Northern Territory Government

DEPARTMENT OF **HEALTH AND FAMILIES**

Common Mosquitoes of the Northern Territory

Descriptions of species, habitats and disease potential

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Descriptions of Species, Habitats and Disease Potential

Introduction

Mosquitoes are small, slender bodied, two winged flies belonging to the family *Culicidae*. They differ from all other flies in having a prominent proboscis or feeding tube projecting from the front of the head.

A pair of sensory palps is on either side of the proboscis. In *Anopheles* species the palps are as long as the proboscis, but in the females of most other species the palps are considerably shorter. The palps of the male mosquito are usually as long as the proboscis and are often more hairy and sometimes ornate. The males also have more bushy antennae when compared with the sparse antennae of the female.

The body and wings of mosquitoes are clothed in scales. Colour, size, shape, and arrangement of the scales are used to identify the different species of mosquitoes. In the Northern Territory there are approximately 100 different species of mosquitoes. Of these only about 40 species are known to bite people and only about 20 species occur in numbers large enough to cause pest problems. The mosquitoes which are known to occur in the Northern Territory are listed in Appendix A.

Both the male and female mosquitoes feed on plant nectar, but the female of most species also requires a blood meal to supply sufficient protein for egg development. Mosquitoes show considerable variation in their preference for hosts, with some species feeding variously or preferentially on mammals such as cattle, horses, marsupials or people. Some species are fastidious about the source of their blood meal. For example *Uranotaenia* feed on reptiles and frogs, and *Aedeomyia* feed on birds. Other species, such as *Culex annulirostris* will generally feed on whatever source of blood is available, although it has a preference for mammals.

The time of feeding varies for different species. Many mosquitoes feed just after sundown, while others such as some *Anopheles* species can have minor biting peaks later in the night, and others will bite preferentially in the early morning. Some species of *Aedes* bite preferentially during the day or around crepuscular times of dawn and dusk.

The place of feeding also varies, with some species flying far in search of a blood meal, while others remain very close to the breeding site. Some species will enter buildings in search of a host, others will only bite outdoors.

After feeding, the female chooses a suitable resting place, usually cool and humid, where the blood meal can be digested and egg development can proceed. A time lapse of two to three days usually occurs from blood meal to egg laying.

Mosquitoes have four distinct stages in their life history – egg, larva (or wriggler), pupa (or tumbler) and adult. The larval and pupal stages occur only in water, while the adult is an active flying insect.

Eggs are laid singly on the water surface by *Anopheles* mosquitoes, in rafts on the water surface by *Culex* mosquitoes, and singly on moist surfaces above the water level or on moist substrates by *Aedes* mosquitoes. *Aedes* eggs can withstand drying for many months without ill effect, and will hatch when the water level rises and the eggs are flooded.

The larvae emerge from the eggs and live in the water through four growth stages. The skin is moulted between each growth stage as the larva increases in size and complexity. Most larvae feed by drawing water into their mouths by means of fan shaped mouth brushes on the front of the head. Particles of food are drawn in with the water. Some species of larvae are predaceous on other larvae and have modified mouth brushes for capturing and holding their prey.

Most species of mosquitoes have larvae which come to the surface of the water to breathe. Most larvae have a siphon on the last segment of the abdomen, which carries the breathing tubes. They obtain air by hanging suspended by the siphon from the water surface. *Anopheles* mosquitoes do not have a siphon, but instead have breathing tubes on the surface of the last segment of the abdomen, and lie flat at the water surface to breathe. Some species with very short siphons may be mistaken for *Anopheles* at first glance.

Some genera, such as *Mansonia* and *Coquillettidia*, obtain air from submerged aquatic or semi-aquatic plants. They have a specially modified tip on the siphon with which they can pierce the air chambers in submerged stems or roots of plants. These species have no need to regularly come to the water surface.

At the conclusion of the last larval growth stage, the skin is shed and the pupa emerges. The pupa is a non-feeding stage, during which the adult form develops within the pupal skin. When the adult has developed, the pupal skin splits along the dorsal surface, and the adult emerges onto the surface of the water. The pupal stage usually lasts around two days.

The time taken from egg to adult varies, depending initially upon the species concerned, but secondly on temperature, food availability and the extent of crowding. In the Northern Territory 10 to 14 days would be sufficient time for most species to mature from egg hatch to adult. For species in temporary situations such as tidal pools or ephemeral flooded areas in the inland, the period can be around 6 days. Typical coastal mosquito breeding situations are depicted in Appendix B.

The following text describes some of the more common and important mosquitoes occurring in the Northern Territory, with some detail of biology, adult habits, distribution and their association with disease.

