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A MOSQUITO SURVEY AND ASSESSMENT OF POTENTIAL MOSQUITO PROBLEMS OF THE BRISBANE AIRPORT DEVELOPMENT AND ENVIRONS

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SUMMARY
Thirty-five species of mosquitoes have been recorded from Brisbane Airport development and adjacent areas. The principal pest species are *Aedes vigilax* associated with brackish water and *Culex annulirostris* associated with fresh water. Engineering techniques which could promote intensive mosquito breeding during airport construction and available alternatives are discussed. Complete development will eliminate many present breeding places of *Aedes vigilax* but subsequent water management practices could give rise to severe mosquito infestations. Continued surveillance of the area by a health surveyor during and after development is recommended.

INTRODUCTION
Thirty-five species of mosquitoes have been recorded from the area embracing the proposed Brisbane Airport Development and from adjacent areas that provide a similar range of habitats (Appendix A). Only a few of these merit consideration as pests, potential pests, or as potential disease vectors. Results of previous mosquito surveys (Appendix B) have provided a general picture of mosquito activity at different seasons.

From July 1972 to March 1973 field observations and collections were made in the area, especially around Landers Pocket, and a flight over the area on 14 August allowed assessment of the extent of potential mosquito problems.

Potential mosquito problems may be divided into those associated with brackish or salt water and those associated with fresh water, in which the principal pest species are, respectively, *Aedes vigilax* and *Culex annulirostris*. Understanding of the habits of these species is needed in order to understand the problems. Some other potential problem species will also be considered.

There is no doubt that the proposed Brisbane Airport Development will eliminate many breeding sites of pest mosquitoes. We will discuss how it may create others during or after development and how this might be minimised or avoided.

BIOLOGY OF PEST MOSQUITOES

*Aedes vigilax* (the salt marsh mosquito) breeds in salt marsh areas which retain stagnant water from the highest tides of the month, principally on the

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open flats vegetated with the small succulent plants *Salicornia* and *Suaeda* or with marine Couch grass (*Sporobolus*), i.e. the herbfield (salt marsh) and marine Couch grassland of L. Durrington's report on vegetation. (See p. 19 of this volume and Volume V, Figure 3-4.)

Occasionally it breeds in mangrove forest; the factors influencing this are not clear but it has been observed by P. Kertridge (see Appendix B) at times of low tide and low rainfall in places isolated from daily tides. The eggs are laid on soil that is covered by couch or *Salicornia* or at the bases of low-growing plants close to breeding pools (P. Kertridge's observations) and can withstand drying for some weeks or months. Not all eggs hatch at the first flooding. Larval and pupal stages can be completed in 5-6 days in mid-summer and 9-12 days in mid-winter, in a range of salinities from greater than sea water to fresh. Rains enhance breeding as they delay drying out of pools or flood salty depressions that recent tides have not reached, but breeding is much reduced following continued heavy rainfalls. The adults seek humid resting places, initially amongst marine couch or mangroves. Females bite at any time, but the main flight activity is just after sunset and before dawn. When enormous numbers emerge within a limited period, as happens usually after one or more of the summer high tides, mass migrations occur for distances up to 32 km or more from breeding areas.

Disregarding the important effects of rainfall and temperature, as a generalisation it may be said that for the Brisbane area (our limited observations at Landers Pocket support this) extensive *Aedes vigilax* breeding in the *Salicornia* zone will follow 2.1-2.2 m tides and extensive breeding on the marine couch flats follows tides of 2.3 m or greater.

*Culex annulirostris* (the common banded mosquito) breeds in a variety of sites along the margins of slow-flowing streams, in weedy waterholes and hoofprints, nearly always in association with floating or emergent vegetation. The female lays a raft of eggs on the water surface and larval and pupal stages occupy about a week in summer, longer in winter.

*Culex annulirostris* particularly favours shallow grassy sites, and when heavy rain, floods or irrigation lead to water lying on grassy paddocks for a week or two, or a rise in the level of a water storage covers grassy banks, it may quickly breed up in great numbers and plague infestations result. Sometimes it breeds in similar but slightly brackish sites. The adults shelter among vegetation and may travel long distances.

**Other species**

*Culex sitiens* breeds in the same sites as *Aedes vigilax* but probably finds most favourable conditions when tidal flooding of marine-couch flats is extended by rain. Sometimes it occurs with *Culex annulirostris* in slightly brackish sites. It does not appear to be common in the study area at present. Summer migrations of *Aedes vigilax* often include a proportion of *Culex sitiens*.

