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MOSQUITO COLLECTIONS IN A HIGH RAINFALL AREA OF NORTH QUEENSLAND, 1963-1964

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Abstract: Light traps and chicken-baited traps were used to sample the mosquito fauna near Innisfail on the NE coast of Australia. Weekly collections at fixed trapping sites in rain forest, swamp forest, mangrove forest and farm land from June 1963 to June 1964 yielded 29,395 ♀ mosquitoes of 61 species.

The mosquito fauna resembled that of Papua, and at least 43 species are common to both areas. The habitat sequence rain forest, swamp forest, mangrove forest was associated with progressive restriction in mosquito fauna. Of the 39 farm land species 8 were not taken in other habitats.

Densities were highest during the wet season (January to May), and lowest during periods of low temperature from June to September.

All species confirmed as arbovirus vectors in Queensland were recorded. In most cases these were at lower levels than at Mitchell River Mission, near the Gulf of Carpentaria, where higher virus transmission rates have been found. *C. annulirostris*, the most important arbovirus vector in Queensland, was widely distributed but did not reach high density. *Coq. crassipes* was the most common mosquito. *Aedeomyia catasticta* was taken for the first time in animal baited traps.

From their first settlement the high rainfall areas of northeast Queensland (annual rainfall greater than 225 cm) have had a history of febrile illness (Derrick 1957) which has attracted medical workers, a number of whom made collections of mosquitoes and passed specimens to interested specialists. The Innisfail area has therefore received frequent mention in literature (Theobald 1910; Taylor 1915, 1916, 1927, 1944; Edwards 1924; Lee 1946; Marks 1955, 1958, 1963), but no list of species has been published since Taylor (1916) listed 9 species.

Studies elsewhere in the world have demonstrated the importance of the rain forest ecosystem as enzootic areas of arbovirus transmission (Causey et al. 1961). It was decided therefore to undertake mosquito collections in the Innisfail area in the hope of demonstrating arbovirus activity in vertebrate-arthropod cycles. The present paper records observations on the populations and biology of mosquitoes made during this study. Attempts to isolate virus from mosquitoes and birds and to detect arbovirus infections by serological methods are recorded elsewhere (Doherty et al. 1968b).

MATERIALS AND METHODS

Innisfail (146°0'E, 17°30'S) lies at the junction of the North and South Johnstone Rivers in a fertile valley of elevation less than 15 m. The valley lies almost parallel to the coast from which it is separated by a narrow strip of land 5 to 7 km wide bearing the Graham, Seymour and Moresby Ranges, with an average elevation of 150 m (FIG. 1). It is bounded on the west by the eastern slopes of the Atherton Tablelands. Formerly clothed with tropical lowland rain forest and low *Melaleuca* shrub forest (Webb 1966), the valley is now extensively cleared for the cultivation of sugar cane.

The climate has been described (Harrison 1962a) as monsoonal, with an average annual rainfall of 361 cm, 73% of which falls in the period January to May. The daily minimum temperature measured at the trap sites varied from 6° to 27°C (FIG. 2).

Mosquitoes were collected in light traps (modified from those described by Sudia & Chamberlain 1962) and drum traps (modified from those described by Bellamy & Reeves 1952) baited with chickens. Eight trap sites (FIG. 1) were used: 1 in mangrove forest; 3 in open farm land; 2 in low *Melaleuca* shrub forest (Webb 1966) on the edge of a large freshwater swamp, and 2 in mixed mesophyll vine forest (Webb 1959). Each week for 1 year from 4 June 1963, 8 light trap and 16 chicken-baited trap collections were made (1 light trap and 2 chicken-baited trap collections at each site). Light traps were suspended 1.4 m above ground. Chicken-baited traps were set at right angles to each other 0.4 m to 1 m above ground, near but out of sight of the light traps. A thermometer recording maximum and minimum temperatures was exposed at each site.

Insects in light traps were killed with chloroform vapor, and mosquitoes were removed and stored in sealed tubes on solid carbon dioxide. Mosquitoes in chicken-baited traps were removed with a mechanical aspirator, held alive for 24 hr, then killed and stored in the same manner. Each week collections were transported on solid carbon dioxide to Brisbane and processed as described previously (Standfast & Barrow 1968).

