MOSQUITOES COLLECTED IN THE HOLLANDIA AREA, NETHERLANDS NEW GUINEA, WITH NOTES ON THE ECOLOGY OF LARVAE

BY

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Probably few areas occur in New Guinea where the mosquito fauna was investigated more thoroughly than in the Hollandia area. This is not in the last place due to the work done by American entomologists stationed there during the Pacific War, especially W. V. King and H. Hoogstraal have to be mentioned in this respect. The present author had an opportunity for further study during a three years stay in New Guinea.

The Hollandia area, as understood in this paper, is well defined by its natural borders. It comprises the area between the western shore of Humboldt Bay (north of Kotabaru Pantai) and the eastern shore of Tanahmerah Bay (east of Tablanusu). Its southern demarcation is formed by the depression between Tanahmerah Bay and Sentani Lake, the northern shore of the lake and the depression between Sentani Lake and Humboldt Bay (fig. 1). The area is very mountainous, comprising the entire Cyclops Mountains Range (highest peak, Mount Baboko, 2160 m). By far the greatest part of the area is covered with dense rain forest with a transition to mountain forest and moss forest in the Cyclops with increasing

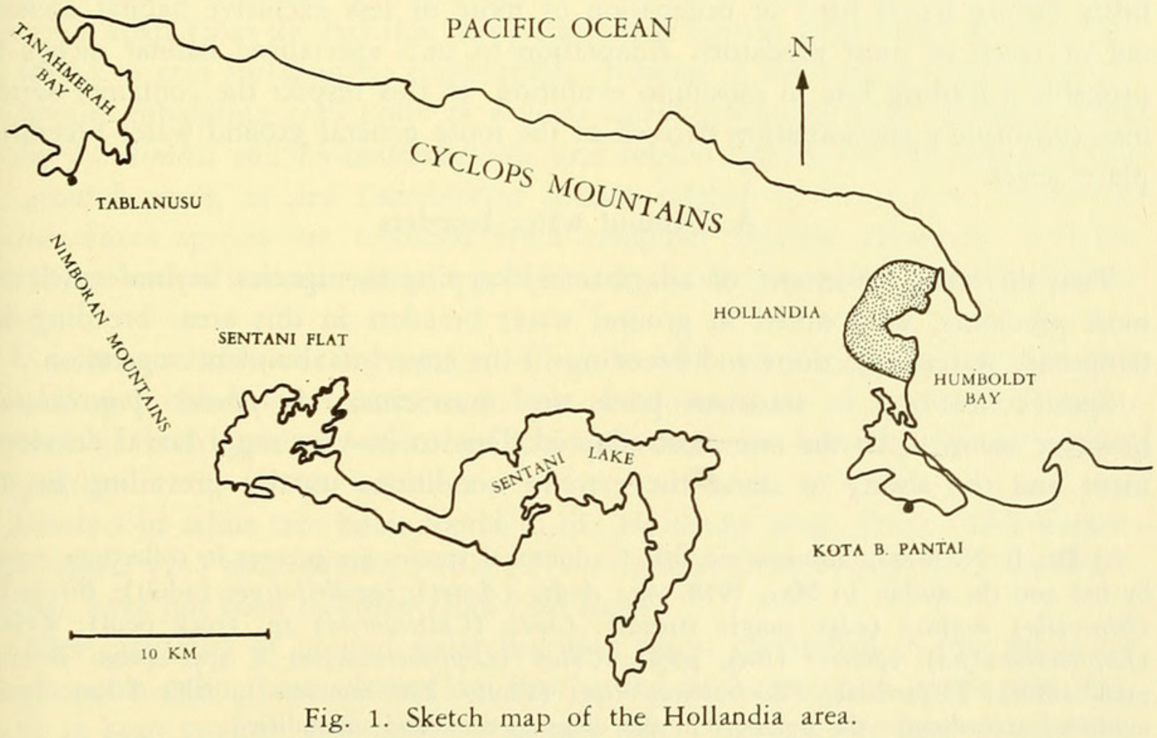

Fig. 1. Sketch map of the Hollandia area.

altitude. The Cyclops are uninhabited and rather difficult to access, due to the dense vegetation and the steep slopes; in places they rise almost perpendicularly from the Sentani flat, at the northern side they rise steeply from the Pacific Ocean. Mountain currents with rocky beds are very numerous. The mountain foothills between the ridge and Sentani Lake are largely deforested and covered with grasses, with a dominant *Pandanus* vegetation in wetter places, especially along drainage lines. An extensive sago swamp is situated in the Sentani flat at the northern shore of the lake and another between the lake and Humboldt Bay. A vegetation of mangroves borders the shallow southwestern part of this bay. The urban centre of Hollandia is situated along the western shore of Humboldt Bay, offering a scenery competing with the most beautiful ones in the world. A rural area with scattered farm houses is situated in the Sentani flat.

