Managing backyard mosquitoes: Implications for pool-to-pond conversions

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EXECUTIVE SUMMARY

- Management of urban wildlife is critical. The “Pool to Pond” program coordinated by Ku-ring-gai Council is playing an important role in creating new habitats for local wildlife. However, concerns will always be raised regarding potential increases in mosquito populations and associated pest and public health risks.
- There are over 50 different mosquito species known to exist across the greater Sydney metropolitan region. Relatively few of these species pose a serious nuisance-biting pest risk or are associated with the transmission of disease-causing pathogens such as Ross River virus. The most significant pest problems are typically associated with the mosquitoes found in estuarine wetlands but those of bushland and backyard habitats can also be important.
- Properly maintained swimming pools do not pose a risk of producing mosquitoes. Neglected swimming pools are often identified as a source of nuisance mosquitoes but this is not always the case.
- Swimming pools converted to ponds may pose a minimal risk of providing a source of mosquitoes where they are managed appropriately. Any actual or perceived pest mosquito problems may be due to species associated with other backyard habitats or nearby bushland areas.
- Mosquitoes are a natural part of wetland ecosystems and during the warmer months, it should be expected that some may be present in swimming pool to pond conversions. However, with an established ecosystem of aquatic wildlife, mosquitoes will be maintained at tolerable levels and, in many instances, may only be associated with these habitats at very low levels.
- The mosquitoes most likely to be found in swimming pool to pond conversions are *Culex annulirostris* and *Culex quinquefasciatus*. However, the suitability of these habitats for mosquitoes will be greatly reduced where water levels are maintained at consistently deep levels (>300mm), vegetation is kept to a minimum and native fish are introduced to prey on mosquito larvae.
- The most important nuisance-biting mosquito in backyard habitats will be *Aedes notoscriptus.* This mosquito is unlikely to be associated with swimming pool to pond conversions as it prefers smaller water-holding containers. However, this mosquito is one of the most common nuisance-biting pests in Sydney and it is important that the impacts it causes are not directly associated with the backyard ponds.
- Should mosquitoes be identified as a problem, there is a suite of mosquito control strategies available should active management of mosquitoes be required. Aquatic vegetation should be prevented from becoming “overgrown”, small native fish will assist in keep mosquito populations low and sustained release formulations of the insect growth regulator *s*-methoprene can be applied to control problematic mosquito populations.

INTRODUCTION

Mosquitoes are typically thought to be associated with swamps but some of Australia's most annoying pest species are found in the suburbs. Mosquitoes have adapted to life in residential areas; finding a home within water holding containers in and around the home. While these mosquitoes may not be particularly abundant, they will bite people and their pets. They'll even come indoors to buzz around our ears and disturb our sleep. We're also making life a little easier for these mosquitoes by increasing the storage of water around our homes in the form of rainwater tanks and other water conservation strategies.

Swimming pools, particularly neglected swimming pools, are a source of concern for residents, neighbours and local authorities. A pool that has turned green with algae is often perceived to be a source of pest mosquitoes and in some circumstances it will provide a potential habitat for mosquitoes. However, they're often not a locally significant source of mosquitoes compared to other urban habitats or surrounding bushland or wetland environments. Less obvious sources, such as pot plant saucers, bird baths and ornamental ponds (not to mention discarded plastic containers and other garden accruements) can be more productive habitats for mosquitoes. These mosquitoes can also cause nuisance-biting pest impacts.

The conservation of native wildlife is an important objective for local authorities and in heavily urbanised areas or where bushland is highly fragmented and/or degraded, the creation of refuges within residential areas is a key component of conservation strategies. Ku-ring-gai Council have initiated the "Backyard Buddies" program that aims to encourage conservation through the creation of refuges and translocation of native wildlife within the local area.