RESULTS

A total of 29,395 female mosquitoes were col-

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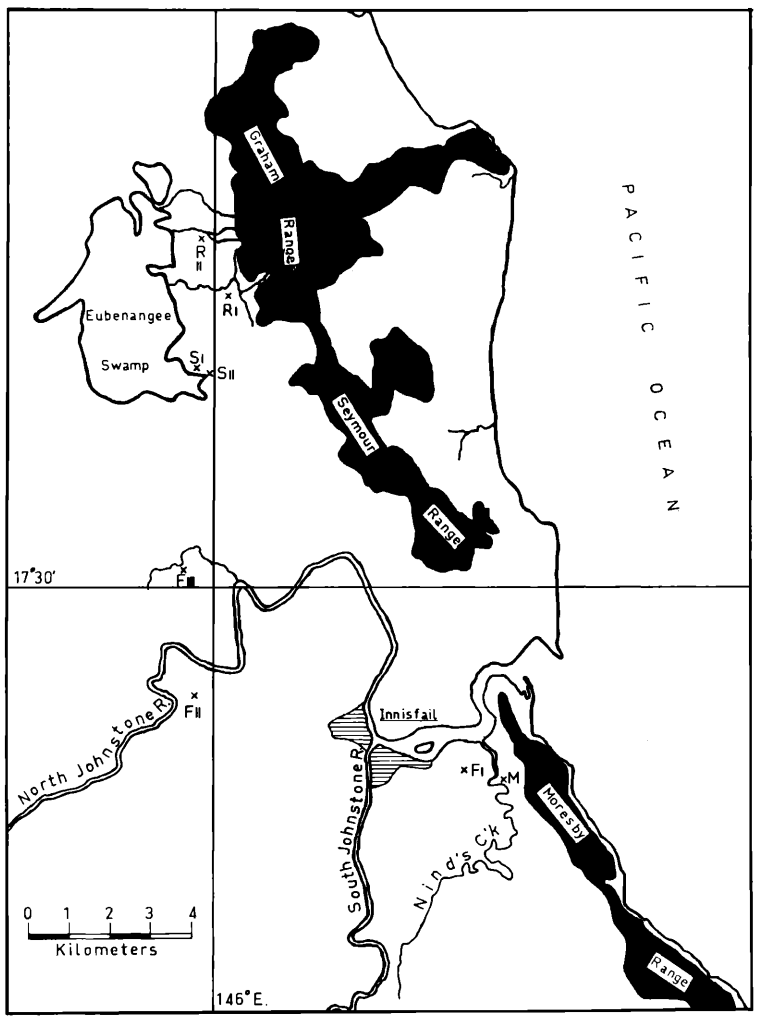

FIG. 1. Location of trap sites near Innisfail. RI, RII: Rain forest; SI, SII: Swamp forest; FI, FII, FIII: Farm land; M: Mangrove forest.

lected in 354 light trap and 668 chicken-baited trap collections. The 61 species collected are listed in the appendix.

Seasonal abundance. Mean catches from 16 light traps for each month are presented in TABLE 1. Most species listed were collected in greatest numbers in the period January to May; less common species not listed in the table showed a similar seasonal distribution. Mean catches for each week for 5 common species are plotted in FIG. 2 against minimum temperature and rainfall.

Variation with habitat. The 4 habitats (rain forest, swamp forest, mangrove forest and farm land) provided collections differing in species composition and density (Appendix and TABLE 2). A total of 53 species was recorded in collections from rain forest, 43 from swamp forest, 39 from farm land and 38 from mangrove forest. Twenty-eight species were common to all habitats; 8 were restricted to rain forest, 8 to farm land, 1 to mangrove forest, but none to swamp forest. Mangrove forest sites produced the highest catch rates in total number of mosquitoes.

Host preference. In addition to those species listed in TABLE 2, *T. bimaculipes*, *T. magnesianus*, *T.* sp. no. 55, *M. uniformis*, *Aedeomyia catasticta*, *Ae. alternans*, *Ae. aurantius*, *Ae. tremulus*, *C. starckeae*, and *C. vicinus* were taken in chicken-baited traps.

