

Purchased by United States Department
of Agriculture for Official use.

THE MOSQUITOS OF AITUTAKI, SOUTHERN COOK ISLANDS.

BY

MARSHALL LAIRD, M.Sc., Ph.D.

Reprinted from the BULLETIN OF ENTOMOLOGICAL RESEARCH, Vol. 45, Part 3,
September, 1954.

LONDON :
COMMONWEALTH INSTITUTE OF ENTOMOLOGY,
41, QUEEN'S GATE, S.W.7.

READING :
PRINTED BY THE EASTERN PRESS, LTD.

1954

THE MOSQUITOS OF AITUTAKI, SOUTHERN COOK ISLANDS.¹By MARSHALL LAIRD, M.Sc., Ph.D.²

(PLATE XXXV.)

The Cook Islands, dependencies of New Zealand, comprise two scattered groups bounded by the Latitudes of 8° and 23°S. and the Longitudes of 156° and 167°W. Aitutaki belongs to the Southern or Lower Cook Islands, and lies in Lat. 18°55'S., Long. 159°45'W. It is an atoll, the main island of which is of partly volcanic formation. Non-periodic filariasis occurs there, data gathered by Lambert (1926) indicating a microfilaria rate of approximately 50 per cent., while Davis (1949) found microfilariae in the blood of 102 of 240 subjects over nine years of age.

Only one species of mosquito, *Aedes* (*Stegomyia*) *polynesiensis* Marks (1951b) (= *A. pseudoscutellaris* (Theobald) in part) has previously been recorded from Aitutaki. This insect is the intermediate host for *Wuchereria bancrofti* in the Cook Islands (McKenzie, 1925; Davis, 1949).

Lambert (1926) worked in the southern part of the group from November 1925 until January 1926, and sent the mosquitos which he collected to Dr. F. M. Root at Johns Hopkins University. He found "*Stegomyia pseudoscutellaris*" to be especially prevalent, and thought that he "recognized most of the familiar forms of Fiji and Tonga" (Lambert, 1926). According to a letter from Dr. Root to Dr. Buxton (Buxton & Hopkins, 1927), however, Lambert collected only "*Aedes variegatus* var. *pseudoscutellaris*" at Aitutaki, while at Rarotonga he found this species and but two others, *Aedes* (*Stegomyia*) *argenteus* (Poiret) (= *A. aegypti* (L.)) and *Culex* (*Culex*) *fatigans* Wiedemann (= *C. pipiens fatigans* Wied.). Buxton & Hopkins thought it probable that an undetermined *Aedes* which McKenzie (1925) collected at Rarotonga was *Aedes* (*Aedimorphus*) *vezans* (Meigen); but no records of this species from the Cook Islands have since been published. Finally, Davis (1949) mentioned the occurrence of *Culex* (*Culex*) *annulirostris* Skuse in Rarotonga.

Marks' (1951a) synopsis of the mosquitos known from south-eastern Polynesia contains no information additional to that given above concerning the CULICIDAE of the Southern Cook Islands, and fails to note Davis' record of *C. annulirostris* from Rarotonga. The only other relevant data which I have been able to discover, concern the introduction of *Gambusia* into the Lower Group Islands (Anon., 1936, 1937).

Our knowledge of the mosquitos of the Cook Islands thus being virtually confined to Rarotonga, advantage was taken of a routine flight by an RNZAF aircraft to undertake a brief mosquito survey at Aitutaki. Collections were made throughout the main island of this atoll from 14th to 16th March 1953.

Results of the Survey.

A total of seventeen mosquito larval habitats of all kinds were investigated, with the results summarised in Table I.

¹ These studies form part of a project initiated by the Royal New Zealand Air Force and supported by a grant from the N.Z. Department of Scientific and Industrial Research. Their publication is authorised by the Chief of Air Staff, RNZAF.

² Medical Branch, RNZAF.

TABLE I.
Synopsis of larval records.

Species	Habitats	No. of times collected
<i>Aedes polynesiensis</i>	Petrol drums (3), coconut husk (1), rot-hole in tree (1), beached canoe (1), whaling try pot (1), truck tyre (1)	8
<i>Culex pipiens fatigans</i>	Steel tank containing water with masses of decomposing vegetation and other organic debris (1), beached canoe (1), petrol drum (1)	3
<i>Culex annulirostris</i>	Irrigation ditches between taro beds (5), borrow pits (2), swamp (1), beached canoe (1)	9

The following larval associations were noticed:—

A. polynesiensis, *C. pipiens fatigans* and *C. annulirostris* (once, in beached canoe);

A. polynesiensis and *C. pipiens fatigans* (once, in petrol drum).

A. polynesiensis was by far the most troublesome mosquito throughout Aitutaki at the time of my visit. Adults were collected while attempting to bite during the hours of daylight, both in areas of dense vegetation and inside houses at the villages. *C. annulirostris* was quite common at night from end to end of the island; while adult *C. pipiens fatigans* were never seen at all.