The conversion of backyard swimming pools to "ponds" has raised concerns about potential mosquito risks. Swimming pools maintained as recommended for recreational swimming do not represent a suitable habitat for mosquitoes. Chlorinated or salt-treated swimming pools, properly filtered with well-maintained water levels will not provide a habitat for mosquitoes. When pools are neglected, they can become a productive source of mosquitoes. This is particularly the case for "in-ground" pools where water levels drop substantially and there is a considerable accumulation of organic material and detritus. In these situations, many mosquitoes can be produced. However, when converted to "ponds", swimming pools replicate a natural water body and the ecological balance they provide does not create idea conditions for mosquitoes.

This report summarises some of the key risks and strategic responses to the actual and perceived risks mosquitoes associated with the "pool-to-pond" conversions currently promoted in the Ku-ring-gai Council region.

MOSQUITO BIOLOGY

Mosquitoes are small blood sucking insects that belong to the family of flies called Culicidae (Order Diptera) and there are more than 300 different species in Australia with each species closely associated with particular habitats and often playing unique ecological roles in the local environment.

Mosquitoes have a relatively short but complex life cycle consisting of eggs, four aquatic larval stages (often referred to as “wrigglers”), an aquatic pupal stage (often referred to as “tumblers”) and a terrestrial adult stage. Mosquitoes vary greatly in their appearance; from drab pale brown to bright orange.

Mosquitoes are dependent on water, with the immature stage totally aquatic, and without access to free-standing water of some kind, the larvae cannot complete their development to the adult phase. As a result, mosquitoes cannot complete their development in mud or wet vegetation. Mosquitoes can be associated with a wide range of aquatic habitats, from freshwater to highly saline conditions and from pristine to polluted environments. Many mosquitoes demonstrate highly specific habitats associations.

It is only the female mosquito that bites. She need the nutrition blood provides to develop eggs. While many mosquitoes are generalist feeders, some specialise in feeding on humans, mammals, birds or amphibians.

A gravid adult female mosquito will typically lay eggs either on the water surface (usually with eggs in the form of a floating raft) or on a frequently inundated substrate (usually singularly or in small groups). This location may include frequently inundated soil or vegetation at the edge of a wetland, soil or leaf litter where temporary pools form in bushland areas after rainfall or inside natural or artificial water holding containers (e.g. tins, tyres, bird baths, tree-holes, bromeliads).

While some mosquito eggs (such as those laid by *Aedes* or *Verrallina* species) can be desiccation resistant and remain unhatched for many months, most eggs (particularly those laid by *Culex* and *Anopheles* species) will hatch within 2-3 days. On hatching, the young larvae feed continuously on aquatic particulate matter and grow through four different instars or moults. The larvae of some mosquito species have developed specialised mouthparts and are predatory, feeding on other mosquito larvae and aquatic invertebrates. The final larval stage develops into a pupa from which the adult mosquito emerges approximately 2 days later. During summer, it generally takes seven to ten days from the hatching of larvae to the emergence of adults.

On average, a female mosquito may live approximately 2-3 weeks but the male's lifespan is much shorter. Adult mosquitos are most active from dusk until dawn, seeking refuge during the day in cool and humid habitats such as well-vegetated areas or under houses. Some pest species, however, can be active during the day and disperse many kilometres from larval habitats.

MOSQUITOES AND BACKYARD HABITATS

There are over 50 mosquito species recorded from the greater Sydney metropolitan region. This diverse group of insects includes species that pose a significant pest and public health risk and are found in close proximity to humans and their homes. There are, however, a wide range of species found in close association with natural habitats that rarely cause a pest or public health risk due to their relatively low abundance and lack of preference for biting people.

Notwithstanding nuisance biting impacts, the public health risks associated with mosquitoes can be a concern. While the mosquitoes posing the greatest threat are currently associated with naturally occurring wetlands, creeklines and bushland areas, there are mosquitoes found in backyard habitats and urban stormwater/waste-water infrastructure that can be problematic.

There are some mosquito species, in particular *Aedes notoscriptus*, *Anopheles annulipes*, *Coquillettidia linealis*, *Culex molestus*, *Culex quinquefasciatus*, *Lutzia halifaxii*, *Mansonia uniformis* and *Toxorhynchites speciosus* that can be found in a variety of backyard habitats. These mosquitoes can be present most of the year around Sydney but are generally most abundant in the warmer months of late Spring, Summer and early Autumn. The seasonal abundance of each mosquito varies with temperature and rainfall.