Species from which virus strains have been isolated. Arbovirus strains have been isolated from 12 Queensland mosquito species (Doherty et al. 1963a, 1963b, 1968a, 1968b); in addition the In1074 strain was isolated from a pool of 11 species. All 8 species from which repeatable isolations have been made were recorded in this series: 2 (*An. amictus* and *Ae. normanensis*) were rare; 4 (*Aedeomyia catasticta*, *C. annulirostris*, *C. bitaeniorhynchus* and *C. squamosus*) were found most often in collections from farm land and 2 (*An. annulipes* and *Ae. vigilax*) most often in swamp forest and mangrove forest,

TABLE 1. Monthly variations in species composition of light trap collections (all sites), Innisfail, June 1963 to May 1964.

Species	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May
Anopheles bancroftii	0.2*	0	0.6	0.4	0.3	0.7	1.5	1.3	0.9	1.0	0.3	0
An. farauti	1.8	0.2	0.8	2.2	0.8	2.5	3.1	2.5	1.8	7.0	3.0	0.4
Ficalbia metallica	0	0	0	0	0	0	0	0.7	0	0.1	0	0
Mansonia septempunctata	1.5	0.2	0.2	0.5	0.3	0.2	0.5	0.2	2.1	3.0	0.9	0.5
M. uniformis	0	0	0	0	0	0.1	0	0.1	0.2	0.5	0.1	0
Coquillettidia crassipes	6.3	0.4	1.1	2.6	3.0	4.1	3.9	6.6	16.3	20.3	38.9	9.7
Uranotaenia albescens	0.1	0	0.6	0.5	0.2	0.7	0.3	0	0.2	0.7	1.8	0.5
U. nivipes	0	0	0.1	0	0	0	0.1	0.2	0	0.2	0.6	0
U. sp. number 54	0	0	0.1	6.1	0.4	0.7	0.9	1.2	0.5	1.0	2.6	0.8
U. sp. number 66	0.9	1.5	0.4	0.1	0.1	0.1	0	0	0.4	0.3	0.4	0.6
U. sp. number 102	0	0	0	0	1.3	2.1	4.5	1.6	0.7	0.1	0.5	0
Hodgesia quasisanguinae	0	0	0	0.4	0.1	0	0	0.2	0.3	0	0.3	0
Aedes vigilax	0	0	0.2	0	0.1	0	0	1.2	0.1	0.4	0	0
Ae. kochi	0.5	0.3	1.5	1.4	0.8	1.6	2.0	2.5	2.1	1.5	1.0	0.3
Ae. notoscriptus	0.1	0.1	0.1	0	0.1	0	0.1	0.5	0.3	0.1	0.2	0
Ae. alboscutellatus	0.1	0	0.1	0.1	0.1	0.3	0.5	0.6	1.3	0.9	0.3	0.1
Ae. carmenti	0.4	0.2	0	0.1	0.2	0.3	0.7	2.9	2.2	0.7	0.6	0.2
Ae. funereus	0.1	0	0	0	0.2	0.1	0.4	1.3	4.0	1.7	1.5	0.4
Ae. lineatus	0.6	0.2	0.2	0	0.8	0.5	0.6	2.1	4.4	1.9	2.4	0.4
C. (*Lophoceraomyia*) sp.	0.4	0.1	0.5	0.6	0.5	0.8	1.6	2.6	3.1	2.3	1.0	0.1
C. annulata	0	0.1	0	0.8	0.5	0.2	0.2	0.6	0.9	1.2	0.5	0.1
C. pullus	0.6	0.3	1.3	0.7	0.8	0.9	0.2	1.3	1.0	3.4	2.5	0.3
C. annulirostris	1.4	0.4	1.3	0.4	1.3	1.8	0.4	1.0	4.2	3.2	2.3	1.8
C. bitaeniorhynchus	0	0	0.1	0	0	0	0.1	0.1	0.5	0.5	0.2	0.2
C. sitiens	0.1	0.1	0.5	0.1	0	0.3	0.3	0.5	1.0	1.5	1.7	1.7
C. squamosus	0	0	0.1	0.1	0	0.2	0	0.5	0.1	0.9	0.4	0.1
Rainfall in cm	6.1	1.1	6.6	1.1	32.5	6.5	16.5	71.2	46.5	85.4	19.4	85.6

*Mean (Williams 1937) of 16 light trap collections per month.