In all 111*) species of mosquitoes, divided over 13 genera, have been recorded from this area. The subgenera *Finlaya* and *Aedes* (genus *Aedes*) and *Rachisoura* (genus *Tripteroides*) account for the greatest diversity per subgenus, with 16, 12 and 13 species, respectively. *Finlaya* and *Rachisoura* are notably rich in species in other parts of New Guinea as well, especially in the Central Mountain range. In Table 1 the numbers of species recorded have been classed with the different subgenera to which they belong. The records of species dealt with below, have been arranged according to the two main types of larval habitats prevalent in the area:

A. Ground water breeders,
B. Container breeders.

Within both types several categories are described, some of which are easily defined by a characteristic species association — those which require a relatively high degree of specialisation by the occupying species — others, however, are delimited quite arbitrarily.

Mosquito larvae are very vulnerable to predators. Their only means of defence are specific evasive behaviour patterns (e.g., prolonged death feigning or immobility during larval life) or occupation of more or less exclusive habitat niches, out of reach of most predators. Adaptation to such specialised habitat niches is probably a leading line in mosquito evolution. In this respect the container series may constitute a specialisation derived of the more general ground water breeding place series.

A. Ground water breeders

Two different tendencies of adaptations, keeping the species beyond reach of most predators, were noted in ground water breeders in this area: breeding in temporary water collections and breeding in the cover of abundant vegetation.

Species breeding in transient pools are numerous; *Anopheles punctulatus* however seems to be the one most adapted. Due to its very rapid larval development and the ability to stand the extreme conditions usually prevailing in its

*) Dr. E. N. MARKS informs me that 7 additional species are present in collections made by her and the author in May, 1958, viz., *Aedes* (*Aedes*) *?quadrifolium* (adult); *Bironella* (*Bironella*) *confusa* (edge jungle stream); *Culex* (*Culiciomyia*) sp. (rock pool); *Culex* (*Lophoceraomyia*) *?petersi* (rock pool); *Culex* (*Lophoceraomyia*) 2 spp. (sago swamp pool, adult); *Tripteroides* (*Rachisoura*) *?leei* (adult). The numbers in table I have been modified accordingly; the numbers in the diagram remained unmodified.

breeding places open to full sunlight, this species is able to exploit ephemere water collections beyond reach of any aquatic predator in this area. Aquatic development may be as short as 7 days (Horsfall & Porter, 1946). Water temperatures in a breeding place were recorded to rise from 25° C in early morning to 42° C at noon. The pH of the water changed from 7.0 after a downpour to 8.9 a few days later.

Breeding in the cover of abundant vegetation was noted most clearly in two distinct associations of mosquito larvae: in the *Culex bitaeniorhynchus-Aedomyia* group and in *Mansonia-Ficalbia* species. The larvae of *Culex bitaeniorhynchus*, *C. squamosus*, *C. vicinus*, *C. whitmorei*, and *Aedomyia catasticta* were taken exclusively (with some exceptions of *C. whitmorei*) from dense clusters of green algae. Laird (1956) recorded the selective feeding habits of the larvae of the *bitaeniorhynchus*-group; they feed exclusively on these filamentous green algae. Besides, a well marked tracheation of the head, probably with a respiratory function, allows these species to stay submerged for relatively long periods.

The adaptations of the *Mansonia-Ficalbia* group go further still. In all *Mansonia* species and in *Ficalbia modesta* larvae a high degree of immobility is attained, due to peculiar modifications of the abdominal siphon, enabling them to pierce living vegetable tissue. The necessary oxygen supply is obtained by connection with an air cavity inside water-weeds of favorable kinds (in this area *Pistia stratiotes* and *Hydrocharis asiatica*). Regular excursions to the water surface for a breath of air do not occur; the larvae stay submerged continuously and lead an almost sessile life. This immobility is of distinct survival value in their eutrophic, natural environment, crowded with predators of many kinds (van den Assem, 1958a, 1958b).

A very specialised category of ground water breeding places (ground water containers!) are crab holes, in this area still imperfectly known. Laird (1956) treated them as saline derivates of small containers, because they constitute the favoured breeding places of *Aedes* (*Skusea*) in the Pacific. In the Hollandia area however, apart from the fact that many crab holes contain fresh water — they may be found in rain forest up to considerable altitudes in the Cyclops Mountains — no species inhabiting crab holes as well as small containers were recorded. Both *Aedes parasimilis* and *Uranotaenia atra*, and related species are common breeders in ground pools, as are *Culiciomyia* species related to *C. nailoni*. However, *Pseudoskusea* species are recorded from container habitats elsewhere. Colless (1957) records a common ground pool breeder from crab holes in the Singapore area.

