

A SURVEY OF THE MOSQUITO FAUNA OF THE SOUTHERN PARTS OF WESTERN AUSTRALIA.

By

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In a previous report (Hodgkin and Britten, 1955), mosquitoes encountered during a survey of the tropical or northern parts of the State were described. At the instigation and under the general direction of Dr. D. J. R. Snow, Director of Epidemiology, a survey covering the remainder of Western Australia has now been carried out and the results are described in the present report. The essential purpose was to determine the species of mosquitoes present and their distribution, with special reference to those capable of transmitting disease.

The territory under investigation was divided into eight zones, and each zone was surveyed separately. In addition, special supplementary surveys were undertaken in the vicinity of Onslow and in the Leonora area because of unseasonal heavy rains; and the opportunity was seized while returning overland from leave in the Eastern States to collect specimens along the Eyre Highway.

As many sites as possible within each zone were visited, and larval specimens were collected from a wide variety of locations including rivers, billabongs, swamps, rock-holes, road-side pools, drains, and rain-water tanks. While attention was concentrated on larvae, adult mosquitoes were caught whenever seen to be attacking, and at other times when found resting in the vicinity of obvious breeding places.

Wherever doubt existed as to the identity of particular larvae, attempts were made to breed out adults. A number of such specimens, including some not adequately described in available literature, were referred for final identification to Dr. E. P. Hodgkin, Mr. D. J. Lee, or Dr. E. N. Marks.

ZONE 1. GERALDTON-NORTHAMPTON-MORAWA: APRIL and MAY, 1955

The only anopheline mosquito identified was *A. annulipes*. It was by far the most prevalent of all the mosquito species seen and occurred more or less throughout the area. Larvae were found breeding in a wide range of locations which included small muddy pools, roadside potholes, slow moving brackish water in creeks, clear water in the upper reaches of the Irwin River, large open expanses of shallow water with reeds.

Nine other species were collected in the zone. They included *Aedes tremula*, *Aedes alboannulatus*, *Aedes sagax*, *Aedes camptorhynchus*, *Aedes occidentalis*, *Culex fatigans*, *Culex pipiens australicus*, *Culex annulirostris*, and *Culex fraudatrix*?

Adult *A. tremula* were caught at a dam in company with *A. alboannulatus*, and specimens of the latter species were bred out from pupae taken at the same location. Larvae of *A. sagax* were found in muddy salt water thirty miles from Geraldton, and in turbid fresh water at a railway culvert and a creek near Mullewa. Larvae of *A. camptorhynchus* were recovered from dark stagnant water in the Greenough River bed and from small open salty pools in the vicinity where they were in great abundance. They were also found in roadside drains not far from Geraldton and Mullewa.

A. alboannulatus group were widely prevalent. Larvae were found in a muddy pool at Winchester, in open water in the Irwin area, and in widespread shallow water overlying a cane grass flat near Nabawa. Near Northampton these larvae were recovered from pools in a creek bed, at Ellendale from clear rock pools, and in the Morawa and Carnamah area from stagnant water in rock holes.

C. fatigans were found widely scattered over the entire zone. Adults were caught in rooms and larvae were found breeding in rain-water tanks, stagnant water in river beds, and waste water from settlements. It was the main rain-water tank breeder in the zone.

C. pipiens australicus and *C. annulirostris* were found together in the Irwin River and in various mud-holes overgrown with grass. The former was particularly common throughout the zone and outnumbered all other species with the exception of *A. annulipes*. In general the larvae of these two *Culex* mosquitoes appeared to favour stagnant semi-permanent collections of water containing grass, algae, and debris. Larvae of *C. fraudatrix*? were found only at one location—a creek of clear running water near the highway a few miles south of Northampton.

ZONE 2. MOORE RIVER, HILL RIVER, WONGAN HILLS, GOOMALLING: JULY, 1955.

The only anopheline mosquito identified was *A. annulipes*, which was distributed consistently throughout the zone although not always in any great numbers.

Larvae were collected in a wide variety of water such as saline creeks near Moora, and fresh, clear, grassy pools at Gingin, Hill River and Goomalling.

These larvae were more plentiful in fresh water containing much algae and vegetation.

Thirteen other species were collected; these were *Tripteroides atripes*, *Culex fatigans*, *Culex pipiens australicus*, *Aedes sagax*, *Aedes camptorhynchus*, *Aedes alboannulatus* group, *Aedes bancroftianus*, *Aedes clelandi*, *Aedes notoscriptus*, *Aedes occidentalis*, *Aedes* sp. "Ratcliffe's No. 1," and *Aedes* sp. "Ratcliffe's No. 8."

The *A. clelandi* and the two last named species were adults in a batch obtained by an army unit (Malaria Control Unit, Western Command) in the Lancelin Lakes area and identified by Dr. Marks.

Members of the *A. alboannulatus* group were the most prevalent of all mosquitoes found in the zone and were collected in all areas visited and in various types of water; but particularly in clear, fresh, grassy ground pools such as were found at Gingin, Hill River, Dalwallinu and Goomalling.

A. bancroftianus larvae were confined to the Moora district where they were found mainly in the many clear saline creek bed pools; they were also found in clear fresh water. In one instance, in a fresh water earth dam where there existed much grass and weed, larvae were abundant.

A. occidentalis, the identification of which was confirmed by adults bred from larvae, were collected exclusively from rock pools in granite outcrops in the inland country between Dalwallinu and Goomalling.

A. sagax larvae were collected in fresh water in the Hill River area, and near Goomalling, where adults were also caught biting in the shade in daylight. Adults were also caught near Moora.

A. camptorhynchus were collected in the larval stage in saline water at Gingin and in the Moora area. Adults were caught at Goomalling.

A. notoscriptus larvae were found to be plentiful in Moora in rain-water tanks, but were not found elsewhere in the zone.

T. atripes was another rain-water tank breeder which was confined to one town only, that being Goomalling.

C. fatigans larvae were collected from rain-water tanks, septic tanks and in several instances fresh water soaks throughout the zone. It was more prevalent than all the other species which breed in artificial containers.

C. pipiens australicus larvae were found in a variety of waters consistently throughout the zone, but appeared to favour fresh clear, grassy, pools.

An adult *C. annulirostris* was caught biting in daylight near Goomalling. No larvae of the species were found in the zone at the time of the survey. On January 28th, 1957, some larvae were collected near Moora.

ZONE 3. MUCHEA, YORK, CORRIGIN TO ROCKINGHAM: JUNE-JULY, 1956.