TABLE 2. Species composition of collections made in different habitats near Innisfail, 1963–1964.

	Light Trap				Chicken-baited Trap				
Species	Rain forest	Swamp forest	Mangrove forest	Farm land	Rain forest	Swamp forest	Mangrove forest	Farm land	No. collected
Bironella gracilia	0.1*	0	0	0	0	0	0	0	80
Anopheles bancroftii	1.2	0.3	0.1	0	0	0	0	0	330
An. farauti	2.8	1.7	0	0.5	0	0	0	0	1,075
Mansonia septempunctata	0.4	0.7	0.8	0.4	0.1	0.3	0.1	0.2	863
Coquillettidia crassipes	5.8	3.0	10.4	1.5	5.0	2.5	14.3	0.6	11,812
Uranotaenia albescens	0.3	0.1	0.1	0.3	0	0	0	0	227
U. nivipes	0	0.5	0	0.1	0	0	0	0	95
U. sp. number 54	1.6	0.3	0.5	0.2	0	0	0	0	866
U. sp. number 66	0.3	0.4	1.0	0.1	0	0	0	0	333
U. sp. number 102	1.1	0.2	0.7	0	0	0	0	0	776
Hodgesia quasisanguinae	0.1	0.1	0	0	0.1	0	0	0	114
Aedes vigilax	0	0	0.4	0.1	0	0	0.1	0	145
Ae. kochi	0.9	0.8	2.6	0.3	0	0	0	0	968
Ae. notoscriptus	0.1	0.2	0.2	0	0	0	0	0	83
Ae. alboscutellatus	0.6	0.1	0.2	0.1	0	0	0	0	198
Ae. carmenti	0.6	0.4	1.2	0.1	0	0	0	0	428
Ae. funereus	0.4	0.1	0.8	1.1	0	0	0	0	876
Ae. lineatus	0.5	0.1	1.3	0.7	0	0	0.1	0	884
Culex (*Lophoceraomyia*) sp.	1.0	0.6	0.8	0.3	1.8	0.7	11.9	0.6	4,995
C. annulata	0.6	0.4	0.2	0.1	0.1	0.2	0	0	304
C. pullus	0.4	0.5	0.2	1.0	0	0.1	0.1	0.1	876
C. annulirostris	0.6	0.5	0.7	1.4	0.2	0.1	0.4	0.6	1,395
C. bitaeniorhynchus	0	0.1	0	0.2	0	0	0	0	116
C. fatigans	0	0	0	0.2	0	0	0	0.3	199
C. sitiens	0.2	0.1	1.1	0.3	0.1	0	0.6	0.2	722
C. squamosus	0.1	0.1	0.1	0.2	0	0	0	0	105
Mean collection per trap night	20.3	9.5	25.1	9.8	7.5	4.1	27.9	2.8	
Number of collections	89	70	48	135	180	142	92	266	
Total female mosquitoes collected	5,198	2,563	4,217	5,426	3,292	1,271	5,623	1,907	

*Mean (Williams 1937) catch per trap night.

