U.S.Bureau of medicine and surgery.Malaria and epidemic disease control(South Pacific area)
Tropical breeding and resting places of Anopheles punctulatus moluccensis in South Pacific.

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TYPICAL BREEDING AND RESTING PLACES OF ANOPHELES PUNCTULATUS MOLUCCENSIS IN THE SOUTH PACIFIC

Allied Forces, South Pacific Area

Prepared by
Malaria and Epidemic Disease Control
South Pacific Area

April, 1944

(RESTRICTED)

As a visual aid in the instruction of personnel in Malaria Control this manual is designed to illustrate the typical breeding and resting places of the important malaria vector in the South Pacific Area.

The information in this manual is not to be communicated either directly or indirectly to the press, nor to any person not in the Armed Forces (Allied).

W.J.P.

Dry season breeding places for moluccensis in the New Hebrides-Solomons area consists primarily of rivers, streams, springs, seepage areas, ponds, taro gardens, swamps, and occasional open wells located near native plantations.

During the rainy season, breeding may occur in almost all the additional water collections which form. At this time larvae may be found in all types of natural and man-made puddles, such as ruts, foxholes, bases of uprooted trees, borrow pits, poorly graded ditches and in such places as hog wallows and in the coral above high tide mark. Rather commonly too, larvae will be discovered in such artificial containers as large tin cans, open gasoline drums, watering troughs, tubs and occasionally in beached boats. The water in all of the above mentioned types of wet season breeding places may be clear, turbid, somewhat stagnant, brackish, or pure rain water; and there may or may not be water plants present. In almost all cases, breeding in extensive water areas is associated with flotage or emergent materials. However, in small confined places such as pools, puddles and road ruts, larvae will commonly be found on the open surface.

Figure 1. HOOF PRINTS.

Hoof prints and tracks made by cattle, hogs and horses which roam throughout the native plantations and jungle areas produce moluccensis in large numbers.

Figure 2. ROAD RUTS.

This site is a classical example of "man-made" malaria in the South Pacific. As long as the jungle areas remain undisturbed, moluccensis will rarely be found.

Figure 3. STREAMS.

Stream margins with collected bits of debris, logs, fallen branches and leaves provide effective protection for larvae along stream margins.

Figure 4. STREAMS WITH EMERGENT VEGETATION.

Along these typical jungle streams, natives frequently plant water-cress for food, and it is among such vegetation that moluccensis can frequently be found. The association of moluccensis larvae with water plants leads one to believe that sunlight is necessary for larval development. With rare exceptions this is usually the rule.

Figure 5. RIVER MARGINS.

Similar to situations encountered in stream breeding, moluccensis finds adequate protection along the river margins among collected bits of leaves, twigs and flotage.

Figure 6. RIVER MARGINS WITH ALGAL GROWTH.

Anopheline larvae are found in large numbers along river margins among algal mats. This is particularly true in the dry season when the stream is not subject to fluctuation.

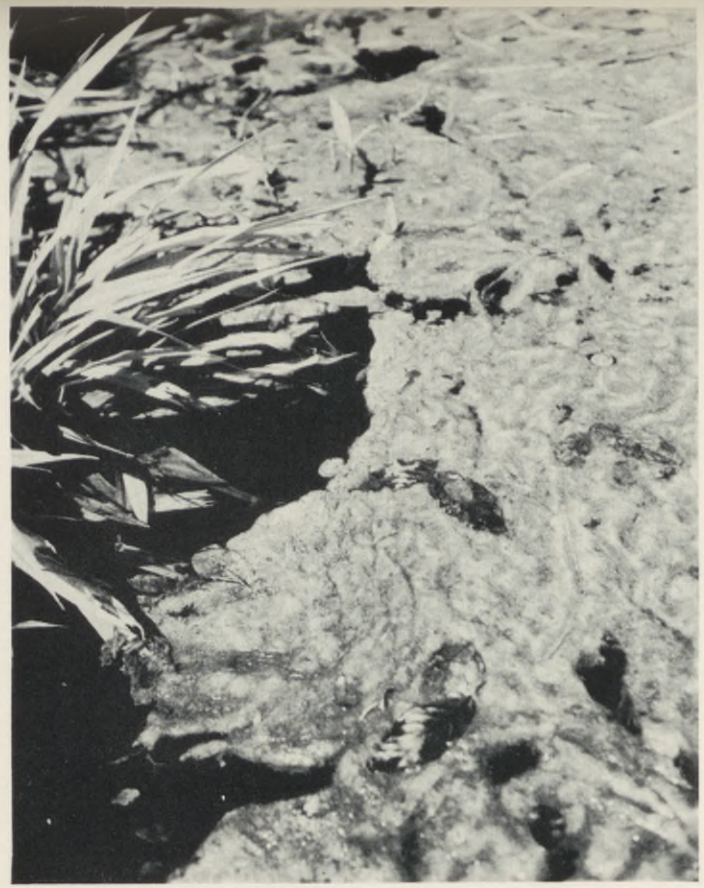

Figure 7. CLOSE UP OF ALGAL MATS.