Culex quinquefasciatus

"The Brown House Mosquito"

Description of female

A brown mosquito with a square tipped abdomen. Tarsi of hind legs all dark with no white bands. Curved white transverse bands on top of the abdomen at the base of each segment. Pale underneath the abdomen, with a variable amount of dark scales medially, sometimes in medial patches. Palps are much shorter than proboscis. Proboscis all dark on top with pale scaling underneath on basal ¾.

Description of larvae

Grey brown larvae with a light brown head and siphon. Antennae a grey colour. Siphon medium length with a characteristic bottle shape with 3-4 groups of hairs on the underside. Hangs down by siphon from surface of water.

Breeding Places

Polluted or organic water close to human habitation. A very important source of large numbers of this species is the unscreened septic tank. Other sources are polluted ground pools, stormwater drains, sumps, gully traps and any artificial container holding water such as tins, tyres, drums, disused swimming ponds and rain water tanks. Eggs are laid in rafts on the water surface. Found throughout the Northern Territory where suitable sites are available.

Adult Habits

Bites mainly at night both indoors and outdoors and is frequently the cause of complaints in domestic situations in the Northern Territory. It will feed readily on poultry when available and commonly bites dogs. *Culex quinquefasciatus* is the mosquito most commonly found inside houses. It will remain inside houses to digest a blood meal. It will harbour in dark humid areas like cupboards, underneath sinks and near toilets and baths. This species travels 1 to 2 km from the breeding place. It bites mainly at night, and stands with the body horizontal to skin. The wings make an annoying buzzing sound that is frequently heard as it approaches.

Distribution

Worldwide in tropics and subtropics. Found domestically around towns throughout the Northern Territory.

Disease potential

It is capable of carrying heartworm of dogs. Has been shown in laboratory trials to be a poor vector of Murray Valley encephalities virus and Ross River virus. In other neighbouring tropical countries it is a vector of human filariasis.

Mansonia uniformis

"The aquatic plant mosquito"

Description of female

A gingery speckled mosquito with mottled wings of broad dark and pale scales and a dark wing fringe. It has a broad deep tip to the abdomen. There are white basal bands on tarsi of hind legs with apical sections dark. In fresh specimens the eyes are green. Proboscis mottled on basal half and dark on apical half.

Description of larvae

A grey larvae and a very sluggish swimmer. The tip of the black siphon pointed and serrated which is an adaption for insertion into the roots and stems of aquatic plants to obtain air

Breeding Places

In permanent and semi-permanent freshwater swamps and water-holes with aquatic and semi aquatic plants. Eggs are laid in clusters under the surface of floating leaves such as water lillies. The larvae attach by the siphon to roots or stems of aquatic and semi aquatic plants such as *Eleocharis* sp*, Typha* sp*, Nymphae* sp *or Nelumbo* sp to obtain air. Larvae do not need to come to the surface of the water to obtain air. The lavae are very difficult to locate.

To find the larvae, these water plants should be quickly dumped in a bucket of clear water and shaken vigorously and the plants and water examined closely. In the Darwin area they are found in Marrara Swamp, Holmes Jungle Swamp, Knuckey's Lagoon and regionally in Nhulunbuy Lagoon, Coonjimba Lagoon near Jabiru, and large semi permanent swamps and wetlands around the flood plains of the larger river systems.

Adult Habits

The adult rests by day amongst dense vegetation near swamps and waterholes. Females bite mainly in the evening and night, but are also active in daytime, especially near breeding areas with shady trees. Bites people, domestic animals, birds, and other mammals. It is strongly attracted to light. This species will travel up to 4 km in search of a blood meal, but is generally in high numbers within 1 km of the breeding site. It is a serious pest during the early dry season in areas where there are extensive swamps and lagoons with aquatic vegetation.

Distribution

Australasia, Orient, Africa, Moluccas, Island of New Guinea, mainly coastal to sub-coastal in Australia from north west of Western Australia, tropical Queensland to Brisbane, north NSW to Conjola, and Victoria in the Mildura area. Found throughout the Top End and coastal areas of the Northern Territory in association with permanent to semi-permanent vegetated swamps, creeks and wetlands. In the NT

this species has not been recorded further inland than Mataranka and extends coastally and sub-coastally from Bradshaw Station in the west to Borroloola in the east.

Disease potential

Not known to spread human disease in Australia but can carry filariasis in neighbouring countries.

Culex sitiens

"The Salt Water Culex Mosquito"

Description of female

A medium sized mosquito with a square tipped abdomen and a narrow white band on the middle third of the proboscis, with the white band shorter when viewed from above compared with from below. The wings are all dark scaled. The femora of the hind legs are mottled and the tarsi of the hind leg have narrow basal bands of white scales. There are basal straight white bands on the top of the abdomen on each segment and uninterrupted apical black bands on the segments under the abdomen.