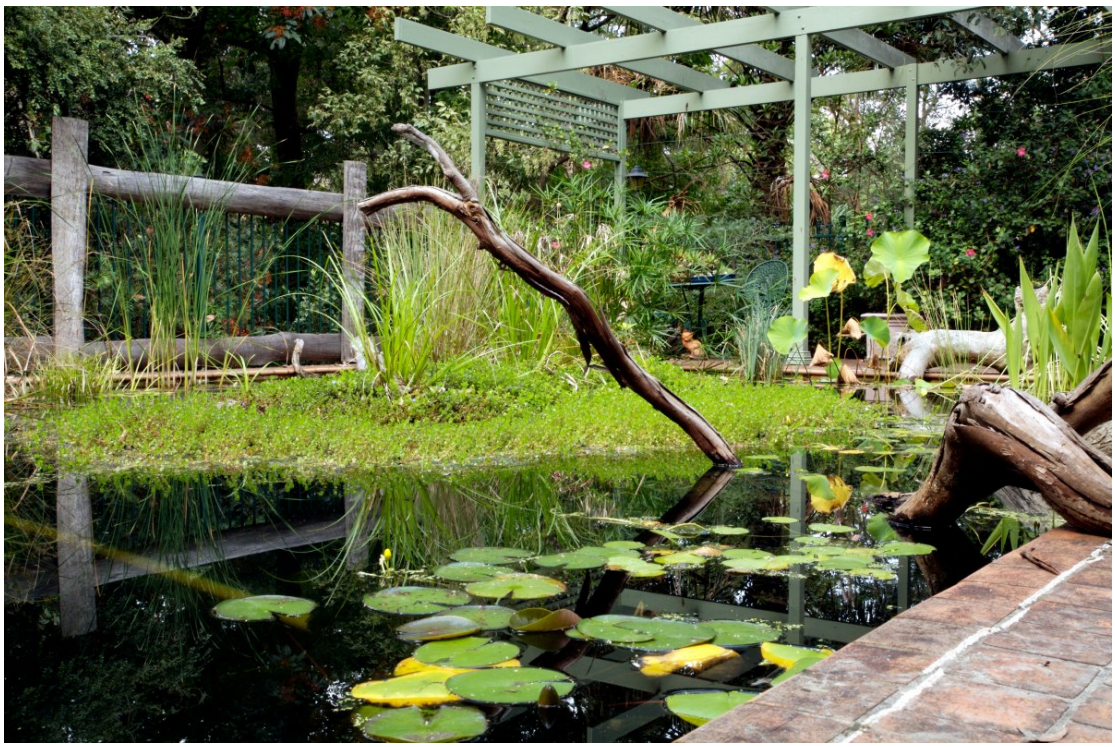

Figure 1: An example of a swimming pool to pond conversion in the Ku-ring-gai Council (Photo taken from Clarke 2011, EMR Project Summaries, Ecological Management & Restoration).

Aedes notoscriptus is the most significant pest. It is a nuisance-biting mosquito often biting early in the afternoon. This is one of the most common pest mosquitoes found in urban environments across Australia. The larvae of this mosquito is typically found in small volumes of water in artificial containers such as pot plant saucers, buckets, blocked roof guttering and pooling water collected on tarpaulins covering boats or trailers. The mosquito is also found in natural habitats including tree-holes and water-filled leaf axils of plants. Water-filled bromeliads are a particularly suitable habitat for this mosquito. The mosquito can be found in unscreened rainwater tanks, where screens have been removed or the tank is damaged, allowing mosquitoes access to the water within the tank. Highly unlikely to be associated with pool to pond conversions as the mosquito prefers shallower water that experiences frequently fluctuated water levels.

Anopheles annulipes is closely associated with freshwater habitats with an abundance of algae. The immature stages of this mosquito are often found in the thin film of water above algal mats. Although this mosquito has been implicated in the historic transmission of malaria parasites in Sydney, it is not considered a pest of any significance in current times. It may be occasionally abundant but unlikely to be associated with pool to pond conversions unless there is a substantial cover of floating algae.