Anopheline larvae are found in the interstices of the algal mats, and also are taken by running the dipper along the margins or gently skimming the mat surface.

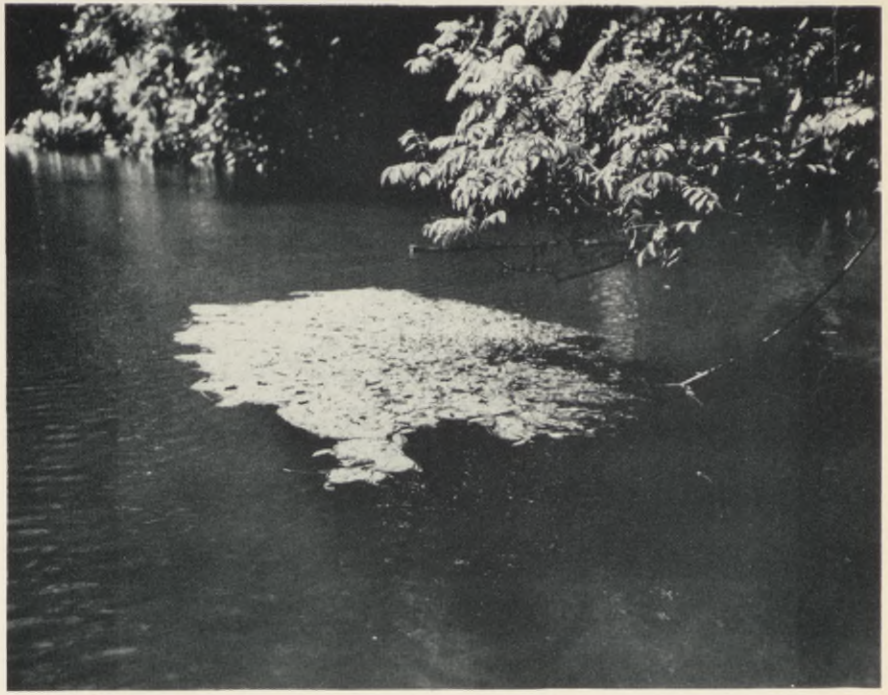

Figure 8. FLOATING ALGAL MAT IN MID-STREAM.

Among these mats, where the water is unaffected by currents and winds, collections of moluccensis can easily be made. When the stream is subject to extreme fluctuations, especially during the rainy season, these mats are of no importance for they are usually washed free during the first floods.

Figure 9. ALGAL MATS.

Algal mats supporting growths of water-cress soon lend themselves to efficient protection for anopheline larvae against aquatic enemies, wind and currents.

Figure 10. ANCHORED MATS.

Trailing vines and roots provide anchorage for algae and other detritus, which results in the formation of ideal breeding sites in rivers and occasionally in large streams.

Figure 11. SEEPAGE AREAS AND SPRINGS.

The topography of the islands of the Solomons group lends itself well to the breeding of anophelines in such springs and seepage pits.