*Anopheles amictus hilli* breeds in the same sunlit sites as *Aedes vigilax*; *Anopheles annulipes* occurs in the same sites as *Culex annulirostris*; both may breed in large numbers in shallow muddy pools.

*Mansonia uniformis* and *Coquillettidia xanthogaster* breed in fresh waterholes and swamps where their larvae and pupae attach their breathing tubes to the roots of aquatic plants from which they obtain air. The early stages are thus very difficult to find, and to control.

*Culex fatigans* may breed in great numbers in fresh water polluted by animal or vegetable materials.

**THE PRESENT SITUATION**

Collections in 1947-48 indicated that *Aedes vigilax* were numerous in a summer with about average rainfall (Sandgate records: average October-March 800 mm; October 1947-March 1948 767 mm).

The plants *Salicornia* (Arthrocnemum spp. in report on vegetation) and *Suaeda* are frequently reddish in colour which makes the zone of their occurrence easy to pick out from the air. Observations (including those at Landers Pocket) indicate that the water-holding depressions within this zone are likely to be the main year-round breeding sites of *Aedes vigilax*, with considerable extensions into the zone above, the marine couch flats, when tides and/or rain flood its depressions.

Examination of the proposed Brisbane Airport Development area from the air on 14 August, 1972, showed that the *Salicornia* and marine couch zones are very extensive.

**Landers Pocket**

The photogrammetric survey map (SB 33-308°. 4-B) indicates that less than half the area of marine couch flats at Landers Pocket exceeds 2.6 m height. It is likely that high tides exceeding 2.5 m from 18-21 January 1973 penetrated extensively over the flats and provided attractive oviposition sites for *Aedes vigilax*. A visit was made on 21 February soon after a combination of high tides and 203 mm of rain (during week ending 18 February). (Tides reached 2.4-2.5 m on 15-19 February.)

Wherever there were even slight depressions among the marine couch, there was water lying, and there, and even in parts of the *Salicornia* zone, the water was quite fresh (to taste). Pools in a tidal drainage channel and near a creek edge were brackish. In all pools, both fresh and brackish, there was prolific breeding of *Aedes vigilax* and larvae of mixed ages, and pupae were present. *Aedes alternans* larvae and pupae were present in many pools. *Culex* larvae up to third instar were present—*Culex sitiens* in the brackish drainage channel and *Culex annulirostris* in some fresh water pools.
Large numbers of *Aedes vigilax* attacked the collectors, and adults (mainly males) were exceedingly numerous resting among the grass.

The area was checked on 2 March. About two thirds of the breeding pools had dried out. In those remaining, breeding was continuing though numbers appeared smaller. The reduction may have been associated with increased algal growth. *Culex annulirostris* breeding was, however, more extensive.

**Cribb Island**

On 21 February, pools on a tidal flat were brackish with third and fourth instar *Aedes vigilax* larvae and pupae, and with adults resting in the grass and biting. In light trap collections, 21 February to 2 March, numbers of *Aedes vigilax* were fairly constant except for a seven-fold increase on 26 February and five-fold on 27 February. Numbers of *Culex annulirostris* trebled on 1 and 2 March. In truck trap collections at dusk, the catch of *Aedes vigilax* on 25 February was 24 times greater than on 23 February.

**Boondall**

In light trap collections, 21 February to 2 March, *Aedes vigilax* numbers were greatly increased on 26, 27 and 28 February. *Culex annulirostris* numbers rose from 6 on 22 February to 146 on 28 February.

These observations in the Brisbane Airport Development area in February 1973 show that in a summer period of high tides and heavy rainfall, very extensive breeding of *Aedes vigilax* and *Culex annulirostris* occurs over large areas. This is undoubtedly one of the major breeding areas for *Aedes vigilax* close to Brisbane.

**MOSQUITO PROBLEMS ASSOCIATED WITH DEVELOPMENTS**

**Saltwater problems**

The destruction of mangrove swamps can pose problems. In normal circumstances there is no mosquito breeding among mangroves at the level of daily tides. Whether mangroves are killed by permanent flooding with impounded water and fall over, or are felled by other means and left lying, there results an area of fairly shallow water, well sunlit, with rotting vegetation and with many protected sites among the logs and stumps. *Aedes vigilax* may breed prolifically within such an area.