Description of larvae

The larvae are similar to *Culex annulirostris* except that the anal segment has small rounded transparent papillae and the saddle is cut away at the side, to roughly resemble a riding saddle. The larvae have a medium length siphon with a gentle taper to the tip and with 5 to 6 pairs of ventral hair tufts and one pair of lateral tufts

Breeding places

Brackish to salt ground pools, including artificial receptacles, influenced by the high tides or sea spray. Often found with *Aedes vigilax* and *Anopheles hilli* in salt marshes or pools that have at least some salt influence. Eggs are laid in rafts on top of the water and contain up to 150 eggs. The larvae are found in the Darwin area at Casuarina Coastal Reserve, Leanyer Swamp and Coconut Grove Swamp.

Adult habits

Culex sitiens bites mainly in the evening and at night. It will bite humans, birds and other animals, although it is not as avid a biter of humans as *Cx annulirostris*. It is only an appreciable human pest in the NT when very productive breeding sites are nearby. It may travel up to 10 km, but is mainly found in relatively high numbers within 2-3 km of prolific breeding places. High numbers biting usually indicates a breeding site within 1km. When biting it stands horizontal to the skin.

Distribution

Widespread throughout coastal South East Asia and adjacent tropical area of the Oriental region. Also Micronesia, South Pacific and Australasia, including Timor and New Guinea. In Australia it is recorded from coastal areas from as far south as Perth and north in WA, up to the NT and across to Qld and down to NSW as far south as Batemans Bay.

In the NT it has been recorded inland as far as Katherine and Mataranka but at low numbers.

Disease potential

No evidence of causing disease in Australia, although a possible vector of Ross River virus.

Culex annulirostris

"The Common Banded Mosquito"

Description of female

A medium sized, brown mosquito with a square tipped abdomen and a wide white band on the middle quarter of the probocis. The legs have mottled femora and the tarsi of the hind legs have narrow white basal bands with tarsi five all dark .

The segments on the top of the abdomen have basal white bands produced into a triangular point in the middle, while the segments on the underside of the abdomen has black transverse bands interrupted in the middle by white scales. Can be confused with *Cx. palpalis* which generally has a wider band up to almost ½ on the proboscis, tergal basal bands not produced into marked triangular points and has a white splash on the hind tibia.

Description of larvae

Larvae are pale with a long siphon with 6 groups of hairs along each side underneath the siphon. Antennae on the head have the bottom 2/3 white and the tip of the antennae dark. Has pointed pale transparent anal papillae at the hind end of the abdomen. Larvae hang down from the surface of the water when obtaining air. Feed amongst submerged vegetation.

Breeding Places

Natural freshwater swamps, pools, streams that have vegetation, but will also breed in many artificial situations such as stormwater drains, grassy edges of sewerage ponds and disused swimming pools . They may breed in large numbers in low lying grassy areas where the water lays for 1-3 weeks.

It has been found in brackish water in salt marshes, although is not usually found in areas exceeding one third salt water. This species may breed in large numbers in the dry season in vegetated sewage lagoons and stormwater drains. Eggs are laid in rafts on the water surface and can contain up to 200 eggs. In the Darwin area it breeds in large numbers in the wet season and early dry season in Leanyer Swamp, Marrara Swamp and Coconut Grove Swamp. Commonly in high numbers around Nhulunbuy Lagoon, Ilparpa Swamp in Alice Springs, sewage evaporation areas in Tennant Creek, sewage pond areas in Katherine, and the extensive wet season floodplains of all the major rivers and creeks in the Top End.

Adult Habits

Culux annulirostris commonly bites people, birds and other animals after sundown and in the early part of the night. It is the chief non-domestic mosquito pest in Australia and the most common mosquito biting in the Northern Territory. It can fly from 4 to 10 km from its breeding place, but generally is in higher numbers within 2km of productive breeding sites.

Distribution

New Guinea and island of Timor. Common throughout Australia. In the NT found in high numbers seasonally from Darwin to Alice Springs wherever and when suitable breeding sites exist.

Disease potential

Culex annulirostris is the confirmed and major vector of Murray Valley encephalitis (MVE) virus in Australia, and is capable of carrying Kunjin virus, Ross River virus, Barmah Forest virus and other viruses. It is probably the major vector of Ross River virus in the NT from January to April. It can transmit heartworm of dogs and is capable of carrying human filariasis in New Guinea .

Aedes notoscriptus

"The Receptacle Mosquito"

Description of female

A small to mid sized black mosquito with a conspicuous lyre shaped pattern and fine white lines on the top of the thorax. The proboscis has a white band around the middle, and the palps are very short compared with the proboscis. The abdomen tapers towards the apex. Tarsi of all legs have distinct wide white basal bands.