It seems probable — and continued search will certainly throw light on this interesting problem — that the crab hole mosquito fauna is of a mixed origin, derived of both ground water breeders and container breeders by convergent adaptations.

Breeders in saline tree holes found in the Hollandia area, *Aedes* (*Sk.*) *dasyorrhus*, *Aedes* (*F.*) *notoscriptus*, *Aedes* (*F.*) *novalbitarsis* and *Aedes* (*S.*) *scutellaris* ?subsp. have not been recorded from crab holes.

Other categories of ground water breeding places mentioned in this paper are jungle pools (also those which flow slowly, and back waters of jungle streams), pools in sago swamps and putrid, stagnant water supplies, the latter most man-made in urban or rural areas. Sago pools may probably be defined by a rather distinct association of species but at present the delimitations of these categories are indicated very arbitrarily and await further investigation.

B. Container breeders

Rock crevices constitute a natural transition between ground water and container habitats. Mosquito representatives of both series may be found together here, most often in the larger crevices. Small rock holes, sometimes with contents not exceeding a few cc, are inhabited by proper container breeders only.

As stated above, the container habitat series seems to be derived from the more general ground water series. The number of potential predators in permanent or semipermanent collections is usually very large. The predator fauna of transient pools is mainly composed of water bugs, beetle larvae and many *Odonata* larvae; besides a mosquito larva with predatory habits, *Culex* (*Lutzia*) *halifaxi*, may be abundant, especially in the more temporary categories. *Culex halifaxi* invades occasionally containers of the larger type (holes in logs, drums, and rain-filled canoes). Only one predator species, *Toxorhynchites splendens*, a mosquito larva itself, is clearly adapted to container habitats*) in this area. It was collected by the present author from all containers except fallen leaves and plant axils, never from any ground water breeding place nor from large rock crevices. Drums, canoes and log holes may harbour both mosquito predator species. Still a third predator species occurs in this area, viz., *Aedes* (*Mucidus*) *aurantius*; biting females only were collected occasionally by the author. The larvae are recorded to inhabit transient pools.

While the risk of predation is considerably reduced, there is other drawback of container habitats, viz., the small contents which may easily cause overcrowding and starvation. Several mechanisms however seem to be in existence to cope with that. In a *Tripteroides bisquamata* population inhabiting *Nepenthes* pitchers, obvious preference by the egglaying females for very recently opened pitchers and cannibalism among the larvae may be such regulating mechanisms (VAN DEN ASSEM, 1959). Distribution of limited numbers of eggs per container (occurring, e.g., in *Toxorhynchites*), prolonged larval development and ability to survive through periods of food shortage may be other such mechanisms.

The fauna of log holes, tree holes and cut bamboos is notably rich in species, besides there are many species in common. Probably they represent the general and natural type of container habitat, though both tree holes and bamboos yielded some species not found elsewhere. The larval association *Aedes (*F.*) notoscriptus*, *Ae.* (*F.*) *novalbitarsis*, *Ae.* (*S.*) *albolineatus*, *Ae.* (*S.*) *scutellaris*, *Culex* (*N.*) *brevipalpis*, *Tripteroides* (*R.*) *vanleeuweni*, *Tr.* (*Tr.*) *bimaculipes*, *Uranotaenia nigerrima* and *Toxorhynchites splendens* may constitute the characteristic general container fauna of the area, at least in altitudes from sea level up to 500 m.

Artificial containers (drums, tins, canoes, coconut shells) have no species of their own, as may be expected; they are largely invaded by species of log holes,

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*) Large containers (e.g., drums, canoes, sometimes big tree holes) may be occupied by *Odonata* larvae and water bugs.

tree holes and crevices; besides, some groundwater breeders are found here, as is mentioned above.

Fallen leaves and fallen palm bracts do not seem to constitute a very specialised habitat niche in this area. Only one species was found breeding exclusively in this niche (*Aedes* (*F.*) *argenteitarsis*); other species are shared with bamboos, tree holes, log holes and crevices.

Two categories of highly specialised container habitats are represented by the small water collections remaining in the leaf axils of several plant species and by the fluid inside the pitchers of *Nepenthes mirabilis* and *Nepenthes* spec. Obviously, occupation of these niches requires a high degree of specialisation and the proportion of species inhabiting them exclusively is high. Characteristic breeders in *Nepenthes* pitchers are several *Tripteroides* species; exclusive axil breeders in this area are *Culex* (*Acallyntrum*) spp. in *Metroxylon* (sago), *Malaya leei* in *Colocasia* and *Alocasia* spp., *Aedes kochi* group spp. in *Colocasia, Pandanus, Crinum*-like plants and *Metroxylon* spp. There is an american record, however, of *Aedes wallacei* from fallen leaves.