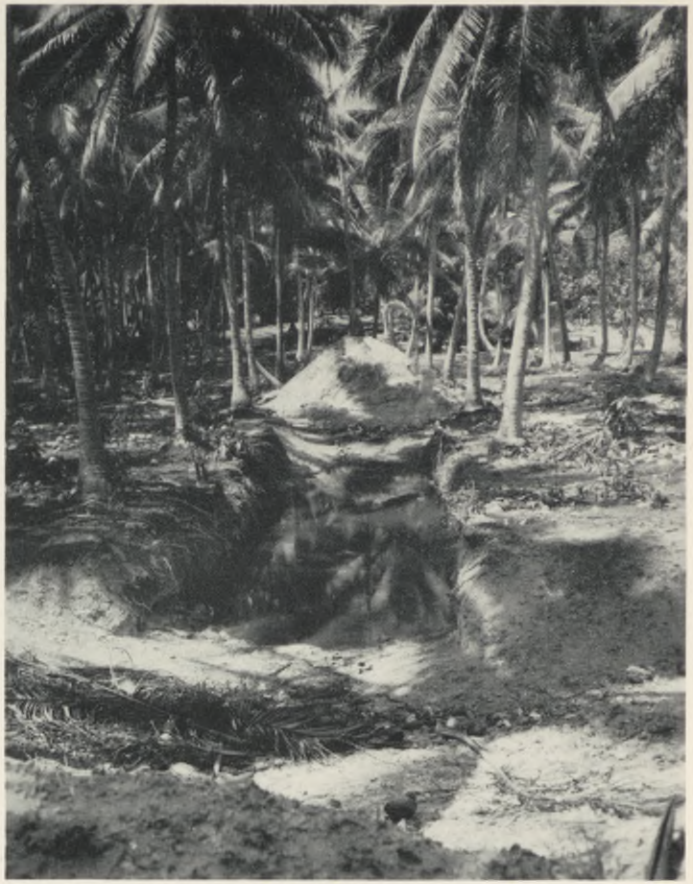

Figure 12. BORROW PITS.

These occur quite frequently throughout all of the South Pacific Islands, wherever man has established campsites or has merely "borrowed" coral for road construction. They soon become permanent water catchments and, with an accumulation of coconut fronds and debris, provide breeding areas for moluccensis.

Figure 13. CORAL PITS.

Throughout all of the islands of the New Hebrides-Solomons group, roads are primarily surfaced with coral dug from such pits as those illustrated in figures 12, 13 and 14. Usually no outlet for drainage is provided, and with continued rains, such sites.....

Figure 14. CORAL PITS.

.....eventually become favorite breeding places for the sun-loving moluccensis.

Figure 15. ROADSIDE DITCHES.

In many instances roads are constructed from coral dug along either side. In such instances, these improperly graded "ditches" provide ideal breeding sites. Larvae are commonly found on the open surface. Miles of such ditches have warranted the use of power-driven sprayers throughout all the South Pacific.

Figure 16. ROADSIDE POOLS.

Where no drainage ditches are constructed along the coral roads, roadside pools become ideal breeding spots. Under such conditions, in these confined places, larvae will commonly be found along the margins and upon the open water surface in large numbers.

Figure 17. PONDS.

Ponds supporting plant growth such as lodged mats of Lemma, algae, and other vegetation provide ideal spots for anophelines.

Figure 18. OPEN OIL DRUMS.

In instances where dirt and debris have collected to form a mud bottom, anopheline larvae are frequently taken in such artificial containers. They have been taken readily in wooden Japanese tubs found commonly at Munda, Kolombangara and other islands once occupied by these forces.

Figure 19. UPRIGHT OIL DRUMS.

In areas where there still is a promiscuous dumping of oil drums, collections of water within the rims will support anopheline breeding. This site is a favorite place for the breeding of pest mosquitoes. In fuel dumps where coral roads have not been laid, miles of road ruts running throughout the jungle and coconut groves soon become prolific breeding places of moluccensis.

Figure 20. OPEN FOX HOLES AND SLIT TRENCHES

During the rainy season such man-made breeding sites are ideal for anopheline production. In areas where these are no longer being used, they soon become partially covered with plant growth and may be overlooked in survey work.