Culex annulirostris is one of the most important pest mosquitoes in Australia. In addition to being a nuisance-biting pests, it is also able to transmit disease-causing pathogens. It is found in a wide range of freshwater habitats, from grassy ephemeral pools to pristine wetlands. Most commonly a problem in rural areas, particularly where extensive freshwater wetlands occur or when above average rainfall causes flooding of low lying areas. Generally less of a problem in metropolitan regions, the rise in constructed wetlands incorporated into urban developments has raised concerns about this mosquito but where wetlands are relatively small, mosquito populations are rarely substantial or cause serious pest problems. Although it generally prefers shallower water, this mosquito may be associated with pool to pond conversions, especially if there is plenty of aquatic vegetation and shallower and sheltered sections of the pool.

Culex molestus is generally uncommon and breeds exclusively in subterranean habitats (e.g. septic tanks and associated infrastructure) but can be a nuisance-biting pest and will often come indoors. This is one of the few mosquitoes active all year in Sydney. It was accidently introduced in the 1940s and has steadily spread across many metropolitan regions in southern Australia. This mosquito is unlikely to be directly associated with swimming pool to pond conversions. However, it may be found in associated pumps, pipes or other below ground structures that store water.

Culex quinquefasciatus is one of the most widespread mosquitoes internationally. It is a very common mosquito in urban environments but is rarely a significant nuisance-biting biting pest. It typically prefers habitats with a high organic content (e.g. drains, septic tanks, backyard ponds and neglected swimming pools) but will also be found in small water-holding

containers on occasion. The primary nuisance caused by this mosquito is that it often comes indoors and is the mosquito most likely responsible for "buzzing" in the bedroom at night. This is one of the most likely mosquitoes to be found in pools converted to ponds and has been found in high numbers in neglected swimming pools across Sydney.

Lutzia halifaxii rarely causes nuisance as it is generally not thought to bite people, it prefers to bite birds. It is found in association with a wide range of freshwater habitats including natural and artificial water-holding containers. The immature stages of this mosquito prey on other mosquito larvae and small aquatic insects. This mosquito may be found in swimming pools converted to ponds but typically only when there is already an abundance of other mosquitoes. As a consequence, it is unlikely to pose any substantial pest problems itself.

Toxorhynchites speciosus is an unusual mosquito. The largest and most distinctive mosquito in Australia, this species does not feed on blood, only plant sugars. Rarely found in any substantial numbers, it is more likely to elicit curiosity rather than cause any nuisance problems. Will occasionally come indoors. The immature stages of this mosquito are typically found in small to medium sized water-holding containers and prey on other mosquito larvae and small aquatic insects. This mosquito would rarely be found in swimming pools converted to ponds but typically only when there is already an abundance of other mosquitoes.

Coquillettidia linealis and *Mansonia uniformis* are two mosquitoes that can be nuisance-biting pests and may be associated with swimming pools converted to ponds under specific circumstances. These two mosquitoes (and a suite of closely related species found elsewhere in Australia) are unlike most other mosquitoes in that they do not breathe at the water-air interface but rather attach themselves to the roots and other submerged parts of aquatic plants. *Coquillettidia linealis* is generally associated with emergent plants such as reeds and rushes while *Mansonia uniformis* is generally associated with floating plants. Small numbers of plants in swimming pools converted to ponds are unlikely to cause a significant problem. These two mosquitoes are generally only a major pest problem when there are extensive areas of freshwater wetlands. Ensuring the swimming pool to pond conversion is not overgrown with floating or emergent vegetation will significantly reduce mosquito risks.

There are also other mosquitoes associated with bushland and wetlands habitats that may occasional fly into backyards. There are many habitats within the Ku-ring-gai Council region that may support these mosquitoes, particularly ephemeral ground pools that form after rainfall or freshwater rockpools. If substantial and ongoing nuisance mosquito problems are experienced, it is important to distinguish that backyard pest problems are not due to mosquitoes dispersing into the area from nearby natural habitats and not the swimming pool to pond conversion.