It has to be borne in mind that a breeding place harbouring larvae of a certain species, has offered a favourable stimulus situation to the gravid females of that species at the moment of egg-laying; this stimulus situation in fact had to be present to release oviposition. Breeding places having many species in common may reflect some common stimulus situation. Figure 2 is an attempt to illustrate such interrelations as found in this area. In some species the stimulus situation releasing egg-laying may be rather simple and rather indifferentiated, thus leaving ample opportunity for choice; such a situation is supposed to be present in species with catholic breeding habits, as are *Culex fragilis* and *Culex pullus*. Other species, however, are obligatorily restricted to a single category, due to a highly specialised, innate scheme, releasing oviposition in an unique situation only. The *Tripteroides* species in *Nepenthes* or the *Culex* (*Acallyntrum*) species in *Metroxylon* probably are good examples of such mosquitoes.

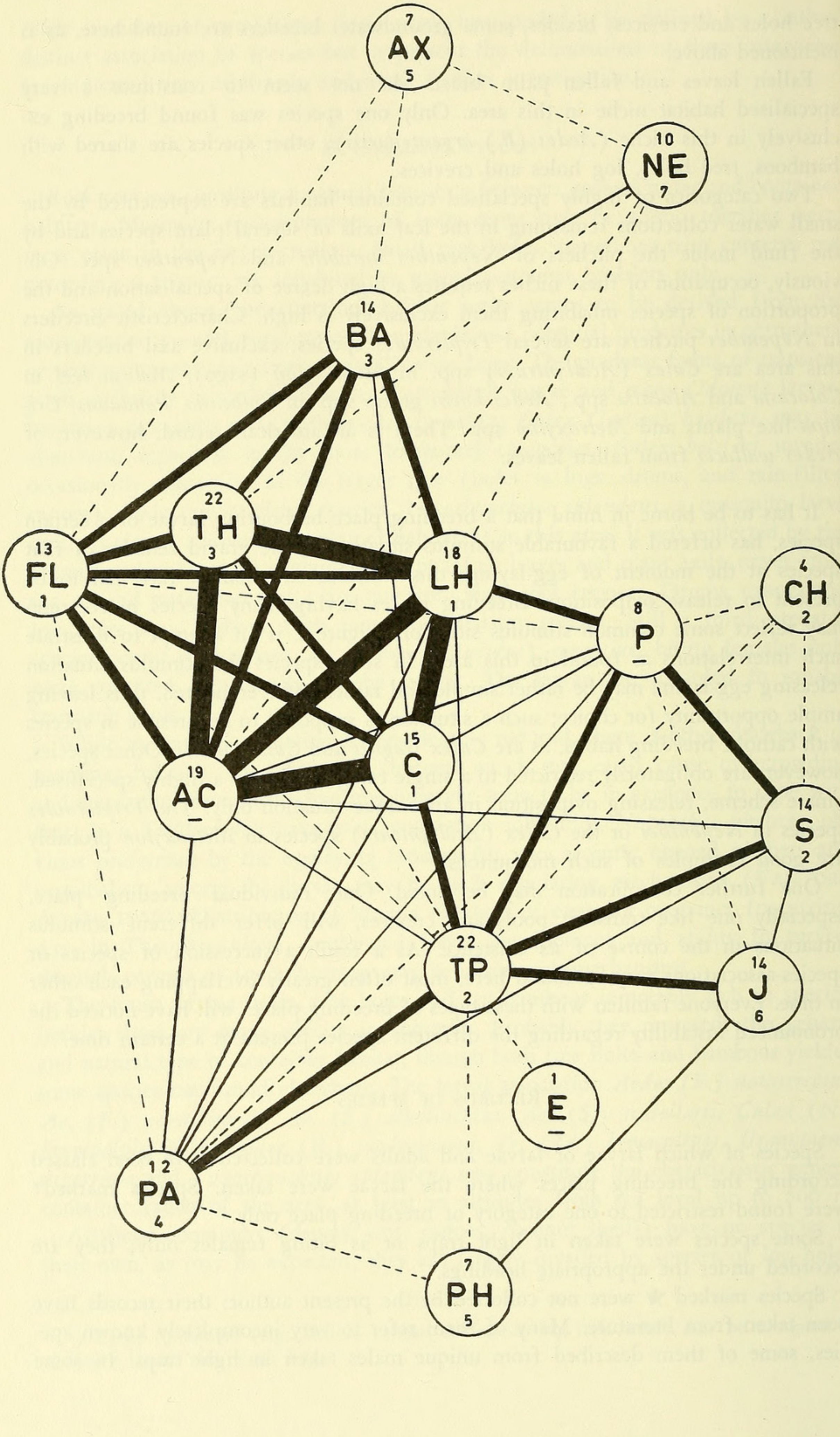
One further complication may be noted. One individual breeding place, especially one like transient pools and crevices, will offer different stimulus situations in the course of its existence. As a result a succession of species or species-associations may be found here, most often greatly overlapping each other in time. Everyone familiar with these types of breeding places will have noticed the pronounced instability regarding the different species present at a certain time.

