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BLOOD-SUCKING DIPTERA OF THE COCOS (KEELING) ISLANDS

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Abstract

Three species of mosquitoes, Aedes albopictus (Skuse), Culex sitiens Wiedemann and Culex quinquefasciatus Say, were collected on the Cocos (Keeling) Islands, Indian Ocean, in September 1980. Previous records of mosquitoes from these islands, their habits, breeding places, medical importance and possible control measures are discussed.

Introduction

The Cocos (Keeling) Islands (12°5'S, 96°53'E) lie in the Indian Ocean 1200 km SW of Sumatra and Java, 2768 km NW of Perth, Australia, and 2240 km SE of Colombo, Sri Lanka. The main atoll comprises some 20 islands (Fig. 1) which rise to a few metres above sea level from a volcanic seamount with its base at 5000 m. The islands form an almost continuous ring around a lagoon which is deepest in the north-east, and which has extensive sand and mudflats at low tide in the south and east. The limited soil is formed from coral rubble and cinder combined with finer sands and humus. The solitary atoll of North Keeling Island lies 24 km to the north.

The first recorded entomological collection was that of Darwin in 1836 (Darwin 1845). Forbes' 1879 collection was lost but he published notes on the insects present (Forbes 1885). Subsequently 2 important collections were made by Wood-Jones in 1905-6 (Wood-Jones 1909) and Gibson-Hill in 1941 (Gibson-Hill 1947, 1950a, b). When the QANTAS flight route from Australia to South Africa was being planned, the Department of Civil Aviation arranged for Mr. T. G. Campbell of the Division of Entomology, CSIRO to make a survey of insects of medical, veterinary and agricultural importance in 1952, which he repeated in 1964 (Campbell unpubl. data in Internal Reports of CSIRO, Division of Entomology, Canberra, 1952, 1966).

In 1980 (10-24 Sept.), M. D. Murray made a survey of potential vectors of viral diseases of livestock, as a quarantine station to enable the importation of disease-free livestock to Australia was under construction on West Island. The data on blood-sucking Diptera are reported here.

Methods

The techniques used, the islands sampled, and the number of collections containing relevant insects were:-

Light traps (CDC type with 12V, 21W globes): Horsburgh Island 2, West Island 21 of which 20 were from 2 light traps placed at different sites on 10 nights.

Truck traps (runs from dusk to dawn): 2, West Island.

Attracted to human bait (0800-2400 h): Direction Island 2, Horsburgh Island 1, South Island 1, and West Island 4.

Aspirated from resting site: 1, West Island.

Breeding places: Direction Island 2, Home Island 1, Horsburgh Island 2, South Island 1, and West Island 2.

Breeding sites were sought along the margins of fresh and brackish lakes, in temporary fresh, brackish and salt spray pools, in tree holes, in crab holes, in man-made containers, wells and drains, and in natural containers such as abandoned husks, damaged coconuts and leaf axils.

Results

Species found

No blood-sucking ceratopogonids, simulids, phlebotomines or tabanids were collected. A collection of 3836 mosquitoes comprised 3 species: Aedes albopictus (Skuse) (99), Culex sitiens Wiedemann (3735) and Culex quinquefasciatus Say (= fatigans Wiedemann) (2). Although no differences from the Australian race of Cx sitiens are apparent in the larva and male terminalia of specimens collected, the females differ in abdominal scaling, having the apical dark bands of the sterna usually completely interrupted by pale scales in the mid line, and the basal pale bands of the...
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\textit{Aedes albopictus} bit man during daylight and at night. It was particularly abundant near resting places, such as the dense undergrowth of "sea lettuce" (\textit{Scaevola sericea}), from which females emerged in droves to bite. Few were caught in light traps. Immature stages were found only in fresh water, in container situations—tree holes, man-made containers such as tanks and tins, and the axils of \textit{Crinum sp. (asiaticum?)}. It probably breeds also in the numerous abandoned husks and coconut trees damaged by rats, although no larvae or pupae were found in husks or in 30 fallen coconuts examined.

