns and effects on the local water table.

How do Local Governments plan mosquito management?

Some mosquito management activities have the potential to have an adverse impact on the environment, and therefore should be undertaken under the **Mosquito Management Code of Practice**, available on the Local Government Association of Queensland website www.lgaq.asn.au

The Mosquito Management Code of Practice (MMCoP) states ways of achieving compliance with the general environmental duty under *Environmental Protection Act 1994*, and provides a means of demonstrating that reasonable and practicable measures are being taken to minimise environmental harm from mosquito control activities. Compliance with the Mosquito Management Code of Practice requires the development of a Mosquito Management Plan (MMP) to identify the desired outcomes and options to achieve these outcomes.

Where mosquito management using chemicals is required in a declared Fish Habitat Area, the DAFF *Code of practice for the lawful use of physical, pesticide and biological controls in a declared fish habitat area* (FHACoP01) requires DAFF to be notified. This Code of practice also applies to other pest management activities (e.g. weed control) that do not require a development approval in a declared Fish Habitat Area.

How is mosquito management authorised by DAFF?

Any modification of saltmarsh mosquito breeding areas in tidal wetlands is required to be assessed against fisheries legislation. All marine plants (including mangroves, seagrasses and saltmarsh species) and declared Fish Habitat Areas are protected by this legislation.

Runnelling programs that include the disturbance to marine plants or that are undertaken within declared Fish Habitat Areas are considered development under the *Fisheries Act 1994* and the *Sustainable Planning Act 2009*.

Runnelling is now authorised under the **self-assessable code** for *Minor impact works in a declared fish habitat area or involving the removal, destruction or damage of marine plants* (**MP06).** When works comply with this code, runnelling **does not require a development approval**.

Local Governments may undertake runnelling under code MP06 if done in accordance with the code's requirements:

- preparation of an Integrated Mosquito Management Program (which needs to be endorsed by DAFF)
- prescribed methods and designs for runnelling
- notification and signage.

Any runnelling proposed within declared Fish Habitat Areas also requires a prior resource allocation authority under the *Fisheries Act 1994*.

Where the proposed runnelling does not comply with the requirements of MP06, a development approval is required and, if in a declared Fish Habitat Area, a resource allocation authority is required prior to applying for a development approval.

Further information

Maintenance of runnels

The maintenance of approved runnels is covered under the **self-assessable code** for *Maintenance works on existing lawful structures (other than powerlines and on-farm drains) in a declared fish habitat area or involving the removal, destruction or damage of marine plants* (**MP02**).

Where maintenance can not be performed in accordance with MP02, a development approval is required.

DAFF publications

Phone DAFF on 13 25 23 or visit www.daff.qld.gov.au for copies of these relevant documents:

- Code of practice for the lawful use of physical, pesticide and biological controls in a declared Fish Habitat Area (FHACoP01).
- Self-assessable code for Minor impact works in a declared fish habitat area or involving the removal, destruction or damage of marine plants (MP06).
- Self-assessable code for Maintenance works on existing lawful structures (other than powerlines and on-farm drains) in a declared fish habitat area or involving the removal, destruction or damage of marine plants (MP02).
- DAFF Note – Native fish as alternatives to the exotic fish, Gambusia, for mosquito control.
- Stocking native fish for mosquito control in freshwaters – guidelines for local governments, housing developers, community groups and private landowners, DAFF.
- Declared Fish Habitat Area plans (maps).

Contact details and other links

- For enquiries about runnelling, resource allocation authorities or works under MP06 or MP02, contact your closest Fisheries Centre:
  Northern Fisheries Facility (Cairns): (07) 4057 3700 or
  Maroochy Research Facility (Nambour) (07) 5453 5860.
- For other enquires, visit www.fisheries.qld.gov.au or phone 13 25 23.
- Mosquito Management Code of Practice on the LGAQ website www.lgaq.asn.au
- Mosquito Control Association of Australia http://marc.qimr.edu.au

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