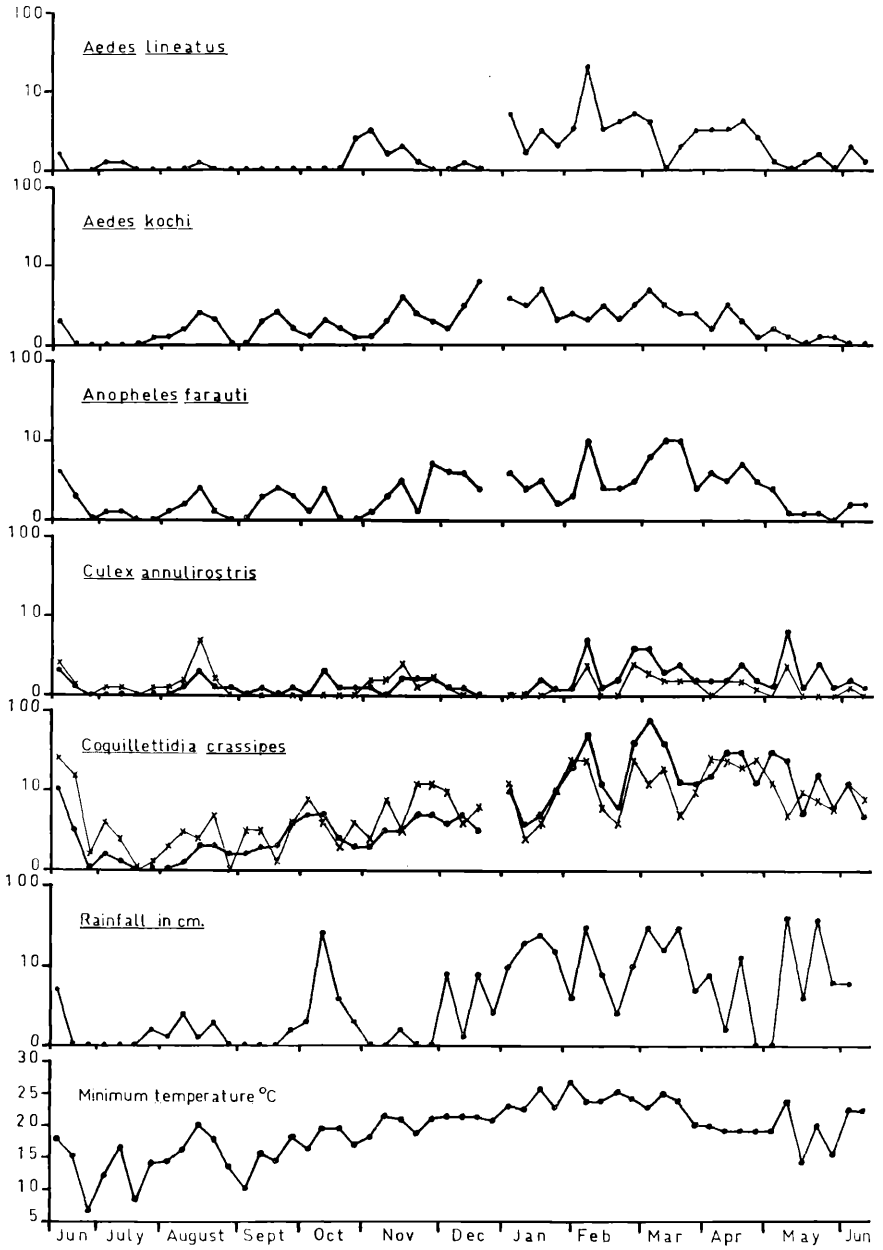

FIG. 2. Weekly means of light trap collections (heavy line), chicken-baited trap collections (light line), minimum temperature and rainfall, Innisfail, June 1963 to June 1964.

respectively. *Coquillettidia crassipes*, from which Wongal virus was isolated in the present study, was the most common mosquito in the collection (11,812) and was recorded at highest density in chicken-baited traps in forest sites. *Aedes aegypti* was collected in houses at a small coastal settlement at the mouth of the Johnstone River. Although the virus has not been isolated from this species in Australia it is regarded as the vector of dengue in previous epidemics (Doherty 1957).

Mass emergence of Uranotaenia sp. On 4 separate occasions (18 September and 27 November 1963, 14 January and 19 February 1964) light traps in rain forest returned high catches of male *Uranotaenia* (262, 680, 893 and 1308, respectively). Each occasion was approximately 4 weeks after heavy rain.