Two species of *Anopheles* were identified, *A. annulipes* and *A. atripes*.

A. annulipes was found consistently throughout the zone in saline water, such as the Avon River at Northam and the river flats at York, but in most cases the larvae of this species were found in fresh water pools and soaks amongst grass algae and reeds.

A. atripes was collected only at Yanchep. Adults were caught biting in daylight in the shade, and larvae were found in clear, fresh, grassy water.

Twelve other species of mosquitoes were identified, and at least two more could not be recognised from literature available.

Those identified included *Aedes alboannulatus* group, *Aedes occidentalis*, *Aedes sagax*, *Aedes camptorhynchus*, *Aedes australis*, *Aedes notoscriptus*, *Aedes clelandi*, *Culex fatigans*, *Culex pipiens australicus*, *Culex annulirostris*, *Theobaldia atra*, *Tripteroides atripes*.

The rainfall in this zone for the months of June and July was above average in most centres, and much fresh ground water was available.

A. alboannulatus group larvae were found to be the most numerous and widespread species, being found mostly in fresh, clear, grassy water, but also in saline water such as at Northam, in the Avon River and in the Grass Valley Brook.

A. occidentalis larvae were found in fresh, clear, open rock pools at Northam, Karragullen and Armadale.

A. sagax were collected from temporary, shallow, and in most cases turbid, pools in the Northam, York, Brookton and Corrigin areas.

A. camptorhynchus larvae were collected sparsely over a wide area and were confined to brackish water, except in one instance at Lake Coogee, where they were found in fresh water pools in association with *A. annulipes* and *A. alboannulatus*.

A. australis were confined to rock pools on the coast line at Triggs Island and Rockingham, where spray from the sea is able to replenish the water as it evaporates.

A. notoscriptus were found near Perth, then at Northam, York and Brookton only. As it is found mostly in rain-water tanks, it could have been missed in other areas owing to the fact that most tanks were overflowing at that time of the year.

A. clelandi larvae were collected in fresh, clear water at Muchea and Rockingham, and an adult was caught resting in the shade at Karragullen in daylight.

C. annulirostris were found in fresh, permanent collections of water throughout the metropolitan area in the drier parts of the year, i.e., October to March, but were not prevalent when the survey was made in June and July; in fact, no specimens were collected outside the metropolitan area in this zone.

C. pipiens australicus larvae were common in almost all centres visited, although not in any great numbers. They were found mostly in fresh, temporary to semi-permanent collections of water where grass and reeds were plentiful. An occasional specimen was collected from saline water, such as the Avon River at Northam and the river flats at York.

C. fatigans were found throughout the zone where rain-water tanks are commonly used, and where a septic installation is not properly treated or adequately screened. They were found to be more plentiful in Northam, York, Toodyay, Brookton and Corrigin.

C. "near" fergusonii. Larvae resembling *C. fergusonii* were collected in clear, fresh water along the coastal belt at Coogee, Rockingham, and inland as far as Serpentine.

Triperoides atripes were found in rain-water tanks in the metropolitan area and Wanneroo, and in great numbers at Toodyay, Northam, York, Brookton and Corrigin.

Theobaldia atra larvae were collected in the metropolitan area, Yanchep and the Toodyay area, in fresh, clear, grassy water, and in one instance, at Toodyay, were found in a covered well which had the water levels near the ground surface.

ZONE 4. HYDEN, LAKE KING, LAKE GRACE, WILLIAMS, HARVEY, WAROONA, BRUNSWICK : MARCH, 1955

Two species of anophelines were found in this zone, *A. annulipes* and *A. atripes*. The former was found widespread throughout the zone, mostly in fresh water with algae or weed, but specimens were also collected from muddy pools and saline water, particularly in the Williams area, where they were plentiful.

One adult *A. atripes* was caught biting in shade at 10.30 a.m. near the Drakesbrook Dam.

The 11 other species identified were *Aedes camptorhynchus*, *Aedes sagax*, *Aedes alboannulatus*, *Aedes occidentalis*, *Aedes notoscriptus*, *Aedes tremula*, *Aedes spinosipes*, *Culex fatigans*, *Culex pipiens australicus*, *Culex "near" fergusonii*, *Tripteroides atripes*.

Adult *A. sagax* were caught in many spots in the bush of the "Lakes Country" from Lake Carmody to Lake King, yet no larvae of the species were found. Some 8 inches of rain had fallen from February 15th to 17th, but most of the casual water had dried up by 21st March, when the survey was conducted. This species was also prevalent, particularly in the adult stage, at Williams, Narrogin, and Harvey.

One adult *A. camptorhynchus* was caught south-east of Narrogin on the Arthur River flats, but no larvae were found in the zone.

A. alboannulatus group larvae were found in fresh, grassy water in great numbers in the Harvey area around the irrigation channels and in the Williams area. Adult *A. alboannulatus* were collected in the same areas.

A. occidentalis adults were caught biting in the Hyden and Waroona areas.

A. notoscriptus adults were caught at Holt Rock. They attacked humans freely "at dusk" from 6.30 p.m. onwards, and again at 7 a.m. next morning. An extensive search failed to locate the breeding place. The area searched included nearby rain-water tanks, rock holes in the rock catchment area, and wells. The vegetation around the catchment was comparatively low scrub.

A. tremula adults were caught flying near the doorway of a farmhouse near Lake King, and *A. spinosipes* were also collected in the same situation. This latter species was also caught biting in a shaded position at 3 p.m., but no larvae were collected.

T. atripes. This species was found widespread throughout the zone in rain-water tanks. In the Williams and Narrogin areas they were very prevalent.

C. fatigans were found widespread throughout the area in rain-water tanks, septic tanks and other polluted as well as fresh water. In one instance in a swamp at Drakesbrook this species was found in countless numbers in a pool containing a dead animal.

C. pipiens australicus larvae were found in fresh grassy pools throughout the zone. They were more prevalent in the Williams area.

C. annulirostris were confined to the western parts of the zone from Williams towards the coast. They were found in the greatest numbers in the fresh water grassy pools around the irrigation drains in the Harvey district.

C. "near" fergusonii were found in the Harvey and Waroona areas, in fresh, clear water.

ZONE 5. SOUTH-WEST CORNER OF THE STATE BORDERED BY BUNBURY, DARKAN AND NORNALUP : MAY, 1956

Two species of *Anopheles* were identified from this zone. *A. annulipes* were found to be widespread throughout the zone, and although specimens were found mostly in fresh water, they were also taken from saline water such as in the Perup River near Perup.