Huge populations of *Culex sitiens* may develop where rotting mangrove leaves accumulate in brackish water, due to leaf shedding by mangroves whose roots have been drowned by impounded water (as has happened at Gladstone).

Filling of low-lying areas by pumping mud or sand with salt water may lead to problems on the reclaimed area itself. If salt water is allowed to pond or if rain subsequently floods the salty ground extensive breeding of *Aedes vigilax* may ensue in any ponding which may result.

Filling by pumping with salt water, where excess water drains on to what are normally fresh-water swamps and low-lying areas, can create considerable problems. Tea-trees and other plants are killed and there is much rotting vegetation in the brackish pools, providing for prolific breeding by *Aedes vigilax*.

Alteration or blocking of natural drainage may keep daily tides from an area but prevent water that enters the site by other routes at king tides or from rain from draining away. In 1969, huge numbers of *Aedes vigilax* larvae were observed in water impounded in this way in a mangrove forest near Redcliffe airstrip.

**Fresh water problems**

*Fluctuating water levels: Culex annulirostris* may breed prolifically where levels of a fresh-water impoundment are raised over shallow grassy banks, or where fresh water is drained on to grassy flats.

*Felled tea-tree swamps: Densely shaded tea-tree swamps usually do not produce great numbers of pest mosquitoes. At Slade Point near Mackay in 1970 there was exceptionally heavy breeding of *Mansonia uniformis* where a large area of tea-trees had been uprooted and left lying. Rank grass had overgrown the area and the holes from tea-tree roots and other depressions provided sheltered breeding sites where *Mansonia* larvae were attached to grass roots. Whether climatic conditions near Brisbane would favour such prolific breeding by *Mansonia uniformis* in a comparable site is unknown.

Shallow muddy pools in wheel ruts and other depressions arising from development works and occurring especially during rainy periods may provide prolific breeding sites for *Anopheles annulipes*, and if slightly brackish, for *Anopheles amictus hilli* also. These species show a preference for feeding on cattle and infrequently attack man in the Brisbane area. They are both capable of carrying malaria, and in view of the likely removal of cattle from the area, and the fact that Eagle Farm is an international airport, they may need to be kept in check.

Pollution of fresh water or incorrect construction of septic tanks can provide conditions for a local plague of *Culex fatigans*.

**RECOMMENDATIONS TO MINIMISE MOSQUITO PROBLEMS**

1. Where trees (especially mangrove or tea-tree) are killed or felled in areas where salt or fresh water will be impounded, destruction or removal of the timber and reclamation or drainage of the area should follow without delay.

The area killed or felled should not exceed the developers' capacity to effect simultaneous treatment of it to inhibit mosquito breeding caused by the changed habitat. In the event
of any upset in this procedure, emergent mosquito control measures need to be instituted immediately.

2. Where reclamation is by pumping sand in salt water, the fill should begin from the landward side, allowing drainage of the water to saltwater outlets. Drainage of salt water on to low-lying land or fresh-water swamps is to be avoided.

3. If natural drainage is blocked by development works, cognisance should be taken of areas that can be flooded by king tides and alternative drainage channels provided.

4. The steeper the sides of drains and impoundments channels, the less likely is mosquito breeding along their margins.

5. Water management practices that cause periodic inundation with either fresh or salt water of extensive areas of grassland are to be avoided (we do not know enough about proposals to re-route the Serpentine to judge their effect in this regard).

6. A health surveyor, experienced in mosquito control, should keep the area under surveillance so that, when necessary, larvicidal control measures can be taken before pest populations develop. This would appropriately be a health surveyor attached to the authority responsible for controlling mosquitoes in the contiguous area.

In this respect, prior advice to the local authority of the likely occurrence of the circumstances involved in recommendations 1 to 5 is desirable.

CONCLUSIONS

Development of Brisbane Airport will eliminate extensive breeding areas of the salt-marsh mosquito *Aedes vigilax*. Our recommendations are aimed at minimising mosquito problems that could arise while development is in progress and should thus minimise also the use of chemical controls. There is little doubt however that mosquito problems will arise and that some will necessitate the use of chemicals. Continued surveillance of the area by a health surveyor experienced in mosquito control should allow these problems to be dealt with before they become acute and in a manner that accords best with plans for the airport environment.