Records of species

Species of which larvae or larvae and adults were collected have been classed according the breeding places where the larvae were taken. Species marked* were found restricted to one category of breeding place only.

Some species were taken in light traps or as biting females only; they are recorded under the appropriate headings.

Species marked ★ were not collected by the present author; their records have been taken from literature. Many of them refer to very incompletely known species, some of them described from unique males taken in light traps. In some


7 AX 5
10 NE 7
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22 TH 3
13 FL 1
18 LH 1
4 CH 2
8 P
15 C 1
19 AC
14 S 2
22 TP 2
14 J 6
1 E
12 PA 4
7 PH 5

species data on vertical distribution are indicated. Species without such indications were collected under 300 m; however, elsewhere in New Guinea they may be recorded from much higher altitudes.

A. Ground water series

a. Permanent pools with *Pistia-Hydrocharis* vegetation.
Anopheles (*Anopheles*) *bancrofti* Giles
Culex (*Lophoceraomyia*) *fraudatrix* Theo.
Ficalbia (*Ficalbia*) *minima* (Theo.) *
,, (*Mimomyia*) *chamberlaini* (Ludlow) *
,, ,, *modesta* K. & H. *
Mansonia (*Mansonioides*) *bonnewepsterae* v. d. Assem *
,, ,, *uniformis* (Theo.) *

b. Permanent or semipermanent water collections with green filamentous algae.
Aedomyia catasticta Knab *
Culex (*Culex*) *annulirostris* Skuse
,, ,, *bitaeniorhynchus* Giles *
,, ,, *mimulus* Edw.
,, ,, *squamosus* (Taylor)
,, ,, *vicinus* (Taylor) *
,, ,, *whitmorei* Giles
,, (*Culiciomyia*) *fragilis* Ludlow
,, ,, *pullus* (Theo.)
,, (*Lophoceraomyia*) *fraudatrix* Theo.
,, (*Lutzia*) *halifaxi* Theo.
Mansonia (*Coquilletidia*) *crassipes* (v. d. Wulp) *

c. Pools in sago swamps.
Aedes (*Aedes*) *carmenti* Edw.
,, ,, *lineatus* (Taylor)
Anopheles (*Cellia*) *farauti* Laveran
,, ,, *koliensis* Owen

Fig. 2. Diagram of interrelations of breeding places in the Hollandia area. The thickness of the connecting bands indicates the number of species in common: wide, 10 or more; half wide, 5—10; thin, 2, 3 or 4; broken, 1 species. No species were found in common between breeding places where connecting bands are lacking. Abbreviations used are: AC, artificial containers of relatively small size (e.g. tins, drums, beached canoes, coconut husks); AX, leaf axils; BA, broken or cut bamboos; C, crevices in rocks; CH, crab holes; E, ephemere water collections; FL, fallen leaves or bracts; J, jungle pools; LH, log holes; NE, *Nepenthes* pitchers; P, putrid, stagnant water collections; PA, permanent or semipermanent water with green filamentous algae; PH, permanent water with a *Pistia* — *Hydrocharis* vegetation; S, pools in sago swamps; TH, tree holes; TP, transient pools. The upper numerals indicate the total number of species collected from a breeding place category, the lower, the number of species restricted to one certain category.

Culex (*Culiciomyia*) *fragilis* Ludlow
„ „ *papuensis* (Taylor)
„ „ *pullus* (Theo.)
„ (*Lophoceraomyia*) *ornatus* (Theo.)
„ (*Lutzia*) *halifaxi* Theo.
Uranotaenia argyrotarsis Leicester
„ *atra* Theo.
„ *neotibialis* K. & H. *
„ *papua* Brug
„ *setosa* K. & H. (1946 a) *