A. atratipes, although not numerous, were collected in both adult and larval stages and were widespread throughout the zone. The larvae were restricted to sheltered, fresh water streams, pools and swamps with ample grass or weed. Adults were caught biting in daylight in shaded situations at Nornalup, Walpole and Pemberton.

Twelve other species were identified, comprising *Aedes camptorhynchus*, *Aedes alboannulatus* group, *Aedes occidentalis*, *Aedes notoscriptus*, *Aedes australis*, *Aedes clelandi*, *Culex fatigans*, *Culex pipiens australicus*, *Culex annulirostris*, *Culex* "near" *fergusoni*, *Tripteroïdes atripes*, *Theobaldia atra*.

A. alboannulatus group larvae were found to be numerous and widespread throughout the zone. They were collected mostly from fresh water which was plentiful at that time of the year. Adult *A. alboannulatus* bred from larvae in many cases, and in one instance *A. occidentalis* adults bred from a mixed collection of larvae from a fresh water creek bed pool near Bridgetown.

A. camptorhynchus were not prevalent in the larval stages, but adults were widespread and were caught biting in the scrub during the day. In the Nornalup area larvae were frequently found in fresh water.

A. notoscriptus adults were frequently found biting in timber country in the south-west portion of the zone, but larvae were found only twice in rain-water tanks. Larvae were again found in rain-water tanks at Donnybrook.

A. australis larvae were found in sea water rock pools in countless numbers, near the Leeuwin Light-house, and at Canal Rocks near Yallingup. In the thick scrub near Cape Leeuwin adults of this species were very numerous in the early evening.

A. clelandi were found in the Nornalup, Collie and Augusta areas, in fresh water pools containing grass and algae, and in fresh open clear water devoid of vegetation.

C. fatigans were collected from rain-water tanks throughout the zone. Adults were also collected emerging from an unscreened septic tank in the Collie district.

C. pipiens australicus were found to be widespread throughout the zone, though not numerous. In one instance, at Boyup Brook, this species was found in saline water, but mostly they were collected in fresh water grassy pools.

C. annulirostris were found in two places, only at Lake Muir and at Manjimup, both in fresh water pools containing grass and weed.

T. atripes were the most prevalent and widespread rain-water tank breeders in this zone.

T. atra were found to be widespread and fairly numerous in the wetter parts of the zone, where they were found in fresh water pools and streams, usually where there was ample shelter both above or near the water and in the water in the form of weeds, grass, etc.

ZONE 6. THIS ZONE COMPRISED THAT PART OF THE STATE BETWEEN WAGIN AND DUMBLEYUNG, THROUGH TO DENMARK AND ALBANY, 6TH TO 15TH AUGUST, 1956

During the previous month much rain had fallen in the zone and there was ample ground water about.

Anopheles annulipes larvae were present in the inland districts, but were not collected along the near coastal strip from Denmark to Albany, nor up in the Porongorup Range.

Anopheles atratipes larvae were collected in the Albany district only, and adults were also caught biting in daylight in scrub country near the Albany Rifle Range.

Of the other 15 species collected, three were identified by Dr. E. N. Marks as undescribed species of *Aedes*, the other 12 included *Culex fatigans*, *Culex pipiens australicus*, *Culex* "near" *fergusoni*, *Theobaldia atra*, *Tripteroïdes atripes*, *Aedes sagax*, *Aedes alboannulatus* group, *Aedes occidentalis*, *Aedes australis*, *Aedes camptorhynchus*, *Aedes bancroftianus* and *Aedes notoscriptus*.

C. "near" fergusoni were found to be plentiful in the Albany, Denmark and Mt. Barker areas where specimens were confined to fresh water containing abundant shelter in the form of grass, weeds or reeds.

C. pipiens australicus larvae were found to be widespread through the zone, and were collected mainly from fresh, grassy waters, but specimens were also taken from brackish water at Mt. Barker.

C. fatigans were found in the inland districts of Wagin and Gnowangerup in rain-water tanks. Of the other rain-water tank breeders, *T. atripes* were found only at Denmark, with *A. notoscriptus*.

A. sagax larvae were found in all areas in the Great Southern district from Wagin to Albany, and in to Gnowangerup, in fresh, temporary pools of water.

A. alboannulatus group larvae were by far the most prevalent and widespread, being found in all areas in the zone in clear to turbid, and fresh to saline waters. These larvae are, however, found mostly in fresh, clear waters.

A. occidentalis larvae were collected from rock pools on a granite outcrop near Wagin, and a shallow soak at Woodanilling. Identification was confirmed from adults bred from larvae. This species was not identified further south.

A. camptorhynchus larvae were found to be widespread throughout the zone, and were collected from brackish waters in creek beds and river flats. They were also collected from fresh water pools. Adults of the species were caught biting during the day, in the scrub, throughout the zone, particularly in the Albany area.

A. bancroftianus larvae were collected at Woodanilling in saline water in the Boyerine Creek. No other specimens of this species were found in the zone.

A. australis larvae were found only at Albany near the "Natural Bridge," both in sea water on the rocky coastline and in saline water on the cliff top.

Of the undescribed species, *Aedes* sp. "Ratcliffe's No. 1," was found in the Denmark, Albany, Porongorup and Gnowangerup areas in fresh water pools amongst weeds and reeds.

Aedes sp. "Ratcliffe's No. 7" was collected along the Great Southern line from Woodanilling to Albany in small collections of fresh water such as a waterlogged rabbit warren, road culvert and roadside drain. In one instance larvae were recovered from a shallow winter swamp with abundant weed, grass and debris.

A. "Prom?" larvae were found at Albany in several situations in fresh, clear water, and in one instance near Woodanilling in fresh water near an earth dam.

T. atra were found to be plentiful in the Albany and Denmark areas, and odd specimens were collected in fresh water in the Katanning, Tambellup and Porongorup areas.

ZONE 7. EASTERN WHEATBELT AREA : JULY, 1956

The only anopheline mosquito identified in this zone was *A. annulipes*, which was found to be widespread throughout the zone although not in any great numbers. In all cases this species was found in fresh water collections, mostly with grass and algae.

Besides one unidentified species of *Aedes*, the eight others included *Aedes alboannulatus*, *Aedes occidentalis*, *Aedes sagax*, *Aedes camptorhynchus*, *Aedes notoscriptus*, *Culex pipiens australicus* and *Tripteroides atripes*.