Figure 2: Neglected swimming pools, particularly those that are left to dry almost completely and only filled by rainfall can produce large numbers of mosquitoes.

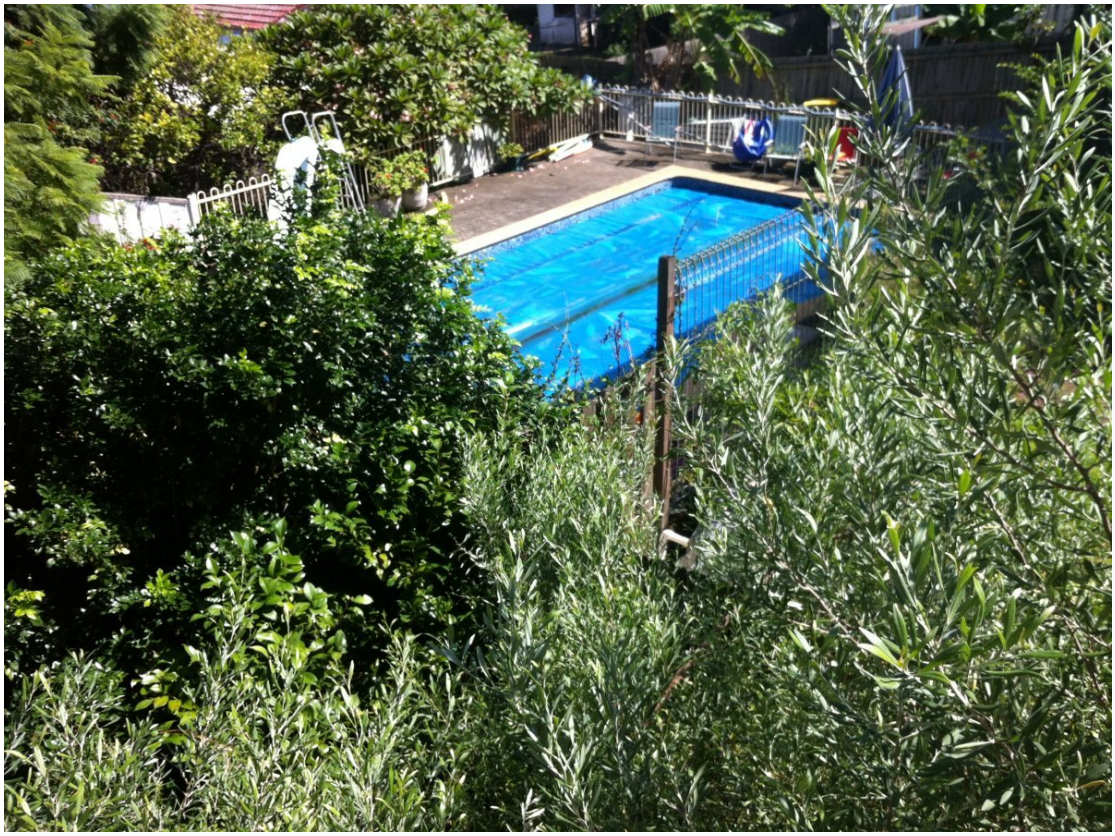

Figure 3: Well maintained swimming pools do not represent a suitable mosquito habitat.

MOSQUITOES AND PUBLIC HEALTH RISKS

Mosquitoes can be more than nuisance biting pests. While the risks of mosquito-borne disease are relatively low in metropolitan regions of Australia, mosquitoes can spread pathogens including Ross River virus (RRV) and Barmah Forest virus (BFV). The symptoms associated with the diseases caused by these pathogens include rash, fever, headache and joint pain. The diseases aren't fatal but there are around 5,000 cases of mosquito-borne disease reported across Australia each year and in many instances, the disease can be quite debilitating.