\textit{Culex sitiens} was abundant where vegetation was dense. It fed during the day and particularly at night when it was captured in large numbers in light traps. A few \textit{Cx sitiens} were caught in truck traps even though the wind averaged 28 kph. Invasions of Home Island were reported when winds blew from the NW. This suggests a considerab\textit{e} brackish lentic and regular raining. \textit{C. sitiens} breeds happened to inundate the atoll lagoon, and the extensive inundation and recreation of a permanent atoll lagoon.

\textit{Culex sitiens} becomes dominant in the present day ecosystem of the Cocos (Keeling) Islands.

\section*{Discussion}

The origin of \textit{Culex sitiens} in the Cocos (Keeling) Islands is a matter of speculation. It is known to have first been recorded in 1941 "The Mosquitoes of the Crinum Islands" by Cranston (1941). Cranston identified \textit{Culex sitiens} from Cocos (Keeling) Islands in 1941. The species has been confirmed in previous studies, including those by Gibson (1950a, 1950b), where it was found in Direction Island and Home Island, and Hill (1958a, 1958b), who documented the presence of the species on Home Island but were unable to confirm its presence on Direction Island. Since then, there have been further studies confirming the present survey data on the distribution of \textit{Culex sitiens} across the Cocos (Keeling) Islands.

Gibson (1954) refers to "\textit{Culex sitiens} is found in both Cocos and Direction Islands in abundance, particularly in the present-day ecosystem of the Cocos (Keeling) Islands."

Wood (1964) refers to "\textit{Culex sitiens} is found in both Cocos and Direction Islands in abundance, particularly in the present-day ecosystem of the Cocos (Keeling) Islands."

Belkin (1965) refers to "\textit{Culex sitiens} is found in both Cocos and Direction Islands in abundance, particularly in the present-day ecosystem of the Cocos (Keeling) Islands."
considerable movement of Cx sitiens throughout the atoll, and that the permanent brackish lake on Horsburgh Island is probably the main reservoir of breeding. The regular rains probably prevent this lake from drying out or becoming too saline. Cx sitiens bred in brackish and salty situations, and exploited temporary situations, as happened on West Island when a tidal surge broke through a levee bank earlier in 1980 to inundate the land behind. This land was dished with a surface impervious to drainage, and the pools persisted until nearly all the free water evaporated leaving an extensive incrustation of salt around water margins. Heavy rains filled the basin, and recreated a suitable brackish breeding site. Thus a cycle ensued which created a more permanent breeding site. Breeding was not found along the sheltered tidal margins of the atoll lagoon or in fresh water pools.

Culex quinquefasciatus (= fatigans) was caught in light traps on West Island at Trannies Beach, 6 km from permanent human residences.

Discussion

The only blood-sucking Diptera found were mosquitoes, 1 species of Aedes and 2 Culex. Neither Darwin in 1836 nor Forbes in 1879 noted mosquitoes on the Cocos (Keeling) Islands. Wood-Jones (1909) reported that in 1905-6 "The mosquito of the islands is a species of Stegomyia, and it exists in great numbers". This material was identified by E. E. Austen who would readily have identified Aedes Stegomyia aegypti (Linnaeus) and it is thus reasonable to deduce that the specimens were Ae albopictus, which was not then a well-known species. Gibson-Hill (1947) stated that in 1941 "The mosquitoes present were Culex pipiens, and two species of Stegomyia (Aedes)". He sent Diptera to the British Museum (Natural History) for identification; his other insect specimens and notes were lost during the 1939-45 War. Dr. P. S. Cranston (in letter to ENM, 14.vii.81) kindly checked the Museum's holdings of Ae albopictus, Ae aegypti, Cx quinquefasciatus and Cx sitiens, and could find no material from Cocos (Keeling) by any collector. Thus, none of these above statements can be confirmed.