A. alboannulatus group larvae were the most widespread and prevalent of all species. They were found in most temporary fresh water ground pools, where flushing out by rain water was not regular, as well as the more permanent ground waters.

A. occidentalis were found in all except two cases in fresh water rock pools on large granite outcrops. They were found to be widespread throughout the zone.

A. sagax were not prevalent, but were found in fresh water pools over a large area. In one instance a single fourth-stage larva was found in a large salt lake at Hines Hill.

A. camptorhynchus were restricted to Dowerin, Bruce Rock and Merredin areas, where they were found in salt lakes, brackish and fresh water. Some of the waterways and river flats, which are normally salty, were at that time of the year mostly fresh owing to the excess rain. The *A. camptorhynchus* population might be greater when the salinity of the water is more normal.

A. notoscriptus larvae were found in two instances only, both in disused wells, one in the Wyalkatchem area and the other in the Bencubbin area. No specimens were collected from rain-water tanks.

T. atripes were found in rain-water tanks in Kellerberrin, Wyalkatchem and Mukinbudin only, but *C. fatigans* were found in them throughout the zone in large numbers. Larvae of *C. fatigans* were also discovered in foul water collections such as in Merredin in the area where the waste water from the Railway and Air Force Station accumulates.

C. pipiens australicus larvae were found to be prevalent and widespread through the area, mostly in fresh collections of water containing grass, weeds and reeds.

The unidentified species was declared by Dr. E. N. Marks to be a new undescribed species of *Aedes*. It was found over a wide area, as in a fresh water dam south of Merredin, a waterlogged rabbit warren at Merredin, a fresh water soak at Koorda, and a fresh water grassy pool at Bruce Rock.

ZONE 8. THIS ZONE INCLUDED THE SOUTH COASTAL STRIP FROM ONGERUP TO ESPERANCE, AND THE DRY INLAND AREA UP TO KALGOORLIE, THEN WEST TO BURRACOPPIN. IT INCLUDED A LARGE AREA OF SPARSELY POPULATED, DRY COUNTRY. THE SURVEY WAS RESTRICTED TO NEAR THE MAIN ROADS AND ACCESSIBLE SOAKS AND POOLS : AUGUST, 1956

Anopheles annulipes was the only species of anopheline mosquito identified in the zone. It was not very prevalent, and was found as far east as the Young River area, in fresh water grassy pools.

Apart from two unidentified species of *Aedes* the nine other mosquitoes found included *Aedes alboannulatus* group, *Aedes occidentalis*, *Aedes camptorhynchus*, *Aedes sagax*, *Aedes notoscriptus*, *Aedes alternans*, *Culex fatigans*, *Culex pipiens australicus*, *Tripteroides atripes*.

A. alboannulatus group, which are usually found in fresh water collections, were also found in saline water in the Young River area. They were found consistently throughout the zone, and were more numerous than any other species. Adults were caught biting in a number of situations during the daytime.

A. occidentalis were found in a rock pool two miles east of the No. 2 rabbit-proof fence, a shallow well in the Young River area, in rock pools on a granite outcrop near Gnarlbine Soak (22 miles south-west of Coolgardie), and in similar rock pools at Moorine Rock and Strawberry Rocks in the Yilgarn area.

A. camptorhynchus larvae were found to be prevalent along the coastal strip where many of the creeks and river pools are brackish. They were also caught in the adult stage during the day and early evening.

A. sagax were more prevalent in the coastal belt in the adult stage. They were caught biting readily in shaded situations during the day time. Larvae were also collected fairly consistently throughout the zone, but were not in any great numbers.

A. notoscriptus larvae were confined to rain-water tanks and artificial containers. They were collected at Esperance, Norseman and Kalgoorlie.

A. alternans. One specimen only in the larval stage was collected from a pothole in a fresh water creek bed leading from Depot Rocks, 22 miles south of Coolgardie.

C. fatigans larvae were collected from rain-water tanks from Esperance to Coolgardie, including Kalgoorlie. In the Esperance area they were found in some of the numerous shallow wells around the town.

C. pipiens australicus, although not numerous, were spread consistently throughout the zone, and were found in fresh water pools, etc. They were found to be plentiful in the several fresh water seepages to Lake Spence at Esperance.

T. atripes were confined to rain-water tanks in Norseman and Kalgoorlie.

EYRE HIGHWAY : DECEMBER, 1955

Owing to the dry state of the country collections were restricted to water catchments and tanks, both natural and artificial.

The only species of anopheline mosquito caught was *A. annulipes*, and these were confined to the water catchment at Newman's Rocks which are some 89 miles east of Norseman.

Five other species were collected. These were *Aedes notoscriptus*, *Aedes alboannulatus* group, *Aedes occidentalis*, *Culex fatigans*, and *Culex pipiens australicus*.

A. notoscriptus larvae were found at Eucla in a rain-water tank and in a rock water catchment behind the motel at Madura. Adults were caught biting in the early evening two miles west of Balladonia and in the early morning at Newman's Rocks.

A. occidentalis adults were caught at the same times and situations as *A. notoscriptus*.

A. alboannulatus group larvae were found in the rock catchment tank at Madura.

C. fatigans larvae were collected from a rain-water tank at Eucla.

C. pipiens australicus were found 91 miles west of Eucla in the Wigunda underground catchment tank, in the Cocklebidly tank and in the rock catchment at Newman's Rocks.

LEONORA AREA : 5th TO 7th JUNE, 1956

In the Leonora area 169 points of rain fell between the 21st to 23rd May, 1956. This was sufficient to leave many ground and creek bed pools, ideal for mosquito breeding. The object of the visit was an attempt to ascertain what species of mosquito made use of the early rains to breed out and cause a nuisance. The weather was cold, the minimum temperature being in the vicinity of 43 degrees and the maximum 65 degrees.

All temporary ground waters where larvae were found proved without exception to contain *Aedes sagax* in the 4th instar stage, and in many cases pupation and adult emergence had already taken place.

No anophelines were found during this visit to the area, but in May, 1954, *A. annulipes* larvae were collected at Station Creek, which is the site of the Leonora water supply.

A. sagax larvae were collected from fresh muddy pools in open clay pan country, fresh muddy creek bed pools, and similar fresh clear pools, over an area stretching from seven miles south of Menzies to ten miles north of Leonora. The breeding of this species was most prolific over the whole area.