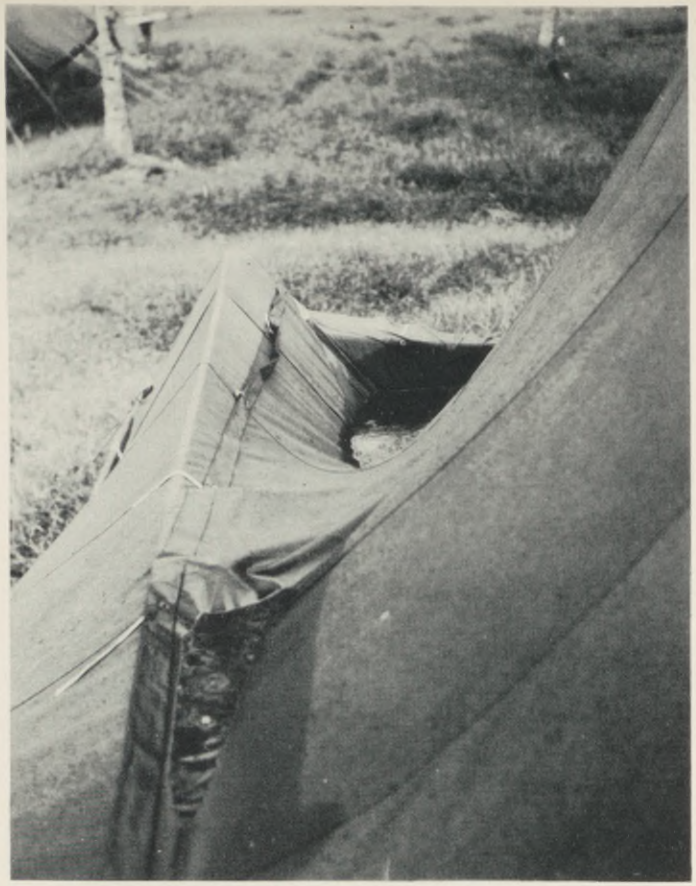

Figure 21. TENT FLAPS.

Carelessly rigged tents will provide excellent sites for culicines, especially Aedes scutellaris subsp., which are very common in this area. Anophelines have never been taken under such conditions.

Figure 22. TARPAULINS.

In carelessly laid "tarps" (which are used very frequently in the South Pacific) or in abandoned campsites where the canvas tents have fallen down, anophelines are rarely taken. However, here again, pest mosquitoes thrive under such conditions.

Figure 23. TIN CANS.

Anopheline larvae are practically never taken in such artificial containers. Rare ones have been taken and reported from Guadalcanal and Espiritu Santo, especially during periods of heavy rains.

Figure 24. AXILS OF THE SAGO PALM.

Anopheline larvae are never taken in such sites. Although each axil will hold as much as a quart of water, no anophelines have been recorded to date. This spot again is a favorite haunt of pest mosquitoes.

Figure 25. RAT GNAWED CACAO PODS.

Anopheline larvae are never taken in such sites, although these pods will hold enough water to support scutellaris breeding.

Figure 26. PANDANUS TREES.

Anopheline larvae are never taken in the axils of these trees, although several species of Aedes have been taken from the water collected in the axils. These trees are especially abundant along the seacoast, and consequently the axils collect much water from rain, mist and ocean spray.

Figure 27. AXILS OF THE BANANA TREE.

Anopheline larvae are never taken here or in the axils of the taro plant illustrated in figure 28. Absence of breeding may be due to the confinement factor co-incident with oviposition. A.....

Figure 28. TARO PLANT.

.....few species of culicine mosquitoes have been taken under such conditions.

Figure 29. TREE HOLES.

Anopheline larvae are rarely ever taken in tree holes. An occasional one has been reported from Guadalcanal and Espiritu Santo. Their absence here may be due to high concentrations of decayed organic matter. Such tree holes, and pockets formed by folds in the trunks of trees, produce.....

Figure 30. WATER HELD IN THE FOLDS OF FELLED TREES.

.....large numbers of pest mosquitoes.

Figure 31. HALVED COCONUT SHELLS.

Anopheline larvae are rarely taken in halved coconut shells. The absence of breeding here may be due to the high content of such organic compounds as dissolved tannins, vegetable oils, etc. However, during periods of frequent rains, coconut shell halves may support anopheline breeding since they flush frequently, maintaining relatively pure water.

Figure 32. OPEN RIVER SURFACES.

Open water surfaces are constantly moving and fluctuating and, unobstructed, hardly ever produce anopheline larvae. This is particularly true during the rainy season when such bodies of water are subject to heavy flooding.

DAYTIME RESTING PLACES OF ADULTS

The daytime resting places for males and unfed females apparently consist of nearly any cool, moist and shaded spot. Although the exact microclimatic specifications for the daytime resting places of adults are still quite unknown, some observations are available upon the subject.

Resting blooded females may be collected at will in houses and native huts, the sites selected being generally dark and somewhat secluded, such as in the folds of clothing and mosquito nets; on the under surfaces of furniture, rafters and hanging objects; and upon walls and low ceilings. This species readily enters any type of shelter in search of human blood, and consequently the native hut has proven the most effective spot for adult night catches in this area.

Figure 33. NATIVE HUTS.

This is the only reliable type of resting place yet discovered for moluccensis. Bed nets of personnel sleeping near breeding sites have been used to good advantage when making night catches.