APPENDIX A—LARVAL HABITATS OF SPECIES RECORDED IN THE AREA

Mosquitoes recorded from the area between Cabbage Tree Creek and the Brisbane River, from the shores of Bramble Bay to, and including, the suburbs of Boondall, Zillmere, Geebung, Nudgee, Banyo and Eagle Farm. (Species marked with an asterisk are discussed in the text of the report.)

The main larval habitats of each species are shown, with less frequent habitats in parenthesis, namely:

1. permanent and semi-permanent fresh groundwaters (e.g. waterholes);
2. temporary fresh groundwaters (e.g. rain-filled depressions);
3. containers of fresh water (e.g. treeholes, old tins);
4. brackish or salt pools in tidal areas.

<table>
<thead>
<tr>
<th>Species</th>
<th>Larval habitats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anopheles annulipes*</td>
<td>1 2 (4)</td>
</tr>
<tr>
<td>Anopheles amictus amictus</td>
<td>1 2</td>
</tr>
<tr>
<td>Anopheles amictus hilli*</td>
<td></td>
</tr>
<tr>
<td>Anopheles bancroftii</td>
<td></td>
</tr>
<tr>
<td>Anopheles meraukensis</td>
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<tr>
<td>Toxorhynchites speciosus</td>
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<tr>
<td>Uranotaenia niveps</td>
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<td>Uranotaenia pygmaea</td>
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<tr>
<td>Ficalbia elegans</td>
<td>1</td>
</tr>
<tr>
<td>Ficalbia metallica</td>
<td></td>
</tr>
<tr>
<td>Mansonia uniformis*</td>
<td></td>
</tr>
<tr>
<td>Coquillettidia linealis</td>
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</tr>
<tr>
<td>Coquillettidia xanthogaster*</td>
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</tr>
<tr>
<td>Aedes alboannulatus</td>
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</tr>
<tr>
<td>Aedes alternans</td>
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<td>Aedes funereus</td>
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<td>Aedes mollochii</td>
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<td>Aedes notoscriptus</td>
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<td>Aedes procax</td>
<td>2</td>
</tr>
<tr>
<td>Aedes vigilax*</td>
<td></td>
</tr>
<tr>
<td>Aedes vittiger</td>
<td>2</td>
</tr>
<tr>
<td>Aedes sp. 'No. 52'</td>
<td>2</td>
</tr>
<tr>
<td>Culex annulirostris*</td>
<td>1 2 (4)</td>
</tr>
<tr>
<td>Culex australicus</td>
<td>1 2 (3)</td>
</tr>
<tr>
<td>Culex bitaeniorynchus</td>
<td></td>
</tr>
<tr>
<td>Culex cylindricus</td>
<td>1 2</td>
</tr>
<tr>
<td>Culex fatigans*</td>
<td>1 2 3 (polluted)</td>
</tr>
<tr>
<td>Culex 'fraudatrix'</td>
<td>1 2</td>
</tr>
<tr>
<td>Culex halifaxii</td>
<td>2 3</td>
</tr>
<tr>
<td>Culex pseudomelanoeonia</td>
<td></td>
</tr>
<tr>
<td>Culex sitiens*</td>
<td>(2)</td>
</tr>
<tr>
<td>Culex squamosus</td>
<td>1</td>
</tr>
<tr>
<td>Culex sp. 'No. 32'</td>
<td>1</td>
</tr>
</tbody>
</table>

APPENDIX B—SOURCES OF MOSQUITO RECORDS FROM THE AREA


Report forms held in Department of Entomology, University of Queensland give details of the sites of almost 5000 larval collections (with identifications mostly by E. N. Marks, some by F. A. Perkins). The survey included extensive collections in the area outlined in Appendix A (November 1947-May 1948).

3. Queensland Institute of Medical Research
   Truck Trap Collections, Cribb Island and
   Nudgee, December 1969-April 1970 (21
   from each locality). Mainly collected and
   identified by B. H. Kay. Recorded on cards
   held at Q.I.M.R. Also a few associated larval
   collections.

4. Department of Entomology, University of
   Queensland. Collections by E. N. Marks and
   P. Kerridge, Cribb Island, January-February
   1970.

5. Brisbane City Council Light Trap collections;
   Boondall and Cribb Island January 1970
   and currently continuing. Identifications by
   C. G. Trouton.

6. Current Survey. Larval collections E. N.
   Marks and C. G. Trouton. Light trap collec-
   tions by C. G. Trouton at Boondall and
   Cribb Island intermittently since January
   1970.