C. fatigans larvae were found in rain-water tanks at Menzies, Leonora and Gwalia, while adults were caught resting inside an office at Leonora.

C. pipiens australicus larvae were found in a well near Leonora, and second instar larvae were found in association with fourth instar *A. sagax* in several situations such as a clear creek bed pool two miles east of Leonora, clear fresh water at Station Creek, and a large turbid creek bed pool five miles north of Leonora.

A. tremula larvae were found in a temporarily disused water supply well at Station Creek where the water was 20 feet from the surface.

T. atripes larvae were found in rain-water tanks at Leonora and Gwalia

ONSLow AREA : JUNE, 1955

This special survey was undertaken as a result of exceptional rain in the area. The totals for the months of May and June were about 3½ inches for each month, which was about 270 per cent. above the average. Travelling was difficult on account of the boggy roads, and specimens were collected only from the more accessible localities.

The only anopheline mosquito found in the area was *A. annulipes*, which was one of the most widespread and prevalent mosquitoes collected. It was located in large permanent fresh pools such as the 10 Mile Pool, west of Minderoo in the Ashburton River, the Jabaddar Pool in the Cain River, and the Wogoola Pool, in roadside drains and pools of fresh turbid water and in one instance in a poultry watering tin at Yanrey Homestead.

C. pipiens australicus larvae were found as widespread and prevalent as *A. annulipes*, and in most instances they were found breeding in association with one another.

C. fatigans were confined to rain-water tanks at Onslow.

C. fraudatrix? larvae were collected from fresh side pools to the large Wogoola Pool near the Wogoola Homestead.

C. annulirostris larvae were found in fresh pools in the Cain and Yanrey Rivers.

C. "near" fergusonii larvae were located in fresh water pools in the Yanrey River, the Wogoola Pool and Cain River.

A. sagax adults were caught about 120 miles south of Onslow near Winning Pool, and near Jabaddar Pool in the Cain River, but no larvae were located.

A. vigilax adults were caught entering a dwelling and biting at Onslow in the early hours of the morning, while a brisk westerly breeze was blowing. No larvae could be found which might indicate the breeding ground.

A. pseudonormanensis larvae were found to be plentiful in turbid, fresh water pools in the Cain and Robe Rivers.

A. tremula were plentiful throughout the district both in the adult and larval stages. Larvae were found in various situations, such as in rain-water tanks at Onslow, tree holes at Minderoo and Yarraloola Station homesteads, a septic tank at Yanrey Station homestead, and a 35 ft. well near Barradale Crossing which is 80 miles south of Onslow.

NOTES ON SPECIES AND THEIR DISTRIBUTION

Anopheles

A. annulipes was collected over a very wide area from Onslow in the north to Esperance in the south, and extending inland to Newmans Rocks on the Eyre Highway and Leonora on the Goldfields. It was found breeding in various types of water, both clear to turbid, fresh to salty (Plates 1 and 4). In one instance at Yanrey, larvae of *annulipes* were collected from a watering tin in a poultry yard, while in another situation at Irwin the same species was found in clear open slowly moving water, the sodium chloride content of which was 1,117 grains per gallon. Although this species is known to breed in artificial containers and saline creeks and pools it appeared to have a preference for clear, fresh grassy pools with an abundance of algae and weeds or reeds.

The only other *Anopheles* collected was : *A. atratipes*, which was found as far north as Yanchepp then along the south coastal belt as far as Albany and inland as far as Collie. This is generally a rare species, but is plentiful along the south, in the timber country of the Manjimup Road District, where it readily attacks man in the daytime, in shaded situations. The larvae in all instances were found in fresh water swamps and Creek beds thick with weeds or reeds.

Tripteroides

Only one species of *Tripteroides* was recovered. Larval and adult specimens were identified by Mr. D. J. Lee as *T. atripes*.

Culex

C. fraudatrix? Larvae of this species were found in only two situations, both being north of Geraldton, one in the Northampton area and the other in the Upper Chapman District, one in slight saline slowly moving water amongst reeds and algae, and the other in open, fresh clear rock pools in a creek bed. The larvae resemble those of *C. fraudatrix* but until males are bred out the identity of this species must remain uncertain.

C. annulirostris. This species was found at Onslow, then in the Northampton district in as far as Mullewa, then spasmodically down the coastal belt to the south coast. It was not found further inland than Williams, about 70 miles from the coast, and it was not found in any great numbers. In most cases specimens were collected from fresh, open grassy pools.

C. pipiens australicus in the larval stage was the most prevalent and widespread mosquito found in the survey. It was found in all areas visited, which included Onslow, Laverton, and Madura on the Eyre Highway. Although it apparently prefers fresh, clear, grassy water, it was also found in stagnant and in saline waters (Plates 2, 3, 4 and 5).

C. fatigans was found as widespread as *C. pipiens australicus*, but because of its preferential breeding habitats it was not so prevalent, but is the main nuisance mosquito in rural towns.

Another species of *Culex* larvae which is referred to as sp. near *fergusoni* was collected as far north as Onslow and also along the near coastal strip from Perth around to Albany. It is a long siphoned larva closely resembling the published description of *C. fergusoni*. Numerous attempts have been made to breed out adults from the larval stage, using both natural temperatures back in Perth and also artificial heating, but without any positive results. These larvae are usually found in clear, fresh water pools or swamps. As noted below, these may be the larvae of *C. latus*, but specimens are no longer available for checking.

Aedes.

A. alboannulatus, which includes those larvae positively identified by breeding out adults, adults caught, and those identified only as *A. albannulatus* group was the most prevalent mosquito found in the area south of Northampton and as far east as Esperance to Coolgardie. It apparently adapts itself to varying types of water, although seems to prefer fresh water pools (Plates 1-4 and 7). It bites readily during daylight in shaded situations in the bush, is particularly fierce in its attack at dusk out of doors, and gradually disappears as darkness falls.

A species with similar larvae, *A. occidentalis* is found more inland in rock pools on top of large granite outcrops which appear throughout the southern portion of the State (Plate 8).

On some large outcrops where rock pools are numerous *A. occidentalis* could be found in one or two pools only, yet others contained larvae of *A. alboannulatus*. It was then noted that pools containing *A. occidentalis* larvae were those through which no water drained; they were filled by rainfall only and not by drainage from higher up. It could be that the eggs are deposited in the "dry" rock holes and hatch out when rain falls, and that the eggs or larvae could be washed out of those pools which receive drainage from other parts of the rocks.