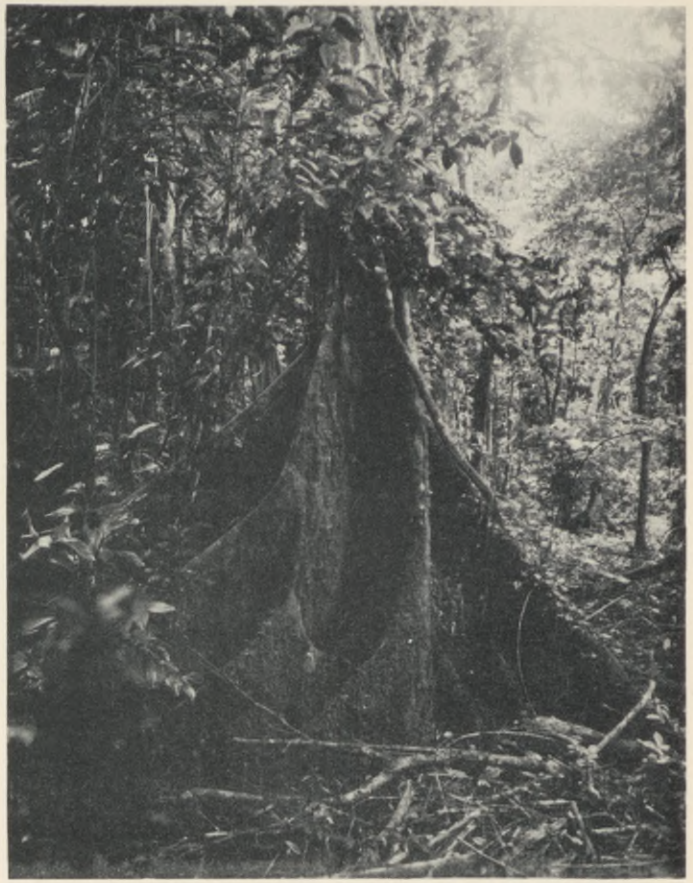

Figure 34. TREE BUTTRESSES.

Occasionally taken in these cool, dark, protected sites. This is a favorite collecting place for Anopheles punctulatus punctulatus in certain areas on Guadalcanal, where the adults are found resting in large numbers one half to three feet from the water surface.

Figure 35. SUNKEN OIL DRUMS.

When these containers are well protected by overhead vegetation, they provide efficient temporary resting places for moluccensis.

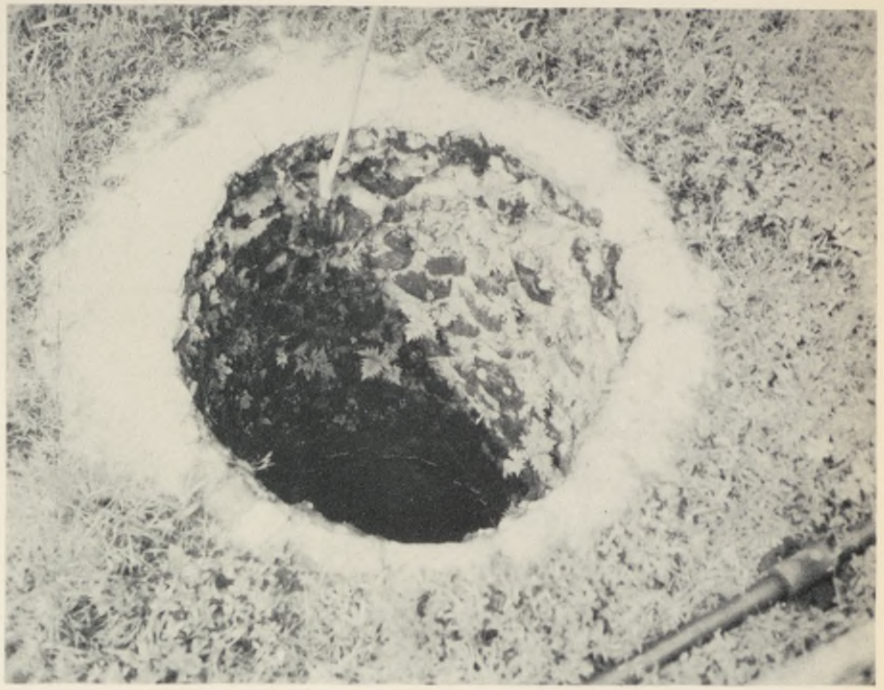

Figure 36. OPEN NATIVE WELLS.

Deep open wells, that are protected from the heat of the day, frequently harbour adult anophelines. These native wells also may be the only source of anopheline breeding, particularly around native villages; consequently such sites should be checked carefully.