Gibson-Hill (1947) stated that the Aedes bred in the coconut plantations either in abandoned husks or in subsurface pockets among the coral cinder, and were a pest on Direction Island where he lived. He recorded Ae albopictus on North Keeling (Gibson-Hill 1950a), Aedes a nuisance on Home Island, and concluded that, as Forbes could not have overlooked similar populations, the Aedes reached the atoll after 1879 (Gibson-Hill 1950b). According to Campbell (1952), Gibson-Hill, in unpubl. notes, mentioned the presence of Aedes aegypti, but, in personal discussion with Campbell in 1952, was unable to state with certainty whether he had taken both Ae aegypti and Ae albopictus. Since there is no confirmation that Ae aegypti occurs, or has occurred, on the atoll, we have disregarded this record. However, the methods of both Campbell's and the present survey might not have revealed low populations of Ae aegypti at the main settlement on Home Island. Both species are potential vectors of dengue fever.

Wood-Jones (1909) did not mention Culex spp., and Gibson-Hill (1947) only refers to "Culex pipiens" on Home Island (in the kampong), even though he visited all localities where Cx sitiens is now abundant. Campbell (1952, 1966) collected Cx sitiens in both 1952 and 1964. Two females of Cx sitiens were taken resting in the airport passenger lounge bathroom on West Island on 1.xii.1960 by E.N.M., who also identified as Cx sitiens a female collected by the Medical Officer and forwarded in May 1964 by E. J. Britten, W.A. Department of Health. Nowadays, this species becomes abundant whenever a suitable breeding site is created.

Belkin (1962) considered that Cx sitiens, as currently understood, is an extremely variable and widely distributed form which may actually be a complex of several species. It is recorded from many countries bordering the Indian Ocean, as well as from the Western Pacific. Because of the differences given above, the Cocos (Keeling) population is unlikely to have originated from Australia. Apparently Cx sitiens became established on the atoll between 1941 and 1952. Campbell (1966) commented that the extensive occupation of West and Horsburgh Islands by service personnel during the 1939-45 War, with resultant increased sea and air traffic, could well have
added more species to the insect fauna of the atoll. In 1943-44, a flying boat from Colombo, Sri Lanka, twice called at Cocos (Keeling) Islands (R. B. Tapp, pers. comm.), and in 1945 a Royal Air Force airstrip was constructed on West Island. Topographical changes due to construction of accommodation and airstrips have probably greatly increased breeding sites for Cx sitiens and contributed to its present abundance. Cx sitiens is not known to be a vector of disease agents.

Campbell returned in 1964 and found Cx quinquefasciatus on both Home and West Islands. He concluded this was the inevitable consequence of man's activities. Gibson-Hill's "Culex pipiens" was probably this species. The true incidence and distribution of Cx quinquefasciatus on the Cocos (Keeling) Islands requires clarification because of its wide association with human disease in Asia and the Pacific. It is undoubtedly more abundant than this survey indicated, particularly on Home Island where the Malays obtain water from family wells, and around the residences on West Island where septic tanks are installed.

On West Island the nuisance caused by mosquitoes is minimal around the administrative settlement on the edge of the airstrip, because the vegetation has been removed and a constant wind of ca 25 kph blows for much of the year. Careful management of coconut plantations to remove some of the undercut of shrubs and thus enable the trade winds to blow through the plantation, would do much to reduce the problem elsewhere on West Island. Temporary pools behind levee banks can be removed by filling and contouring the land. Although spraying with insecticides, as a temporary measure, would further reduce the problem caused by Cx sitiens, the isolation of the Cocos (Keeling) Islands favours programmes to test other methods of mosquito control.

The Cocos (Keeling) Islands are now a cross-roads for traffic from the Pacific and Indian Oceans, Asia and Australia. Quarantine precautions are taken and all aircraft are sprayed with insecticide on arrival, ships when insects are noticed. Even so, it is desirable that the vigilance maintained should include regular surveys for insect vectors and serological monitoring of residents. Recent experiences in the Pacific region have shown how extensively and rapidly arboviruses such as dengue and Ross River virus can spread and cause disease (Austin and Maguire 1982, Rosen 1982).

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References


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