In a few cases *A. occidentalis* larvae were collected from shallow wells or soaks, mainly where winter rains kept the water level near the ground surface.

A. occidentalis were found as far east as Madura on the Eyre Highway but were not found further north than Perenjori.

A. camptorhynchus. The larvae of this species were found from as far north as Northampton, right through the wetter parts of the State round to Esperance. It was particularly numerous in the belt of country from Broomehill through Ongerup to Esperance. Adults of this species were caught biting in shaded situations during daylight, often far from obvious breeding places. Although this species apparently prefers brackish water, it was often found breeding in fresh water.

A. vigilax was found in Onslow in the adult stage, biting inside a dwelling at 1 a.m., and although a search was made in all likely places no larvae were seen. The only other area where *A. vigilax* was found is along the Swan River foreshore of the metropolitan area, where both larvae and adults were collected. The water in this instance, where larvae were found, was quite salty.

A. sagax. The only specimen of this species found near Onslow was one adult. It was further found widespread throughout the State from Mullewa to Esperance and as far inland as Laverton and the Warburton Ranges. Normally only a few specimens were collected over a wide area, but in the dry areas, right after rain, this species predominated, as previously mentioned in the Leonora area, and was found in great numbers.

In Zone 1, 14 miles south of Mullewa in casual turbid water, fourth instar larvae of *A. sagax* were found where rain had fallen only six (6) days before. Larvae, at the second instar stage, of *C. pipiens australicus* were also found in the same water. These conditions occurred in other situations also. Because of its speed of development the situation in which it is usually found is fresh turbid casual waters (Plates 1-5 and 6). In the wetter areas the larvae were found in fresh clear water. When *sagax* larvae were found in brackish water they were very few in number.

A. pseudonormanensis larvae were collected from river bed pools in the Onslow area from the Cain and Robe Rivers, and no specimens were found any further south.

A. bancroftianus. Larvae of this species were found to be very prevalent in the Moora District in fresh to brackish water. Further specimens were found in brackish water at Woodanilling.

A. australis (= *concolor*). This species was found along the coast at Triggs Island, Rockingham, Cape Leeuwin, Canal Rocks, Albany, and Esperance. In June, 1950, when at Pelsart Island in the Abrolhos Group, I collected larvae of *A. australis* from rock pools near the beach. Adults, which could have been *A. Australis*, appeared to be plentiful in the evenings, but even though they buzzed around they did not bite freely and did not enter buildings. No other species of larvae were found on the Island. In all cases but one where *A. australis* larvae were found, sea water had access to the pools at some stage, the exception being near Natural Bridge, Albany, where salt content of the water could only be caused by fine spray from the rocks below in rough weather. Larvae of *A. asworthi* can not be distinguished from *A. australis* and it is possible this species was included in some of the above samples.

A. notoscriptus. Larvae of this species were found in rain water tanks over a wide area, but not in any great numbers, and only at 15 points between Geraldton and Nornalup and east as far as Kalgoorlie and Madura. In the timber country in the southern part of the State adult *notoscriptus* were caught biting in daylight in situations well away from dwellings.

A. spinosipes. Two adults only of this species were found, one near Lake King, which was caught biting at 6.30 a.m., and the other was caught biting at 3 p.m. near Newdegate. No larvae of this species were found.

A. alternans. Single larva of this species was found at Depot Rocks, about 22 miles south of Coolgardie, in a fresh water creek bed pool and in association with *A. alboannulatus* group and *C. pipiens australicus*.

A. tremula. Adult specimens only of this mosquito were caught at Lake Grace and Geraldton, and larvae were found in a well on the Leonora water reserve. Both adults and larvae were collected in the Onslow area in various situations, e.g., rain-water tanks in Onslow, a tree hole in Poinciana at Minderoo Station, and a septic system at Yanrey Station.

Theobaldia.

Species of this genus were collected along the coastal belt of the south-west portion of the State, from Yancheep to Albany. Adults bred from larvae have been identified as *T. atra*. They appear to prefer clear, fresh, grassy pools, and some specimens have been collected from wells which have a high water level. The larvae of this species will be described in due course by Dr. E. P. Hodgkin and the author.

The following mosquitoes have been identified by Dr. E. N. Marks.

Culex latus.

This specimen was collected at Albany. Larva referred to in this report as "near" *fergusoni* may well prove to belong to this species.

Aedes clelandi.

This species was collected from as far north as Lancelin, down along the coastal belt to Albany.

Aedes sp. "Ratcliffe's No. 1."

The above were found in the Lancelin area, Denmark, Albany and the Porongorups.

Aedes sp. "Ratcliffe's No. 7."

This mosquito was found more inland in the Great Southern District between Brookton and Cranbrook.

Aedes sp. "Ratcliffe's No. 8."

Adults of this species were collected from the Lancelin area and Albany.

Aedes sp. "Marks No. 71."

This species was found in the dryer areas in three widely separated situations, Onslow, Coolgardie and Leonora. It occurs also in Western Queensland.

Aedes sp. "Koorda."

This species also was collected in the dryer areas of Koorda, Bruce Rock, Coolgardie, Merredin, Wyalkatchem, and Moorine Rock. This is apparently a new species (Plate 4).

Aedes sp. "Prom?"

A large larva from Albany and Woodanilling, possibly the same species as an undescribed Victorian larva.

SUMMARY

A survey covering the sub-tropical portion of Western Australia has disclosed the presence of two species of *Anopheles* mosquitoes (*A. annulipes* and *A. atratipes*). The former was most prevalent throughout the area, but the latter was confined to the wetter south-west corner of the State.

Six species of *Culex* (the most prevalent and widespread being *C. pipiens australicus*), were found, also one species of *Tripteroides* (*T. atripes*) and one species of *Theobaldia* (*T. atra*).

Nineteen species of *Aedes* were collected (the most prevalent being *A. alboannulatus*). These comprised 13 described species, five previously known but as yet unnamed, and one new species discovered in the present investigation. This last is a member of the subgenus *Ochlerotatus* and is referred to in this paper as *Aedes* sp. "Koorda," specimens of both adults and larvae having first been collected in the vicinity of the small country town of Koorda in W.A. The male of one, and larvae of two of the other undescribed species were also first collected during these surveys. These species are being investigated further and will be fully described by Dr. Marks in due course.

ACKNOWLEDGMENT

I wish to record my thanks to Dr. D. J. R. Snow, Director of Epidemiology, Department of Public Health, W.A., for his kindly direction and generous help, particularly in the compilation and editing of this report.