It is important to note that RRV and BFV are considered zoonotic pathogens. This means that before the mosquitoes can pass the pathogen on to people through their bites, they must acquire the pathogen from biting local wildlife. While birds are often considered "reservoir hosts" of arboviruses, it is macropods that hold the greatest risk around Sydney. At the edges of our city, particularly where there are extensive wetlands, as well as abundant mosquitoes, along with wallabies or kangaroos, there is an elevated risk of RRV. Pets (i.e. cats and dogs) and other common urban wildlife (e.g. possums, Australian white ibis) are not known reservoirs of mosquito-borne pathogens.

In the Ku-ring-gai council area, there is a relatively low risk of mosquito-borne disease as, although there may be small populations of wallabies, the mosquito populations are considered quite low compared to elsewhere in Sydney (e.g. the suburbs along the Parramatta and Georges Rivers).

Sydney is free from more serious mosquito-borne pathogens such as malaria parasites as well as dengue, chikungunya, Yellow Fever, Japanese encephalitis and Zika viruses. In many instances, there are not the mosquitoes present in NSW that can transmit these pathogens. For example, dengue, chikungunya and Zika viruses can only be spread by one mosquito species in mainland Australia, *Aedes aegypti*. This mosquito is currently only found in central and far north QLD. The Asian Tiger Mosquito, *Aedes albopictus*, has the potential to become established in Sydney and would be a significant nuisance-biting pest and potential vector of dengue, chikungunya or Zika viruses. While there are no populations of this mosquito in mainland Australia, specimens are regularly detected by the Department of Agriculture and Water Resources (DAWR) at airports and seaports around Australia. It is important to note that neither *Aedes aegypti* or *Aedes albopictus* would be associated with swimming pool to pond conversions as these mosquitoes are closely associated with smaller water holding containers.

The nuisance-biting problems associated with mosquitoes should not be underestimated. With regard to species associated with neglected swimming pools, such as *Culex quinquefasciatus*, there can be some adverse impacts on local residents. Care should be taken that homeowners don't excuse their lack of pool maintenance as "converting their pool to a pond" if it is creating a pest problem.

HOW CAN YOU TELL THERE IS A MOSQUITO PROBLEM?

For many people, a single mosquito bite while in the backyard is a problem. However, it should be expected that during the summer, mosquitoes will be active across the local area, whether they are emerging from the local pool to pond conversion or not. If there is an actual or perceived problem, the homeowner should not rush to undertake mosquito control until they are sure of where these pest mosquitoes are coming from.

It isn't difficult to determine if there is a mosquito problem in your backyard, nuisance-biting will alert you to that. Similarly, an increase in the amount of mosquitoes found indoors may indicate a change in local mosquito populations. It is important to remember that, in both of these instances, climatic and environmental conditions may be changing mosquito activity and it does not necessarily mean that the swimming pool to pond conversion is to blame.

Immature mosquitoes can be readily seen in the water. These "wrigglers" will generally be easy to spot with the naked eye. They will tend to congregate on the water surface at the edges of the swimming pool and/or around the base of emergent vegetation. Larvae can also be collected by scooping up some water from the edge of the pool with a white bucket or large cup that allows for closer inspection (often reflections from water may make it difficult to see mosquito larvae clearly). The observation of large quantities of mosquito larvae in the pool may indicate a problem.

It is important to look beyond the pool. When investigating potential sources of mosquitoes, check other water bodies around the backyard. Even the tiniest of water filled containers may be a source of mosquitoes. Bird baths, ornamental ponds, frog ponds, drains, gutters, rainwater tanks, pot plant saucers etc. It is also important to remember that mosquitoes can fly over 100m (some species many kilometres) so that the mosquitoes causing a problem may be coming from nearby wetlands or bushland or your neighbours' properties.

If nuisance-problems persist, it may be worth approaching a pest controller or entomologist with experience in mosquitoes to provide an assessment. Special traps, using carbon dioxide to lure mosquitoes, can provide a quick and easy assessment of local mosquito activity and determine if the species present are likely to pose a pest or public health risk and if they're likely to be associated with the swimming pool to pond conversion. Site-specific expert advice may be required to address pest mosquito problems.