d. Transient pools.
Aedes (*Aedes*) *parasimilis* K. & H.
„ (*Aedimorphus*) *alboscutellatus* (Theo.)
„ „ *imprimens* (Walker)
„ „ *vexans* Meigen
Anopheles (*Cellia*) *clowi* Rozeb. & Knight (1946) ★ *
„ „ *farauti* Laveran
„ „ *karwari* (James) *
„ „ *koliensis* Owen
„ „ *punctulatus* Dönitz
Culex (*Culex*) *annulirostris* Skuse
„ „ *bitaeniorhynchus* Giles[1])
„ „ *mimulus* Edw.
„ „ *sitiens* Wiedemann
„ „ *squamosus* (Taylor)[1])
„ „ *whitmorei* (Giles)
„ (*Culiciomyia*) *fragilis* Ludlow
„ „ *papuensis* (Taylor)
„ „ *pullus* (Theo.)
„ (*Lophoceraomyia*) *fraudatrix* Theo.
„ „ *ornatus* (Theo.)
„ (*Lutzia*) *halifaxi* Theo.
Uranotaenia argyrotarsis Leicester

e. Ephemere water collections.
Anopheles (*Cellia*) *punctulatus* Dönitz

f. Jungle pools.
Aedes (*Aedes*) *carmenti* Edw.
„ „ *lineatus* (Taylor)
„ „ *sentanius* K. & H. (1947 a) ★ *
„ (*Aedimorphus*) *alboscutellatus* (Theo.)
„ „ *imprimens* (Walker)
„ „ *vexans* Meigen

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[1]) In presence of filamentous green algae only.

Anopheles (*Anopheles*) *bancrofti* Giles
„ (*Cellia*) *longirostris* Brug *
Bironella bironelli Christophers (= *gracilis* Theo.)
„ *hollandi* Taylor *
„ *papuae* Swell. *
Culex (*Lophoceraomyia*) *fraudatrix* Theo.
„ (*Lutzia*) *halifaxi* Theo.
Hodgesia quasisanguinae Leicester *

g. Putrid water collections in stagnant gutters, septic tanks, etc.
Armigeres (*Armigeres*) *milnensis* Lee
Culex (*Culex*) *fatigans* Wiedemann
„ „ *sitiens* Wiedemann
„ (*Culiciomyia*) *fragilis* Ludlow
„ „ *papuensis* (Taylor).
„ „ *pullus* (Theo.)
„ (*Lutzia*) *halifaxi* Theo.
Uranotaenia atra Theo.

h. Crab holes.
Aedes (*Aedes*) *parasimilis* K. & H.
„ (*Pseudoskusea*) *lunulatus* K. & H. (1946 b) ★ *
Culex (*Culiciomyia*) *nailoni* K. & H. (1946 c) ★ *
Uranotaenia atra Theo.

B. Container series

a. Crevices in rocks.
Aedes (*Finlaya*) near *alticola* B.W. *, collected at 400 m altitude.
„ „ *dobodurus* K. & H.
„ „ *hollandius* K. & H.
„ „ *notoscriptus* (Skuse)
„ „ *novalbitarsis* K. & H.
„ „ *papuensis* (Taylor), from sea level up to at least 500 m.
„ „ *subalbitarsis* K. & H., from sea level up to at least 1000 m.
„ (*Stegomyia*) *scutellaris* (Walker)
Culex (*Culex*) *mimulus* Edw., from sealevel up to at least 500 m.
„ (*Culiciomyia*) *fragilis* Ludlow
„ „ *papuensis* (Taylor), from sea level up to at least 600 m.
„ „ *pullus* (Theo.)
„ (*Lophoceraomyia*) *marksae* K. & H., collected between 75 and 450 m.
„ (*Lutzia*) *halifaxi* Theo.
Uranotaenia nigerrima Taylor

b. Relatively small natural and artificial containers (coconut shells, drums, tins, canoes, etc.).

Aedes (*Finlaya*) *hollandius* K. & H.
,, ,, *notoscriptus* (Skuse)
,, ,, *novalbitarsis* K. & H.
,, ,, *papuensis* (Taylor)
,, (*Skusea*) *dasyorrhus* K. & H.
,, (*Stegomyia*) *scutellaris* (Walker)
Armigeres (*Armigeres*) *breinli* (Taylor)
,, ,, *milnensis* Lee
Culex (*Culex*) *fatigans* Wiedemann
,, ,, *mimulus* Edw.
,, ,, *sitiens* Wiedemann
,, (*Culiciomyia*) *papuensis* (Taylor)
,, ,, *pullus* (Theo.)
,, (*Lutzia*) *halifaxi* Theo.
Toxorhynchites splendens (Wiedemann)
Tripteroides (*Polylepidomyia*) *argenteiventris* (Theo.)
,, (*Rachisoura*) *confusa* Lee
,, (*Tripteroides*) *bimaculipes* (Theo.)
Uranotaenia nigerrima Taylor

c. Log holes.