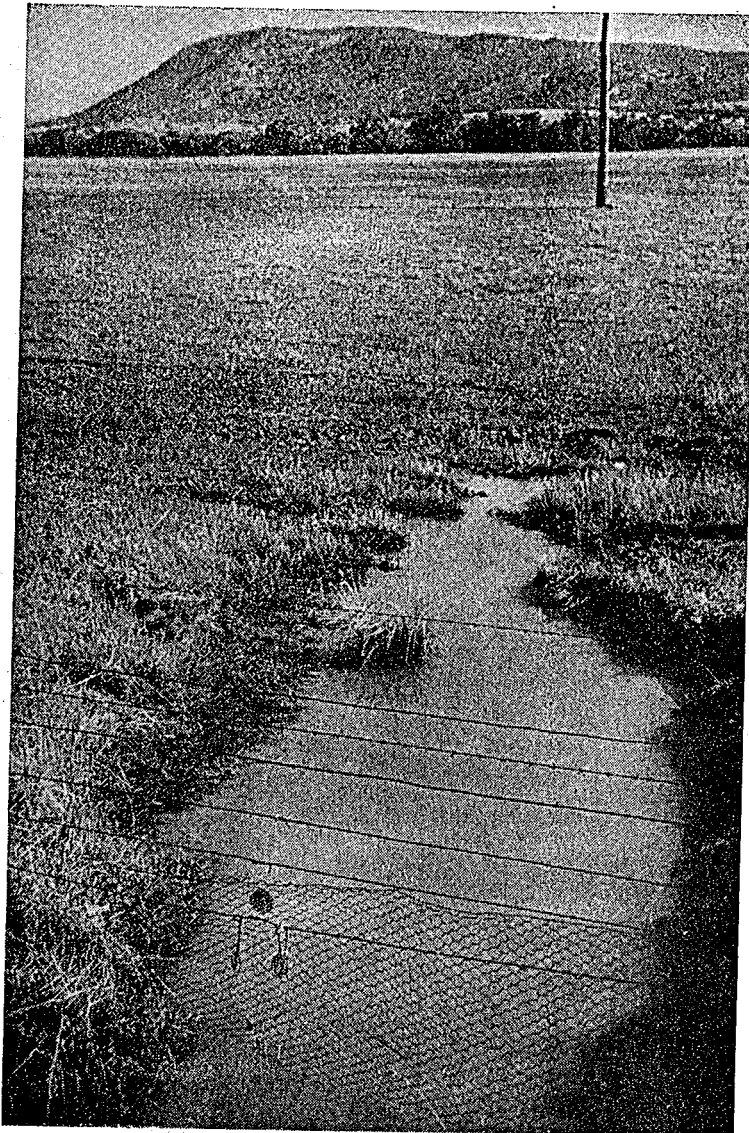
To Dr. E. P. Hodgkin, Reader in Entomology, Department of Zoology, University of Western Australia, for his constant guidance, encouragement and help in identification.

To Mr. D. J. Lee of the School of Public Health and Tropical Medicine, Sydney, for his help, guidance and time given to identification, and to Dr. Elizabeth N. Marks, Department of Entomology, University of Queensland, for her help and advice as well as the supply of literature, prompt identification, and checking of this report.

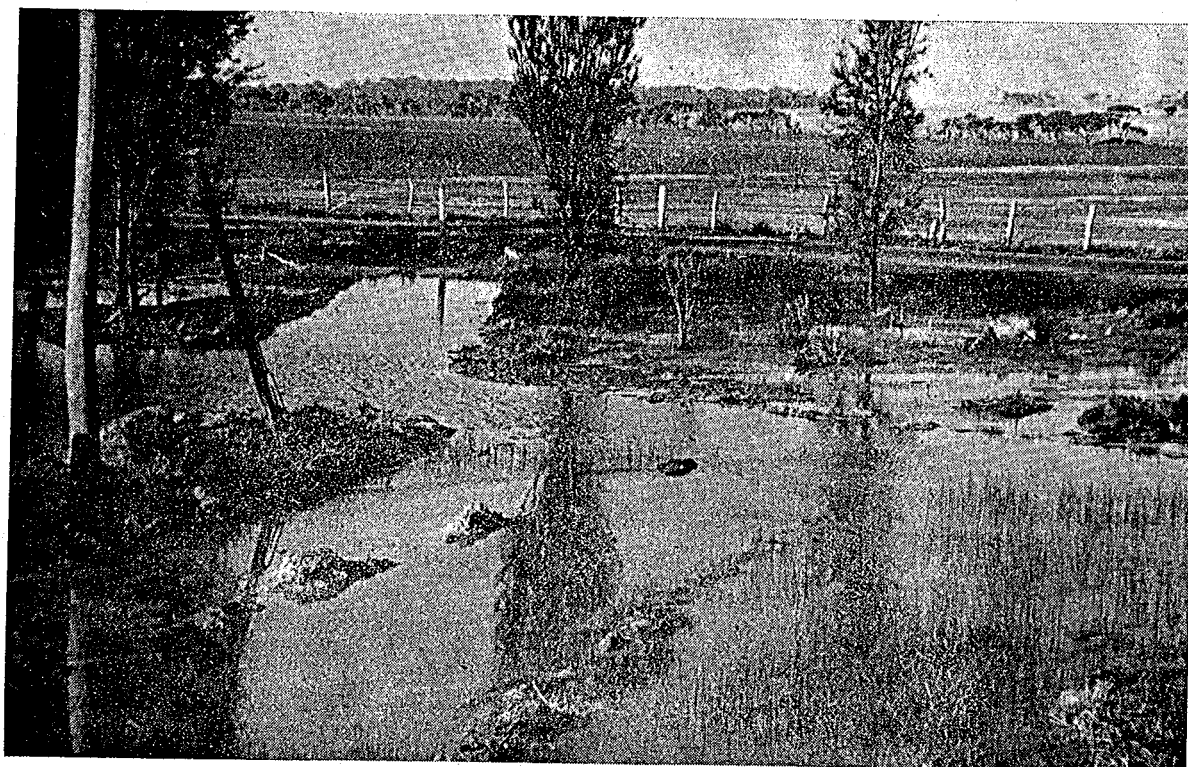
Further, I wish to acknowledge the help I received from the many interested people throughout the country during the survey, to the Army (Western Command, Malaria Control Unit) for their assistance and loan of specimens, and to Mr. A. C. Waldon, Department of Public Health, for his co-operation in producing maps and charts for this report.