Description of larvae

A dark grey larvae with a light brown head and short siphon. The relativly long larvae have a sinuous movement, and the dorsal and ventral pairs of the anal papillae are pointed at the ends and unequal in length. There is a distinctive row of spines at the apex of the saddle.

Larvae often forage at the bottom of receptacles but hang down at the water surface when obtaining oxygen through their siphon.

Breeding Places

The natural breeding places are tree holes, rockpools and fallen palm fronds. This mosquito is domestic in settled areas and breeds in all types of artificial rain filled receptacles such as boats, tyres, tins, drums, domestic water tanks, roof gutters, pot plant drip trays and plant striking containers, particulary where there is some rotting vegetable matter. Eggs are laid singly just above the water line and can withstand considerable periods of drying until they are flooded.

Found commonly throughout the Top End, previously frequently in Tennant Creek but now very rare after the *Aedes aegypti* eradication program in 2006, and infrequently in Alice Springs, Found domestically wherever there are water filled tyres, drums and other receptacles.

Adult Habits

Aedes notoscriptus bites people and mammals. It bites by night or by day in the shade, and is a persistent but easily disturbed minor domestic pest in the Northern Territory. Stands with its body horizontal to the skin when biting. The adults are capable of flying 2-3 km but domestic pest situations are usually from sources within 200 metres of the pest problem.

Distribution

South West Pacific Australia and New Zealand. Found Australia wide. In the Northern Territory from Darwin to Alice Springs wherever artificial receptacles or natural tree holes exist.

Disease potential

It is a very good vector of heartworm of dogs. A suspected vector of Ross River virus in other parts of Australia in urban situations when cases of Ross River virus disease are present. Ross River virus and other viruses have been isolated from this species in the Northern Territory, but its ability to act as a domestic vector of Ross River virus in the Northern Territory is suspected but unconfirmed.

Verrallina funerea

"The Brackish Forest Mosquito"

Description of female

Small dark mosquito with proboscis, head, thorax and legs all dark. White transverse sub basal bands on the top of the abdomen. Apex of abdomen tapering. Palps are short and less than 1/8 length of proboscis.

Description of larvae

Larvae are very dark and have a medium length siphon and relatively long pointed anal papillae. The pair of hair tufts on the siphon are closer to the apex, compared with most other *Aedes* species.

Breeding Places

Brackish to freshwater pools. Usually in shaded swampy areas of paperbarks, brackish ferns, Casuarina forests, beach Hibiscus thickets and sedges near tidal areas. Found just inland from typical *Aedes vigilax* breeding areas although the larvae are often found together. In the Darwin area the larvae have been found at Leanyer Swamp, Coconut Grove Swamp, Casuarina Coastal Reserve, Vesteys Beach swamp and the Botanical Gardens area. Eggs are laid singly on moist substrate at edges of suitable pools or damp areas.

Habits

A vicious and painful biter. Can be an appreciatable pest near productive breeding sites. Bites mainly by day in the shade and does not travel far from the breeding places. Does not disperse outside of dense shade near breeding sites during the day. Many harbour in the mangroves or dense vegetation near their breeding places and large numbers will attack rapidly in these areas during the day in the wet season. Retreating out of the shaded mangrove or paperbark areas during the day is usually sufficient to escape from their biting. Peaks of adults can occur in the breeding sites at the times of spring tides and around 8-15 days after spring tides.

Distribution

Australia and New Guinea. In Australia found in coastal New South Wales, north coast of Queensland, Northern Territory and extreme north west of Western Australia. Extensively in coastal to subcoastal Top End of the NT from Port Keats in th ewest, south to Mataranka and Roper River (Ngukurr), and west to Borroloola.

Diseases potential

Probable vector of Ross River virus in tropical Australia, and potential vector of Murray Valley encephalitis and Kunjin viruses.

Aedes tremulus

"The pale larvae mosquito"

Description of female

A small thick-set black mosquito with distinct wide basal white bands on the hind tarsi with the last tarsi all white. It has indistinct pale markings on top of the thorax, sometimes resembling a diffuse lyre-shaped pattern. The abdomen apex is laterally flattened and abdominal segment have white lateral patches. Has a relatively short all dark proboscis.

Description of larvae

A relatively long white larvae with a light brown head and dark siphon. The siphon is short, stout and tapering. The anal papillae are long, white and have rounded ends. There is a distinctive hardened lateral plate with 4 to 5 long spines on the last abdominal segment. The larvae have a sinuous motion and remain on the bottom when disturbed. A number of other closely related species with undescribed larvae eg Ae. sp 76 have similar looking larvae.