Aedes (*Finlaya*) *hollandius* K. & H.
,, ,, *notoscriptus* (Skuse)
,, ,, *novalbitarsis* K. & H.
,, ,, *quasirubithorax* (Theo.) ★, quoted by KING & HOOGSTRAAL (1946 d).
,, ,, *subalbitarsis* K. & H.
,, (*Stegomyia*) *albolineatus* (Theo.)
,, ,, *scutellaris* (Walker)
Armigeres (*Armigeres*) *breinli* (Taylor)
,, ,, *milnensis* Lee
Culex (*Culiciomyia*) *fragilis* Ludlow
,, ,, *papuensis* (Taylor)
,, ,, *pullus* (Theo.)
,, (*Lophoceraomyia*) *kuhnsi* K. & H.
,, ,, *leei* K. & H. (1955) ★ *
,, (*Lutzia*) *halifaxi* Theo.
Toxorhynchites splendens (Wiedemann)
Tripteroides (*Tripteroides*) *quasiornata* (Taylor)
Uranotaenia nigerrima Taylor

d. Tree holes.

Aedes (*Finlaya*) *aureostriatus* (Doleschall) ★ *, quoted by KING & HOOGSTRAAL (1946 c).
,, ,, *candidoscutellum* Marks (1947) ★ *

,, ,, *hollandius* K. & H.
,, ,, *notoscriptus* (Skuse), up to at least 600 m.
,, ,, *novalbitarsis* K. & H.
,, ,, *papuensis* (Taylor)
,, ,, *plumiferus* K. & H. (1946 d) ★ *
,, ,, *quasirubithorax* (Theo.) ★, quoted by King & Hoogstraal (1946 d).
,, ,, *subalbitarsis* K. & H.
,, (*Skusea*) *dasyorrhus* K. & H.
,, (*Stegomyia*) *albolineatus* (Theo.), up to at least 600 m.
,, ,, *scutellaris* (Walker)
Culex (*Culiciomyia*) *papuensis* (Taylor)
,, (*Lophoceraomyia*) *kuhnsi* K. & H., collections up to 850 m.
,, *marksae* K. & H.
,, (*Neoculex*) *brevipalpis* (Giles)
Toxorhynchites splendens (Wiedemann), from sea level up to at least 600 m.
Tripteroides (*Polylepidomyia*) *argenteiventris* (Theo.), from sea level up to at least 600 m.
,, (*Rachisoura*) *confusa* Lee
,, (*Tripteroides*) *bimaculipes* (Theo.)
,, ,, *quasiornata* (Taylor)
Uranotaenia nigerrima Taylor, from sea level up to at least 600 m.

e. Bamboos.
Aedes (*Finlaya*) *gani* B.-W.
,, ,, *notoscriptus* (Skuse)
,, ,, *novalbitarsis* K. & H.
,, (*Leptosomatomyia*) *lateralis* (Theo.) *
,, (*Stegomyia*) *albolineatus* (Theo.)
,, ,, *scutellaris* (Walker)
Culex (*Neoculex*) *brevipalpis* (Giles)
Toxorhynchites splendens (Wiedemann)
Tripteroides (*Polylepidomyia*) *argenteiventris* (Theo.)
,, (*Rachisoura*) *bisquamata* Lee
,, ,, *longipalpata* Lee *, from sea level up to at least 450 m.
,, ,, *vanleeuweni* (Edw.) *, from sea level up to at least 450 m.
,, (*Tripteroides*) *bimaculipes* (Theo.)
Uranotaenia nigerrima Taylor

f. Fallen leaves and fallen palm bracts.
Aedes (*Finlaya*) *argenteitarsis* Brug *
,, ,, *dobodurus* K. & H., from sea level up to at least 700 m.
,, ,, *hollandius* K. & H., from sea level up to at least 1775 m.
,, ,, *notoscriptus* (Skuse)
,, ,, *novalbitarsis* K. & H., from sea level up to at least 1775 m.

Aedes (*Finlaya*) *wallacei* Edw.
,, (*Stegomyia*) *albolineatus* (Theo.)
,, ,, *scutellaris* (Walker)
Armigeres (*Armigeres*) *breinli* (Taylor)
,, ,, *milnensis* Lee
Culex (*Culiciomyia*) *pullus* (Theo.)
,, (*Lophoceraomyia*) *kuhnsi* K. & H.
Uranotaenia nigerrima Taylor

g. Nepenthes pitchers.
Aedes (*Finlaya*) *gani* B.-W.
Toxorhynchites splendens (Wiedemann)
Tripteroides (*Polylepidomyia*) *microlepis* (Edw.)[1]) * , collected above 1000 m.
,, (*Rachisoura*) *adentata* v. d. Assem *, collected at 450 m.
,, ,, *bisquamata* Lee, from sea level up to at least 500 m.
,, ,, *filipes* (Walker) *, from sea level up to at least 500 m.
,, ,, ?*fuliginosa* Lee *
,, ,, *kingi* Lee *, from 350 up to at least 1450 m.
,, ,, *pallida* Lee (1946) ★ *
,, ,, *pilosa* Lee (1946) ★ * , collected at 1250 m.