All five of the irrigation ditches in which *C. annulirostris* larvae were found supported various other aquatic insects. Species of significance as mosquito predators included the larval stages of the dragonflies *Pantala flavescens* (F.) and *Diplacodes bipunctata* (Brauer) and those of the damselfly *Ischnura a. aurora* (Brauer). These insects have all been recorded from Rarotonga (Liettinck, 1953). The only Hemiptera collected were water-striders, surface-feeders which are known to attack mosquitos on occasion (Hinman, 1934); two species were noticed, *Microvelia* sp. *oceanica* group, and a Gerrid, *Limnogonus* sp. or *Gerris* sp.

Two of the ditches supported *Gambusia* while the other three did not, although all five were otherwise closely comparable both physically and biologically. In those having top minnows, mosquito larvae were rare, being dipped only from the shelter of thick marginal clumps of emergent grasses. By contrast, up to 400 larvae per square foot of water surface were counted in the open parts of the ditches lacking these fishes. The value of *Gambusia* in controlling *C. annulirostris* at the atoll is thus self-evident. Top minnows were not, however, found in the breeding places of either of the other species of mosquitos. The larval habitats of *A. polynesiensis* and *C. pipiens fatigans* were, in fact, quite free from predators of any kind.

Discussion.

A much longer survey would have to be undertaken at Aitutaki before the non-occurrence of *Aedes aegypti* and *A. vexans* could be taken as established. An abundance of larval habitats suited to the requirements of both these species is certainly available there. Such "domestic" breeding places of *A. polynesiensis* as the 44-gallon drum illustrated in Plate XXXV, fig. 1, could undoubtedly harbour the aquatic stages of *A. aegypti*; while, in the South Pacific, populations of *C. annulirostris* and *A. vexans* often alternate with one another in the more temporary kinds of ground pools, explosive appearances of the latter species being correlated with season and rainfall (Buxton & Hopkins, 1927).

Davis (1949) thought it fairly certain that *A. polynesiensis* had reached the

Cook Islands before the arrival of Europeans, and suggested that the original introduction may have followed the carriage of larvae in the drinking-water containers used in the old Polynesian ocean-going canoes. It was of interest in this connection to find all three species of mosquito now known from Aitutaki represented in the larval collection from a beached canoe at Tekoutu (Pl. XXXV, fig. 2). The photograph shows how the islanders keep palm leaves over canoes not in use, the intention being to keep water out. In practice a certain amount of water always seeps through. Shade being provided by the leaves, the resulting infusion becomes an excellent larval habitat for certain mosquitos. Although the baling-out of the canoes before use removes many of the eggs, larvae and pupae, others remain. Adults may likewise stay aboard in the shelter of the bow- and stern-covers. Provided that the mosquitos concerned can withstand the effects of salt spray and of increased salinity in the bilge, the introduction potential is obvious. Buxton & Hopkins (1927), who demonstrated that the eggs of Samoan "*A. variegatus*" (= *A. polynesiensis*) are resistant to drying, were of the opinion that "the distribution of this mosquito . . . has been partly effected in canoes."

As regards the recording of *Culex pipiens fatigans*, Buxton & Hopkins brought forward evidence indicating that this species is a comparative newcomer to the South Pacific. A "domestic" mosquito well suited to survive and breed on board ships, *C. pipiens fatigans*, although apparently absent from Aitutaki at the time of Lambert's visit just over a quarter of a century ago, would not have lacked the means of reaching that island from Rarotonga.

Although there was no definite record of *C. annulirostris* from any of the islands east of Samoa when Buxton & Hopkins published the results of their researches, it is probable that the species was in fact then established among these islands. In 1934, E. C. Zimmerman of the Bernice P. Bishop Museum's Mangarevan Expedition collected *C. annulirostris* at Tahiti and Raiatea (Society Is.), Fakarava (Tuamotu Is.) and Rimatara (Austral I.) (Marks, 1951a). It is unlikely that the insect would have attained as wide a distribution as this in so short a period. Be that as it may, in view of the occurrence of this species in all suitable larval habitats at Aitutaki, and the fact that in the tropical Pacific in general, e.g., Samoa (Buxton & Hopkins, 1927), its larvae are to be found throughout the year, it is unlikely that Lambert would have overlooked it had it been present in the Southern Cook Islands by 1925-26.

It was stated in the Report of the Cook Islands Administration for 1935-36 (Anon., 1936) that *Gambusia* "were introduced into Rarotonga over eighteen months ago, and have been liberated in many places in Rarotonga and also in the Lower Group Islands. They have multiplied rapidly, and are assisting in bringing the mosquito pest under control." A year later (Anon., 1937) it was claimed that "the gambusia, or mosquito-eating fish, is multiplying rapidly throughout the Lower Group and is effective in reducing the mosquito pest, and will assist in preventing the spread of filariasis."

Now the three mosquitos known from the Group at the time of Lambert's visit (*A. aegypti*, *A. polynesiensis* and *C. pipiens fatigans*) utilise small collections of water in natural or artificial containers as larval habitats. Such places are quite unsuited to *Gambusia*, which flourishes in surface waters of various types. *A. polynesiensis* being the most significant (McKenzie, 1925) if not the only (Davis, 1949) vector of *Wuchereria* in the Cook Islands, it is hard to see how the introduction of *Gambusia* could have been expected to assist in preventing the transmission of filariasis in the Group. Unless *Aedes vexans* is in fact established in these islands—and in view of the entire absence of records of this species since the doubtful one in 1925, it is practically certain that this is not the case—the reduction of the mosquito pest claimed in 1936-37 is not referable to any species other than *C. annulirostris*.