Breeding Places

Natural breeding places are holes in trees and stumps, especially narrow holes in eucalypts, paperbarks, and mangroves that have been filled with rainwater. It is often found in domestic sites in artificial receptacles such as tins, tyres, tanks and plant pot bases which have been filled with rain water or artificially flooded. Eggs are laid singly on the insides of receptacles with water and can survive long dry periods. *Aedes tremulus* can become a minor domestic pest anywhere in the Northern Territory where suitable breeding sites exist.

Adult Habits

The adult mosquitoes rest out of doors and do not travel more than 500 metres from their breeding sites. They frequently bite at dawn and during the late afternoon. They will enter houses to bite and sometimes can penetrate mosquito gauze screens because of their small size. They are painful biters, although are not usually present in large numbers. Often males are observed flying around the ankles and landing on the skin or clothes.

Distribution

New Guinea, New Britain and Australian mainland from Geraldton in Western Australia, across the NT and inland South Australia and Victoria to tropical Queensland. Found throughout the Northern Territory. More common in the Top End but has been regularly recorded in inland towns including Tennant Creek and Alice Springs.

Disease potential

Not known to carry diseases in Australia.

Anopheles hilli

"The Salt Water Anopheles Mosquito"

Description of female

A speckled grey mosquito with extremely spotted wings. The palps are as long as the proboscis. There are two dark bands and two wide white bands on the apical half of the palps. The proboscis is dark. There are wide white bands across the joints of the tarsi, on the hind legs. The abdomen is pale on top, with a mottling of scattered pale scales on the underside.

Description of larvae

Larvae has no siphon, and are generally pale in colour, with relatively narrow inter segmental plates. All clypeal hairs are long with the outer ones frayed. Rests horizontally to surface of the water, feeds by filtering particulate matter from the surface of the water.

Breeding Places

Found in natural and artificial coastal ground pools, coastal swamp margins and tidally influenced flood plains in sunlit to partly shaded sites, and with or without ground vegetation present. Breeds almost exclusively in brackish to salt water, and often in typical *Aedes vigilax* salt marsh breeding sites. Larvae in darwin have been found at Coconut Grove/Ludmilla Swamp, Leanyer Swamp and Casuarina Coastal Reserve. This species is most numerous in the Northern Territory at the end of the wet season.

Adult Habits

Bites people, cattle and horses. It is most active after sunset for the first two hours of the night and will enter houses. Fed females can be found inside houses. Flight range is approximately 4 km, with very high numbers often found close to brackish swamps such as Leanyer and Howard Swamps in the late dry season. Like other *Anopheles*, it stands at an angle to bite.

Distribution

Australia and southern part of Irian Jaya. Common across Northern Australia from north west Western Australia, coastally and subcoastally in the Northern Territory to coastal east Queensland, and down to the New South Wales border. Has been found in inland areas of the Northern Territory, occasionally to Katherine, rarely to Larrimah, a few times in Tennant Creek, and one record from Alice Springs at Ilparpa swamp.

Disease potential

Anopheles hilli is capable of carrying malaria. It was a secondary vector in malaria outbreaks in Queensland, and is a suspected vector in the Northern Territory.

Anopheles meraukensis

"The fresh-water reed Anopheles"

Description of female

A speckled grey mosquito with spotted wings. The palps are as long as the proboscis, and there are three wide white bands on the apical half of the palps, separated by two narrower black bands. The proboscis is dark scaled. The underside of the abdomen has paired rounded patches of white scales laterally on most segments, with a few scattered scales in the midline. The top of the thorax has a darker “shoulder patch” on either side sub apically.

Description of larvae

The larvae have no siphon, and the head is as long as it is broad. The outer clypeal hairs on the front of the head are strongly branched. This species can be confused with *An. annulipes* on the appearance of the outer clypeals, but can be separated by the air scoop on the last abdominal segment. In *An. meraukensis* the median plate of the scoop is anteriorly elongated, and has two distinct lateral projections.

Breeding places

Breeds predominantly in sunlit grass or reed fresh water swamps and is often associated with *Eleocharis* reeds. It has been collected occasionally from artificial breeding places such as wheel ruts and bomb craters. It has also been collected breeding in a rain filled 200 litre drum.

Adult habits

Readily bites people, domestic animals and kangaroos. The preferred biting time is just after sunset. Like all *Anopheles* it stands at an angle to the skin to bite. It can be especially numerous during the late wet season when extensive breeding areas are filled with water and lodged reeds.

Distribution

Merauke/Kumbe area in Irian Jaya. In Australia it occurs in the northern areas of Western Australia, Northern Territory and Queensland. It is commonly recorded throughout the Top End of the Northern Territory as far south as Larrimah, to Borroloola in the east, and has been collected rarely as far south as Lajamanu and very rarely at Elliot.