h. Leaf axils.
Aedes (*Finlaya*) *kochi* (Dönitz) *
,, ,, *wallacei* Edw.
Culex (*Acallyntrum*) *hicki* Stone & Penn *
,, ,, *binigrolineatus* Knight & Rozeb. (1945) *
Malaya leei Wharton *
Tripteroides (*Rachisoura*) *bisquamata* Lee
,, ,, *fuscipleura* Lee *

Biting females only

Aedes (*Finlaya*) *sophiae* Marks, manuscript name, collected at sea level and at 450 m.
,, (*Leptosomatomyia*) *variepictus* K. & H., above 800 m.
,, (*Mucidus*) *aurantius* Theo.
Mansonia (*Mansonioides*) *papuensis* (Taylor)
Tripteroides (*Polylepidomyia*) *atra* (Taylor), collected above 400 m.
,, (*Rachisoura*) *latisquama* (Edw.) ★, quoted by Lee (1946), collected at about 1400 m.
,, (?)*concinna* Lee (1946) ★, collected at 1400 m.

Collected in light traps only

Aedes (*Aedes*) *bifoliatus* K. & H. (1947a) ★ (male only)

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[1]) The present author collected this species in the Central Mountain Range only, at about 2000 m altitude.

Aedes (*Aedes*) *foliformis* K. & H. (1947 a) ★
„ „ *leilae* K. & H. 1947 c) ★ (male only)
„ „ *milnensis* K. & H. (1947 a) ★(male only)
„ „ *neomacrodixa* K. & H. (1947 a) ★
„ „ *simplus* K. & H. 1947 a) ★ (male only)
„ „ *trispinatus* K. & H. (1947 a) ★
Culex (*Culiciomyia*) *fuscicinctus* K. & H. (1946 c) ★ (male only)
„ (*Neoculex*) *pedicellus* K. & H. (1947 b) ★ (male only)
Ficalbia (*Etorleptiomyia*) *elegans* (Taylor)
Tripteroides (*Tripteroides*) *elegans* Brug ★, quoted by Lee (1946)
Uranotaenia fimbriata K. & H. (1946 a) ★ (male only)
„ *subtibioclada* K. & H. (1946 a) ★ (male only)

The cosmotropical species *Aedes* (*S.*) *aegypti* is absent from the Hollandia area.

Anopheles (*C.*) *karwari*, an oriental species which invaded this region long before the Pacific War, has distinctly decreased in numbers in recent times. Most probably this is due to the DDT house spraying campaign started in 1954; this provides another example of a not-indigenous species readily to be affected by an increase of the environmental pressure.

The most common, man biting species of the area, in places a pest due to their numbers, are *Anopheles koliensis*, *Aedes scutellaris*, *Culex annulirostris*, *Culex fatigans*, *Aedes carmenti*, *Aedes lineatus* and *Aedes parasimilis*, the three last mentioned especially in sago swamps and swampy forest. There occur very local pests of *Armigeres milnensis*. In mountain forest *Tripteroides argenteiventris* is an annoying biter. *Culex pullus* and *Culex fragilis* (not man-biting) are among the most abundant species of the area.

Table I

Numbers of species recorded from the Hollandia area, arranged according to subgenera to which they belong.

Genus	Subgenus	Number of species recorded
Aedes	*Aedes*	12
	Aedimorphus	3
	Finlaya	16
	Leptosomatomyia	2
	Mucidus	1
	Pseudoskusea	1
	Skusea	1
	Stegomyia	2
Aedomyia	*Aedomyia*	1
Anopheles	*Anopheles*	1
	Cellia	6
Armigeres	*Armigeres*	2
Bironella	*Bironella*	3
	Brugella	1
Culex	*Acallyntrum*	2
	Culex	8
	Culiciomyia	6

Genus	Subgenus	Number of species recorded
Culex	*Lophoceraomyia*	8
	Lutzia	1
	Neoculex	2
Ficalbia	*Etorleptiomyia*	1
	Ficalbia	1
	Mimomyia	2
Hodgesia	*Hodgesia*	1
Malaya	*Malaya*	1
Mansonia	*Coquilletidia*	1
	Mansonioides	3
Toxorhynchites	*Toxorhynchites*	1
Tripteroides	*Polylepidomyia*	3
	Rachisoura	13
	Tripteroides	3
	uncertain	1
Uranotaenia	*Uranotaenia*	8

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