MANAGING MOSQUITOES ASSOCIATED WITH SWIMMING POOL TO POND CONVERSIONS

It should be expected that there will be some mosquitoes associated with the swimming pool to pond conversions. Mosquitoes are a natural part of wetland ecosystems and just as the creation of these habitats provides a refuge for local wildlife (e.g. frogs, birds and fish), insects, including mosquitoes will also move in. However, it does not mean that there will be a resulting nuisance problem caused by the swimming pool to pond conversation.

There is a number of approaches to minimise potential pest mosquito problems.

Biological control

The swimming pool to pond conversion should remain stocked with fish, ideally small native species such as Pacific blue-eye (*Pseudomugil signifer*) or Empire Gudegon (*Hypseleotris compressa*). These fish are generally tolerant of temperate climates and will eat mosquito larvae. There are likely to be other endemic fish available that may be suitable for use in swimming pool to pond conversions. However, they may be difficult to source and fish should never be collected from local waterways and relocated to your backyard.

The plague minnow, *Gambusia holbrooki*, should not be introduced as it is an exotic pest species. This fish was once known as the mosquitofish and distributed widely in Australia to control mosquitoes. Unfortunately, it is a prolific breeder, is tolerant of polluted water and preys on tadpoles and native fish.

There will be some natural recruitment of mosquito predators. The tadpoles of local tree-frog species (e.g. *Litoria dentata*, *Litoria fallax* and *Litoria peronii*) or large native frog species, such as *Limnodynastes peronii*, may occasionally eat mosquito larvae. However, studies have shown that they are unlikely to actively prey on mosquito larvae and are not considered effective for biological control.

Other mosquito predators can be very common and will eat mosquito larvae. Larvae of damselfies and dragonflies, predatory water beetles and other macroinvertebrates that find their way to the ponds will eat mosquitoes. Having diverse habitats within the pond with vegetation and other structures will encourage the establishment of many insects that will assist in balancing the production of mosquitoes.

Many birds, reptiles and bats will eat adult mosquitoes. However, these animals won't provide adequate control of mosquitoes if there is a problem.

Aquatic plants, water levels and water quality

Aquatic vegetation should be actively maintained so that there remains substantial areas (at least 25% but ideally up to 50%) free of floating or emergent vegetation. In most instances, this will be relatively easy given the

depth of most of the swimming pool to pond conversions but floating vegetation can rapidly cover the pond under ideal conditions. Aquatic plants provide habitat for fish and aquatic insects but also refuge for mosquitoes. Submerged vegetation is less likely to create opportunities for mosquitoes.

Maintaining water levels will ensure conditions are most suitable for fish and aquatic mosquito insect predators and reduce opportunities for mosquitoes that prefer frequently fluctuating water levels. While water levels should be expected to be maintained at close to maximum levels, small fluctuations are unlikely to create suitable conditions for mosquitoes. It is only when water levels are allowed to drop substantially (down to <20%) that substantial mosquito problems may develop.

Water quality will influence the suitability of the swimming pool to pond conversion for mosquitoes. Highly polluted, or at least high organic content, water will enhance conditions for mosquitoes such as *Culex quinquefasciatus*. However, poor water quality will not be beneficial for other components of the habitats such as fish or aquatic insects. If high nutrient levels occur, it may predispose the habitat for outbreaks of algae that, in turn, reduces the suitability of the habitat for mosquito predators.

Water movement will reduce the suitability of the habitat for mosquitoes. Wind generated wave action will drown mosquito larvae and make conditions unsuitable for egg laying so pools in exposed areas are less likely to support mosquito populations. Circulation and aeration of the water is unlikely to make significant direct impacts on mosquitoes but it may assist in maintaining water quality and, consequently, improve conditions for plants, fish and aquatic insects. Fountains and sprinklers are often purported as assisting to reduce egg laying by mosquitoes but there is little evidence to support the claims. If they were to be useful, they would need to be operated for the bulk of the day and their noise may cause annoyance to the homeowners and neighbours.