Disease potential

A suspected but unproven vector of malaria. It is not known to transmit viral diseases to humans in Australia, although a number of viruses have been isolated from this species.

Anopheles farauti s.l.

"The Australian Malaria Mosquito"

Description of female

A speckled grey mosquito with extensively spotted wings and with palps as long as proboscis. There are three narrow black bands on the apical half of the palps, with the two most basal of these dark bands seperated by a narrow white band. The proboscis is dark, and the abdomen is all dark, with no pale scales on the udersurface..This is a species complex with at least three species occurring in the Northern Territory, which are not able to be seperated using morphological characters.

Description of larvae

Like all *Anopheles* larvae, it has no siphon. Head is as long as it is broad. This species can be easily distinguished from *An. hilli* as it has larger inter segmental plates. Larvae feeds and rests horizontal to the surface of the water.

Breeding Places

Anopheles farauti s.I occurs in many kinds of permanent and semi-permanent fresh and brackish water sites. It is usually in sunlit locations and uncommon in deep shade. The freshwater species *An. farauti* No. 3 breeds in the margins of shallow vegetated freshwater swamps and streams. *An farauti* No. 1, the brackish water breeding species is found in open brackish pools or swamps near the coast, often in association with *An. hilli, Culex sitiens* or *Cx. annulirostris*.

Adult Habits

Anopheles farauti s.I bites people readily and also bites other mammals and birds. It stands at an angle to the skin to bite. Flight range approximately 2 km. It is normally most numerous in the late wet season and early dry season.

Distribution

An farauti s.l occurs from the Moluccas, New Guinea, Solomon Islands to Vanuatu as a number of sibling species. In Australia it occurs in North Queensland, Top End of the Northern Territory north of Katherine including occasionally in Katherine, very rarely in Ngukurr, and very rarely in the north east coastal area of Western Australia. In the Darwin area larvae have been found in Marrara Swamp, Casuarina Coastal Reserve, Leanyer Swamp and Coconut Grove swamp. *An. farauti* No. 1 has been collected in Leanyer Swamp, Holmes Jungle Swamp, Micket Swamp and Ludmilla Creek swamp, while *An. farauti* No. 3 has been collected in the fresher water swamp areas of Holmes Jungle, Marrara Swamp, the Jabiru area and the Nhulunbuy-Yirrkala area.

Disease potential

An efficient and confirmed vector of malaria. *An. farauti* s.l (probably *An. farauti* No. 1) was the confirmed vector in a past epidemic in North Queensland, and *An.farauti* No. 1 is the suspected vector in the northern section of past malaria occurrences in the Northern Territory. A vector of human filariasis in West Irian.

Anopheles annulipes

"The Common Australian Anopheline"

Description of female

This is a species complex of more than 5 species, of which propably at least two species occur in the Northern Territory. A speckled grey mosquito with extensively spotted wings, although a ginger species occurs in inland areas. The palps are as long as the proboscis. Three wide white bands on the apical half of the palps are separated by two narrow black bands. The proboscis is usually pale scaled on the apical half in northern specimens. The southern specimens may have only slight paler scaling on the apical half of proboscis. Both the top and bottom of the abdomen are dark except for a few white scales both dorsally and ventarlly near the apex.

Description of larvae

The larvae are very variable in colour. They have no siphon. The head is as long as it is broad. The inner clypeal hairs on the front of the head are wide apart, and the outer clypeals are branched. This species can be simular in appearance to An. meraukensis in respect of the outer clypeal hairs, but can be differentiated by the air scoop on the last abdominal segment. In An. annulipes the median plate of the scoop is broad and has no lateral projections. It rests parallel to the surface of the water and feeds on particles on top of water by filtering with a series of brushes near its mouth.

Breeding Places

Anopheles annulipes s.l can breed in all kinds of temporary and permanent fresh water ground pools, stream and vegetated swamp edges and amongst floating algae or vegetation away from banks of streams and swamps. It also occurs in rock pools and large open artificial containers such as drums and disused swimming pools, and is sometimes found in slightly brackish water. Eggs are laid singly on the water and float by means of floats on each side. In the Darwin area larvae have been found at Leanyer Swamp, Ludmilla Swamp, Marrara Swamp, and at Casuarina Coastal Reserve. Found commonly at the edges of Nhulunbuy Lagoon, in Ilparpa Swamp in Alice Springs, and throughout the Northern Territory where suitable sites exist.

Adult Habits

Like all *Anopheles* species, it stands on its head to bite. Bites by night, particularly dusk and dawn and will enter houses. Bites people readily but will also feed on cattle. Resting places in hollow stumps, drums, banks of streams and stormwater pipes. This species is abundant in the Northern Territory from February to April near extensive paperbark and freshwater reed swamps but rarely becomes an appreciable human pest in the Top End, and never very numerous in coastal situations. Flight range is approximately 2 km from breeding areas.