DISCUSSION

Zoogeography. Taylor (1916) noted the similarity between the Papuan and Innisfail mosquito fauna, and Gressitt (1961) regarded north Queensland as an area where the Papuan zoogeographic Subregion and Australian Region overlap. This opinion is supported by the present study. Thus, of the 56 published species taken, only 13 were

not listed in a recent checklist of the Papuan Subregion (Steffan 1966). Of the 13, 5 (*T. magnesianus*, *Ae. alocasicola*, *Ae. palmarum*, *Ae. quinquelineatus* and *Ae. spinosipes*) breed in axils or tree holes and have limited distributions in Australia where they are rarities; 7 (*An. stigmaticus*, *U. nivipes*, *U. pygmaea*, *Ae. lineatopennis*, *C. annulata*, *C. cairnsensis* and *C. starckeae*) are seldom taken in large numbers and are members of genera and sub-genera well represented in the Papuan Subregion; *Aedes lineatopennis* has a wide distribution in the Oriental and Ethiopian Regions. It is probable that some or all of these species will be recorded in New Guinea when the fauna there is more closely studied. It is relevant that the subgenus *Chaetocruiomyia*, formerly regarded as exclusively Australian, was recorded only recently in the Papuan Subregion (Marks 1965).

Habitat distribution. Before settlement the area studied was covered largely with wet tropical lowland rain forest (Webb 1966). Since settlement large areas have been cleared for the cultivation of sugar cane, leaving the natural vegetation undisturbed only in areas unsuitable for cultivation—*Melaleuca* shrub forest (swamp forest) in low-lying areas surrounded by cane fields, mesophyll vine forest (rain forest) as a fringe to the foot hills of the coastal ranges, and closed shrub woodland (mangrove forest) in the estuaries of tidal creeks, where high salinity is a barrier to agriculture. Rain forest, swamp forest and mangrove forest have been considered as a sequence indicating increasingly impeded drainage (Webb 1966). This sequence was associated in the present study with progressive restriction in number of species. All 38 species recorded from mangrove forest (with the single exception of *U. atra*) are included in the 43 species from swamp forest and all these are included in the 53 rain forest species. In contrast 8 species were found only in farm land (including the domestic *Ae. aegypti* and *C. fatigans*). Of 29 species recorded in all 4 habitats, 5, including the common *C. annulirostris* and *C. pullus*, were most common in farm land. Of the rain forest species not recorded in farm land collections 18 have specialized larval habitats restricting them to forested areas; the larval biology of 5 other species has not been recorded. It seems reasonable to suggest that components of the rain forest fauna unable to exploit the swamp and mangrove forest environment have been lost while other species fitted to the recently created open grassland environment have colonized cleared areas.

The presence of small numbers of the salt-marsh-breeding *Ae. vigilax* at all sites and at infrequent intervals is in keeping with its ability to travel long distances. No males were taken in light traps, indicating that trap sites were not close to breeding grounds. *An. farauti*, an important vector of malaria in New Guinea (Peters 1965) and the probable vector of malaria in previous epidemics in Australia (Mackerras 1947), was taken throughout the year with highest density in rain forest.

Seasonal abundance. In contrast to the situation studied at Mitchell River Mission (Standfast & Barrow 1968) mosquitoes would be expected to survive the "dry" season without problems at Innisfail, as the average rainfall for the period from June to December (96 cm) is such that ground pools are never completely dry. In keeping with this the observed seasonal variation in population at Innisfail was much less than recorded at Mitchell River, where some species could not be found during the dry season but reached high density during the wet.

Low minimum temperatures in June and July (FIG. 2) coincided with low mosquito catches, in accord with the known effects of temperature on flight and biting activity (Clements 1963).

Host preferences. The comparison of light trap and chicken-baited trap collections gave some indication of the host preferences of the species recorded. In general, anopheline mosquitoes were not attracted to chickens; this is in accord with results from Mitchell River (Standfast & Barrow 1968) and elsewhere in the world (Mattingly 1960). The recovery of blood-fed *Aedeomyia catasticta* from chicken-baited traps was of particular interest. This is the first indication of the host preference of this species from which a group B arbovirus has been isolated (Doherty et al. 1968a).