Mosquito control products

Mosquito control products are available that can be regularly applied to the swimming pool to pond to reduce mosquito populations. It is important that if insecticides are to be used in or around the backyard, only products registered with the Australian Pesticides and Veterinary Medicines Authority (APVMA) be used and, only then, in accordance with the recommended use as listed on the label.

The application of insecticides to plants and dwellings in backyards is often undertaken to control nuisance insects and a range of products is available that include mosquitoes within their target pests. These can be useful but are not specific to mosquitoes. Insecticides (e.g. pyrethroids) should be avoided as they may be toxic to the beneficial insects, fish and possibly other aquatic life. If mosquitoes are problematic to the extent that major insecticide applications are being considered, it may be worthwhile getting professional advice on the source of the problematic mosquito populations.

The most common approach to mosquito control is Australia is the application of mosquito control products to aquatic habitats to target the immature stages of mosquitoes. This is far more effective and has fewer direct non-target impacts than the use of adulticides. *Bacillus thuringiensis israelensis* (*B.t.i*) is a bacteria-derived product that is toxic to mosquitoes when consumed by the larvae. There are commercial formulations available and they are very specific to mosquitoes. However, they are less effective in highly organic conditions and must be applied when mosquito larvae at particular growth stage. As a result, this product is less likely to be effective in swimming pool to pond conversions.

The most suitable product for use in the pond would be the insect growth regulator *s*-methoprene. This product is specific to mosquitoes and, if applied at recommended rates, will not impact fish, frogs, birds or other aquatic insects. It does not kill the mosquito larvae but rather interrupts their development so that no adult mosquitoes emerge from the pond. This product is available in a range of formulations, some of which provide residual control of mosquitoes for many months.

Surface films are silicone based and when applied to the water surface, form a very thin film that “drowns” mosquito pupae. While surface films could be effective against mosquitoes, there is the potential to impact other aquatic insects and due to the uncertainty, this product is not registered for use in natural habitats in Australia. A swimming pool to pond conversion would be classified as suitable for treatment but consideration should be given to any non-target impacts that may result from its use.

Mosquito traps, gadgets, gimmicks and urban myths

There are plenty of “mosquito traps” available to buy at the local hardware store, garden centre or online retailer. These traps vary greatly in their design and effectiveness. Those that are most effective at collecting mosquitoes are those that use carbon dioxide to lure female mosquitoes. However, while this style of trap is useful for surveillance and monitoring local mosquito populations, they’re rarely found to reduce nuisance-biting impacts unless a large number are used in a relatively small area.

Electrocuting lights are not effective against mosquitoes.

Sound-based devices that use a range of frequencies to “repel” mosquitoes have been demonstrated not to provide protection from mosquitoes.

Many plants, including native species, are marketed as “mosquito repellent” or are often cited as assisting in repelling mosquitoes from backyards but there is no evidence that they offer protection from bites. It is true that many of these plants contain chemicals that, once isolated and concentrated, provide some protection against mosquitoes. However, there is little evidence that the whole plant provides any protection whatsoever.

SUMMARY

Protecting local wildlife is important but it should not be done without balancing the environmental good with adverse impacts to human health. In the case of swimming pool to pond conversions, there is no evidence that a well maintained pond will significantly increase the pest or public health risks in the local area.

Marinating relatively deep and consistent water levels, minimizing aquatic plant coverage, ensuring at least moderate levels of water quality and the introduction of predatory native fish are all factors that significantly reduce the suitability of these habitats for mosquitoes.

There will be mosquito activity in backyards across the Ku-ring-gai Council area during summer. However, the mosquitoes biting in backyards are not necessarily coming from a swimming pool to pond conversion. Notwithstanding the mosquitoes flying into the suburban areas from nearby bushland or wetland areas, the key pest mosquito in urban areas, *Aedes notoscriptus*, prefers small volume water-holding containers. Pest problems are far more likely to be driven by other natural and artificial water holing containers in the backyard or those of neighbours.

If there is an perceived mosquito problem, it is highly recommended that the services of an entomologist with expertise in mosquito management be engaged to investigate the issue. There are methods available to determine the type of mosquito present and their likely source.

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