Distribution

Papua New Guinea and throughout Australia, including Tasmania. Occurs throughout the Northern Territory from Darwin to Alice Springs.

Disease potential

Capable of carrying malaria, and is a suspected vector in the Northern Territory, particularly in areas south of the distribution of *Anopheles farauti s.l.*. A vector of myxomatosis of rabbits

Anopheles bancroftii

"The Black Australian Anopheline"

Description of female

A large black mosquito with bushy black palps and a black proboscis. Wings are mostly dark with few small white patches on the front edge. The top of the abdomen is black. The underside of abdomen has a central row of pale scale patches. Palps are as long as the probocis.

Description of larvae

A dark larvae often with some irregular white patches. Has no siphon. The antennae have a conspicuous branched hair at mid length, with bushy branched outer clypeals on the apical section of the front of the head. Feeds parallel to the surface of the water by drawing in particles on the surface with a series of brushes near its mouth.

Breeding Places

Usually found in shaded freshwater swamps, waterholes and stream margins. Sometimes found in slightly brackish reed swamps where reeds shade the water. Paperbark trees and the areas of spike rush reeds such as *Eleocharis sphacelata* are often good indicators of suitable breeding places. In the Darwin area larvae have been found in Leanyer Swamp, Marrara Swamp, Coconut Grove swamp areas and the Casuarina Coastal Reserve. Common around Nhulunbuy Lagoon and at Baralil Creek near Jabiru.

Adult Habits

An. bancroftii stands almost vertically on its head when biting. It bites principally at night, but readily attacks people by day in the Northern Territory in shaded areas near it's breeding grounds. It also attacks other mammals readily including cattle. The flight range of 2 to 4 km from the breeding areas. This species is usually more numerous in the late wet season and early dry season.

Distribution

Irian Jaya, Admiralty Islands and Northern Australia. In the Northern Territory it is found broadly throughout the Top End, and is seasonally commonly from Wadeye (Port Keats) aropund the north coast to Ngukurr and Boroloola and south to Katherine and Mataranka. In the Darwin area he larvae have been found in Leanyer Swamp, Marrara Swamp, Coconut Grove swamp, and Casuarina Coastal Reserve. It is common in Nhulunbuy and Jabiru and around the extensive coastal flood plains and vegeteated swamp and lagoon areas associated with the larger rivers.

Disease potential

Capable of carrying malaria, and is a suspected vector in the Northern Territory but usually not long lived enough to be an effective vector. A vector of filariasis in New Guinea.

Coquillettidia xanthogaster

"The Golden Mosquito"

Description of female

A medium sized mosquito with a bright gold/orange thorax and abdomen. The legs are dark, and have purple reflections.

Description of larvae

A pale/white larvae with tip of siphon dark and modified for piercing plants. A very sluggish swimmer. Larvae are attached to aquatic plants and rarely seen.

Breeding places

Permanent and semi permanent swamps with aquatic vegetation. Larvae attach to underwater roots or stems of plants. In the Northern Territory it is most frequently associated with the semi aquatic reeds *Eleocharis* sp and *Typha* sp, and the water lilies *Nymphaea sp*. Pandanus, grasses and sedges may be suitable habitats in some localities.

Adult habits

Bites mainly at night, but also in the daytime in shade. It bites people, domestic animals and birds, and may travel up to 4 km from the breeding places. It is attracted to light and is seasonally numerous.

Distribution

The islands of New Guinea, New Caledonia and Vanuatu. Occurs widely in Australia. In Queensland it occurs mainly in tropical coastal areas but is also recorded inland as far as Charleville, and south to near Sanford and Bunya near Brisbane. Found also in the Northern Territory, North West Western Australia and coastal and sub coastal northern New South Wales. It is found widely and common in the Top End of the Northern Territory coastally to sub coastally from Port Keats in the west to Borroloola in the east, and south to Katherine and Mataranka. It has not been recorded inland further south than just south of Mataranka at Warlock ponds except briefly in Ilparpa Swamp near Alice Springs in 2000.

Disease potential

Not known to transmit human disease although a potential vector of Ross River virus and a vector of reptile filariasis in frill neck lizards.

Aedes vigilax

"The Northern Salt Marsh Mosquito"

Description of female

Aedes vigilax is a small, dark, robust mosquito with a pointed abdomen. The proboscis is pale scaled on the basal 2/3 on the underside. There are basal white bands on each segment on top of the abdomen with lateral white patches. The tarsi have basal white bands on each segment, and these are particularly noticeable on the hind legs. Stands with its body horizontal to the skin when biting.