It thus seems likely that *C. annulirostris* became established in the Southern Cook Islands during the decade 1925–1935. Like *C. pipiens fatigans*, this mosquito lends itself to accidental distribution through human agency. In 1929, for example, larvae were discovered in the hold of a ship which had arrived at Auckland, New Zealand, from Suva, Fiji (Graham, 1939). More recently, *C. annulirostris* adults, including a living female, have been collected on board aircraft following their arrival at Whenuapai Airport, Auckland, from Australia, Norfolk Island and Fiji (Laird, 1951). Pratique for the Group being granted at Rarotonga, one would imagine that that island would have been the first to be invaded. The introduction, by an inter-island vessel, might have been made either from Samoa or some other place to eastward or, at least in the latter stages of the decade in question, from the Society Islands.

C. annulirostris once having become established at Rarotonga, small vessels trading within the Cook Group could easily have distributed the species among the other islands. It is probably to be found at Mauke Island as well as at Aitutaki, for there is a statement from the Resident Agent at the former place that "the mosquito-eating fish (gambusia) introduced here last year have been liberated in all the fresh-water swamps on the Island and have increased by millions, and have greatly reduced the mosquito pest" (Anon., 1936).

Summary.

Aedes (Stegomyia) polynesiensis Marks, *Culex (Culex) pipiens fatigans* Wiedemann and *Culex annulirostris* Skuse were collected at Aitutaki, Southern Cook Islands, during a brief visit in 1953. Possible means of introduction of these mosquitos are discussed.

Acknowledgements.

The Resident Agent extended every courtesy, while transport and other assistance were provided by the representative of the N.Z. Civil Aviation Branch. The local Cook Islands Medical Practitioner, Teariki Matenga, helped with much of the collecting. I am indebted to Dr. M. A. Lieftinck, of Bogor, Indonesia, for identifying the Odonata, and to the Commonwealth Institute of Entomology for handling the Hemiptera.

References.

- ANON. (1936). Report of Cook Islands Administration, 1935–36.—N.Z. Parliam. Pap., no. 1-A.3., pp. 1–31.
- ANON. (1937). Report . . . 1936–37.—*Ibid.*, no. 1-A.3., pp. 1–28.
- BUXTON, P. A. & HOPKINS, G. H. E. (1927). Researches in Polynesia and Melanesia. Pts. I–IV.—Mem. Lond. Sch. Hyg. trop. Med., no. 1, 260 pp.
- DAVIS, T. R. A. (1949). Filariasis control in the Cook Islands.—N.Z. med. J., **48**, pp. 362–370.
- GRAHAM, D.H. (1939). Mosquito life in the Auckland District.—Trans. roy. Soc. N.Z., **69**, pp. 210–224.
- HINMAN, E. H. (1934). Predators of the Culicidae (Mosquitoes). I. The predators of larvae and pupae, exclusive of fish.—J. trop. Med. Hyg., **37**, pp. 129–134.
- LAIRD, M. (1951). Insects collected from aircraft arriving in New Zealand from abroad.—Zool. Pub. Vict. Univ. N.Z., no. 11, 30 pp.

- LAMBERT, S. M. (1926). Health survey of the Cook Islands, with special reference to hookworm disease. Appendix to Report of Cook Islands Administration.—N.Z. Parliam. Pap., no. 1-A.3., pp. 27-40.
- LIEFTINCK, M. A. (1953). Notes on some dragonflies (Odonata) of the Cook Islands.—Proc. Hawaii ent. Soc., **15**, pp. 45-49.
- McKENZIE, A. (1925). Observations on filariasis, yaws and intestinal helminthic infections in the Cook Islands with notes on the breeding habits of *Stegomyia pseudoscutellaris*.—Trans. R. Soc. trop. Med. Hyg., **19**, pp. 138-149.
- MARKS, E. N. (1951a). Mosquitoes from southeastern Polynesia.—Occ. Pap. Bishop Mus., **20**, pp. 123-130.
- MARKS, E. N. (1951b). The vector of filariasis in Polynesia: a change in nomenclature.—Ann. trop. Med. Parasit., **45**, pp. 137-140.
-



FIG. 1. Illustrating a method of obtaining rain-water commonly employed at Aitutaki. The corrugated iron sheet down which the water runs into the drum, provides a considerable degree of shade at the water surface. Water in the drum figured held many larvæ of *Aedes (Stegomyia) polynesiensis* Marks, and appeared suited to the needs of *A. ægypti*.



FIG. 2. Beached canoes at Tekoutu, Aitutaki. Water in the one in the foreground contained larvæ of all three species of mosquito now known from the Island. Note the longitudinally arranged coconut palm leaves which, by heavily shading the water surface, help to make the larval habitat an ideal one for such species as *A. polynesiensis*.