Arbovirus epidemiology. Doherty et al. (1968b) demonstrated arbovirus infections of mosquitoes and vertebrates at Innisfail but at a much lower level than previously reported at Mitchell River. It may be relevant that all but 3 of the mosquito species from which arbovirus strains have been successfully reisolated have been recorded at higher density at Mitchell River than at Innisfail (TABLE 3). *C. annulirostris*, the species from which most Australian virus strains have been isolated (Doherty et al. 1963a, 1968a), is a much more important component of the fauna at Mitchell River (25% of the total collection) than at Innisfail (4.7%). The reasons for this difference are not clear. It was thought possible that traps might by chance have been placed away from *C.annulirostris* breeding sites, but extensive trapping in the Innisfail district

TABLE 3. Mean light trap catch at Mitchell River and Innisfail, October and March.

Species	Mitchell River*		Innisfail	
	October	March	October	March
An. annulipes	1.4**	6.3	0	0
An. amictus	0.4	1.4	0	0
Coq. crassipes	0.9	2.4	3	20.3
Aedeomyia catasticta	1.0	0.2	0.1	0.1
Ae. normanensis	0.1	3.6	0	0
Ae. vigilax	0.3	2.3	0.1	0.4
C. annulirostris	5.0	4.4	1.3	3.2
C. bitaeniorhynchus	0.1	2.8	0	0.5
C. squamosus	0	0	0	0.9

*Figures for Mitchell River are for the years 1963, 1964, 1965 and 1966 (October) or 1963, 1965, 1966 and 1967 (March).

**All figures are mean (Williams 1937) catch per trap-night.

in areas thought to be suitable for this species failed to reveal any areas of high density. *C. annulirostris* is known to breed in ground pools, favoring transient pools in flooded grassland sites (Reeves et al. 1954; Laird 1956; Standfast unpublished). In high rainfall areas such as Innisfail ground pools abound but tend to be permanent. These areas are subject to frequent flushing and rapid growth of emergent grasses and support a large and varied fauna of predators and competitors. The larval biology of *C. annulirostris* is under study and will be the subject of a separate paper.

Conclusion. The results of the present study can be considered applicable only to the limited areas in Queensland with an annual rainfall in excess of 280 cm, where agriculture is in the main restricted to sugar cane production. The study must be considered incomplete in the absence of a detailed study of the forest canopy. No attempt was made to measure the degree of stratification of mosquitoes, and Doherty et al. (1968b) tested serum only from ground-dwelling vertebrates (with the exception of 2 genera, *Melomys* and *Uromys*, described by Harrison 1962b, as "middle zone mammals," and some limited tests of bird blood). It remains possible that viruses may be spread in the canopy; this aspect requires further study.

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APPENDIX

Species of mosquitoes collected at Innisfail:

Bironella (*Bironella*) *gracilis* Theobald, 1905. R, S[2]
Anopheles (*Anopheles*) *bancroftii* Giles, 1902. R, S, F, M
Anopheles (*Anopheles*) *pseudobarbirostris* Ludlow, 1902. R, S, M
Anopheles (*Anopheles*) *stigmaticus* Skuse, 1889. R
Anopheles (*Cellia*) *amictus* Edwards, 1921. F
Anopheles (*Cellia*) *annulipes* Walker, 1856. R, S, F, M
Anopheles (*Cellia*) *farauti* Laveran, 1902. R, S, F, M
Toxorhynchites (*Toxorhynchites*) *speciosus* (Skuse), 1889. F
Tripteroides (*Tripteroides*) *bimaculipes* (Theobald), 1905. R, S, F, M
Tripteroides (*Tripteroides*) *magnesianus* (Edwards), 1924. R, S, M
Tripteroides (*Tripteroides*) *quasiornatus* (Taylor), 1915. R
Tripteroides sp. no. 55. Marks, unpubl. R, S
Ficalbia (*Mimomyia*) *chamberlaini* issp. *metallica* (Leicester), 1908. R, S, M
Ficalbia (*Etorleptiomyia*) *elegans* (Taylor), 1914. R, F, M
Mansonia (*Mansonioides*) *septempunctata* Theobald, 1905. R, S, F, M
Mansonia (*Mansonioides*) *uniformis* (Theobald), 1901. R, S, F, M
Coquillettidia (*Coquillettidia*) *crassipes* (Van der Wulp), 1881.[3] R, S, F, M
Uranotaenia albescens Taylor, 1914. R, S, F, M
Uranotaenia argyrotarsis Leicester, 1908. R
Uranotaenia atra Theobald, 1905. M
Uranotaenia diagonalis Brug, 1934. R
Uranotaenia nivipes (Theobald), 1905. R, S, M
Uranotaenia pygmaea Theobald, 1901. R, S
Uranotaenia tibialis Taylor, 1919. R, S, F, M
Uranotaenia sp. no. 45. Marks, unpubl. R, S, M
Uranotaenia sp. no. 54. Marks, unpubl. R, S, F, M
Uranotaenia sp. no. 66. Marks, unpubl. R, S, F, M
Uranotaenia sp. no. 102. Marks, unpubl. R, S, F, M
Hodgesia quasisanguinae Leicester, 1908. R, S, M
Aedeomyia catasticta Knab, 1909. R, S, F, M
Aedes (*Mucidus*) *alternans* (Westwood), 1835. F
Aedes (*Mucidus*) *aurantius* (Theobald), 1907. R, M
Aedes (*Ochlerotatus*) *normanensis* (Taylor), 1915. F
Aedes (*Ochlerotatus*) *vigilax* (Skuse), 1889. R, S, F, M
Aedes (*Finlaya*) *alocasicola* Marks, 1947. R, S
Aedes (*Finlaya*) *kochi* (Donitz), 1901. R, S, F, M
Aedes (*Finlaya*) *notoscriptus* (Skuse), 1889. R, S, F, M
Aedes (*Finlaya*) *palmarum* Edwards, 1924. R
Aedes (*Finlaya*) *quinquelineatus* Edwards, 1922. R
Aedes (*Macleaya*) *littlechildi* Taylor, 1933. R, S
Aedes (*Macleaya*) *tremulus* (Theobald), 1903. R, S, M
Aedes (*Chaetocruiomyia*) *spinosipes* Edwards, 1922. R
Aedes (*Stegomyia*) *aegypti* (Linnaeus), 1762. F
Aedes (*Aedimorphus*) *alboscutellatus* (Theobald), 1905. R, S, F, M
Aedes (*Neomelanoconion*) *lineatopennis* (Ludlow), 1905. F
Aedes (*Verrallina*) *carmenti* Edwards, 1924. R, S, F, M
Aedes (*Verrallina*) *funereus* (Theobald), 1903. R, S, F, M
Aedes (*Verrallina*) *lineatus* (Taylor), 1914. R, S, F, M
Aedes (*Verrallina*) *similis* (Theobald), 1910. R, S, F, M
Culex (*Lutzia*) *halifaxii* Theobald, 1903. F
Culex (*Lophoceraomyia*) *annulata* Taylor, 1916. R, S, F, M
Culex (*Lophoceraomyia*) *cairnsensis* Taylor, 1919. R, S
Culex (*Lophoceraomyia*) sp.[4] R, S, F, M
Culex (*Culiciomyia*) *pullus* Theobald, 1905. R, S, F, M
Culex (*Culex*) *annulirostris* Skuse, 1889. R, S, F, M
Culex (*Culex*) *bitaeniorhynchus* Giles, 1901. R, S, F
Culex (*Culex*) *fatigans* Wiedemann, 1828. F
Culex (*Culex*) *mimulus* Edwards, 1915. R, S
Culex (*Culex*) *sitiens* Wiedemann, 1828. R, S, F, M
Culex (*Culex*) *squamosus* (Taylor), 1914. R, S, F, M
Culex (*Culex*) *starckeae* Stone and Knight, 1958. R, S, F, M
Culex (*Culex*) *vicinus* (Taylor), 1916. R, S, F

[2]R = Rain forest, S = Swamp forest, F = Farm land, M = Mangrove forest.

[3]Females of *Coq.* (*Coq.*) *crassipes* are difficult to separate from *Coq.* (*Coq.*) *xanthogaster*, but only *Coq. crassipes* males were collected.

[4]Males of 3 species were collected.