Description of larvae

The larvae of *Aedes vigilax* are moderate size and relatively dark, with a short siphon, and short, pointed anal papillae. The major head hairs are single. Generally larvae feed on the substate at the bottom of pools and tend to congregate around sheltered areas of vegetation. If the larvae are disturbed they rapidly move to the bottom of the pool.

Breeding Places

Aedes vigilax commonly breeds in sunlit brackish to salt water swamps and temporary pools that are filled after the highest tides of the month and after rain. In Darwin tides over 7.4 m are required to reach their normal breeding areas. These areas are usually sunlit so their development is rapid, with 4 days as larvae and 2 days as pupa. The breeding areas are often associated with salt water couch grass (*Sporobolus)* or various marsh grasses (*Xerochloa*) or salt tolerant succulents (*Tecticornia* and *Halosarcia*) and reeds such as *Shoenoplectus, Eleocharis* and *Typha* sp. Will breed in flooded grass areas above high tide limit where there is some salt influence from the soil or seaspray. Larvae are seldom found under a heavy mangrove cover with daily tide movement, but are often associated with *Avicennia* mangroves and *Shoenoplectus* reeds in brackish swamps reached by tides over 7.4 metres (Darwin area).

In some cases increased *Aedes vigilax* breeding has occurred when sand dunes or mangrove boundaries have been interferred with and the natural drainage of sea water has been blocked. Only complete reclamation by filling or the exclusion of salt water by tidegates and bund walls will remove these breeding areas. The eggs are laid singly in the moist mud, usually at the base of vegetation and are laid at the edges of the depressions as the water recedes. These eggs can resist periods of dryness for up to 12 months until the area is flooded again.

The larvae go through 4 stages in the water and then turn into a pupa which is much rounder and looks like a very small crayfish without legs. The adult mosquito hatches from this pupa as it rests at the surface of the water. The adult mosquito then rests on the surface of the water until the wings are sufficiently hardened to fly. The period from egg to adult is usually only 6 days. The larvae will grow in a range of salinities from slightly brackish to twice sea water. They are also found in freshwater when the

breeding grounds are flooded by rains. Eggs are generally not laid at the edges of fresh water pools or freshwater swamps.

Only the females suck blood, which is needed for the development of their eggs. Both males and females suck plant juices or nectar. After the adults emerge they mate and then remain at their breeding site for 2 days while the females develop their first batch of eggs while harbouring at the breeding site. They do not require a blood meal for this first batch of eggs. Mass dispersal of newly emerged females may take place to points up to 40 km or more from the breeding sites, but are generally in highest numbers from 1–5 km from extensive breeding sites.

After strong prevailing winds from coastal breeding sites, large numbers of *Aedes vigilax* have been found as far from the coast as Pine Creek and Katherine. The adults shelter in vegetation during the day, especially in mangroves and dense forest near their breeding sites, but also in dense vegetation such as mango trees and shade trees in suburban areas.

The female mosquito will bite by day or night and will bite people, other mammals and birds. Peaks flying and biting times are just after sunset and before sunrise .

Plagues of *Aedes vigilax* in the Darwin area occur from the mid and late dry season to the early wet season, starting 9-10 days after the highest monthly tides or the first flooding rains. Numbers reduce rapidly after the wet season rains seasonally flood the extensive salt marsh breeding areas to allow predator fish access, as well as dramatically reducing egg laying sites. The most prolific breeding areas around Darwin are the Casuarina Beach area, Leanyer Swamp and the Ludmilla Creek area.

Distribution

Found in the Oriental region and the South West Pacific area including Australia, Timor, Solomons, New Guinea, New Caledonia, Fiji and Vanuatu. Found coastally in Australia from New South Wales, Qld, NT and WA to Mandurah south of Perth. Found in Victoria inland at Mildura. In the NT it is seasonally common across the Top End and subcoastally to inland, commonly to Katherine, occasionally to Tennant Creek, and rarely in Alice Springs (usually after monsoon or cyclones weather systems and associated north west winds)

Diseases potential

Aedes vigilax is a major pest in the Top End of the Northern Territory. It is regarded as the principle vector of Ross River virus and Barmah Forest virus in the late dry to early wet season, andis a potential vector of MVE. It is capable of carrying heartworm of dogs. It is a vector of filariasis in New Caledonia.

Control

Because of the relatively distant and scattered breeding sites and the large areas involved, larval control, except near residential development is not an economic or

practical proposition. The usual method of control available near residential areas is the application of the insecticides *Bti* or methoprene. In large areas, timely applications have to be done by air. Hand application can be used in small areas. Personal protection is by using repellents, screening homes and avoiding their breeding and resting places during the day or at night.

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