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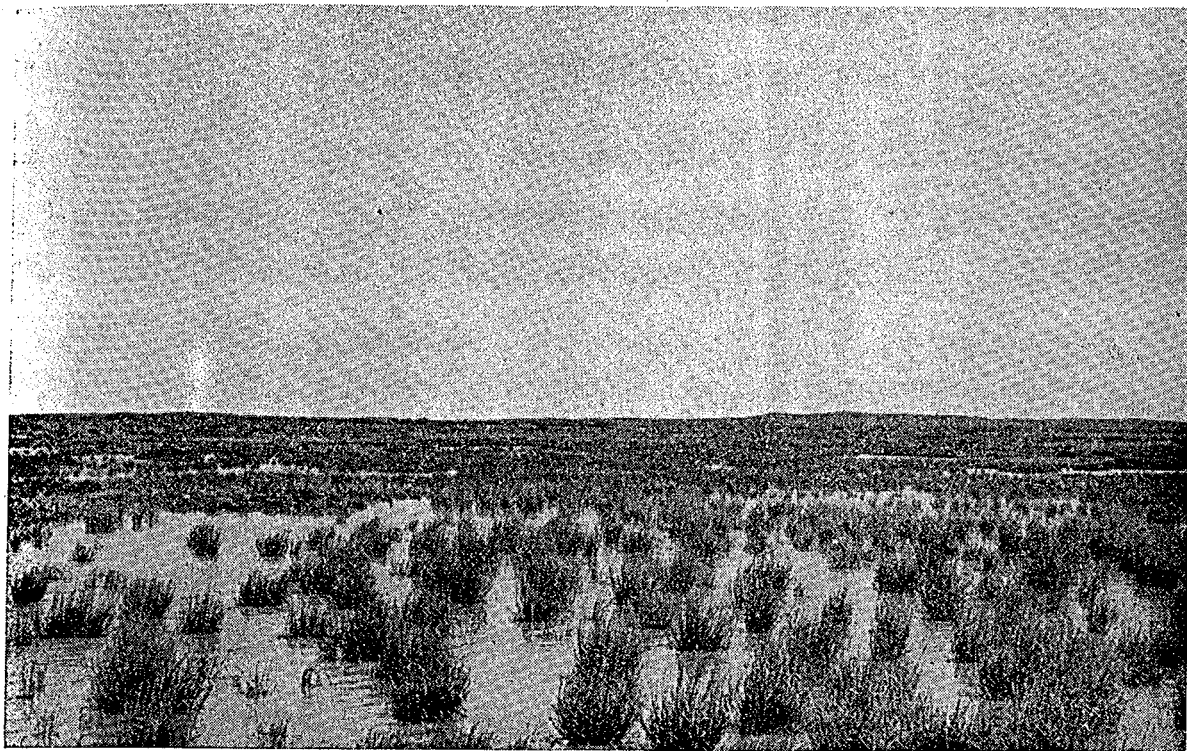
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YORK – Road Culvert Pool, Fresh water
Anopheles annulipes — *Aedes alboannulatus* — *Aedes sagax*



WAGIN – Shallow storm water drain pools, typical habitat of
Culex pipiens australicus



ONSLow AREA — Shallow clay flats — fresh water

Culex pipiens australicus



KOORDA AREA — Fresh water soak near Newcarlbine soak

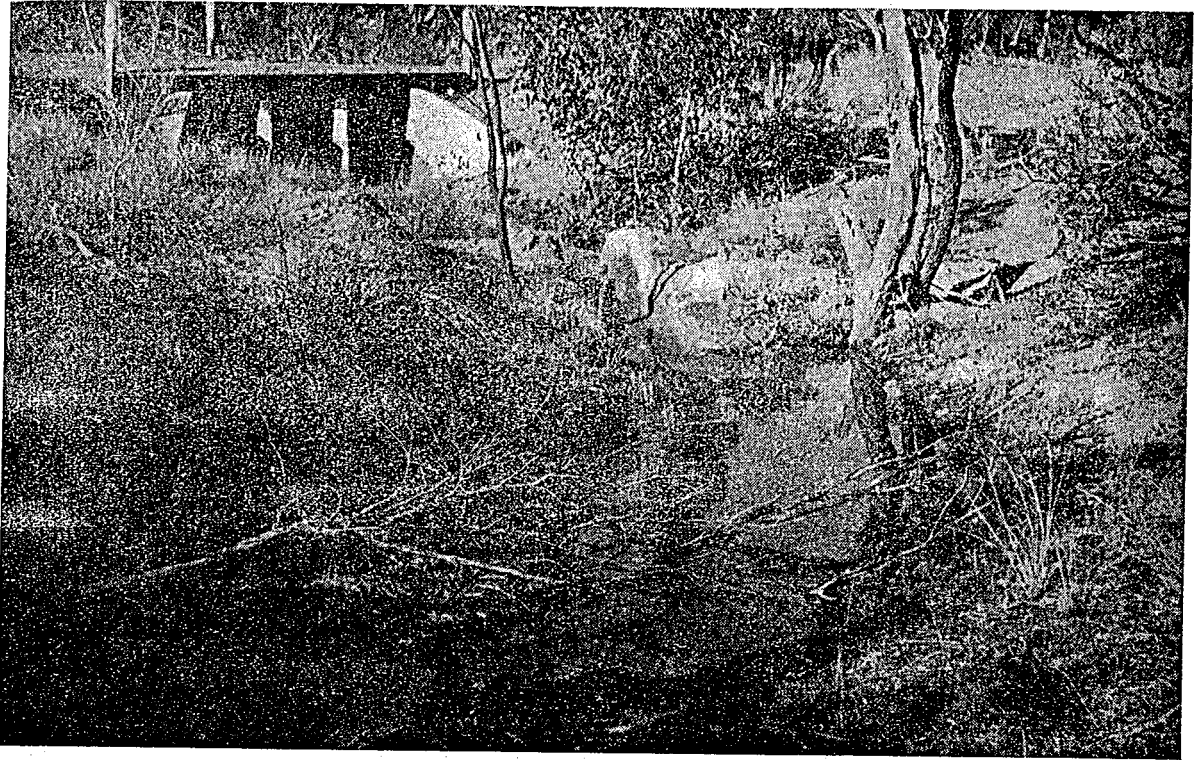
Anopheles annualipes — *Culex pipiens australicus* — *Aedes alboannulatus* — *Aedes* sp. "Koorda"



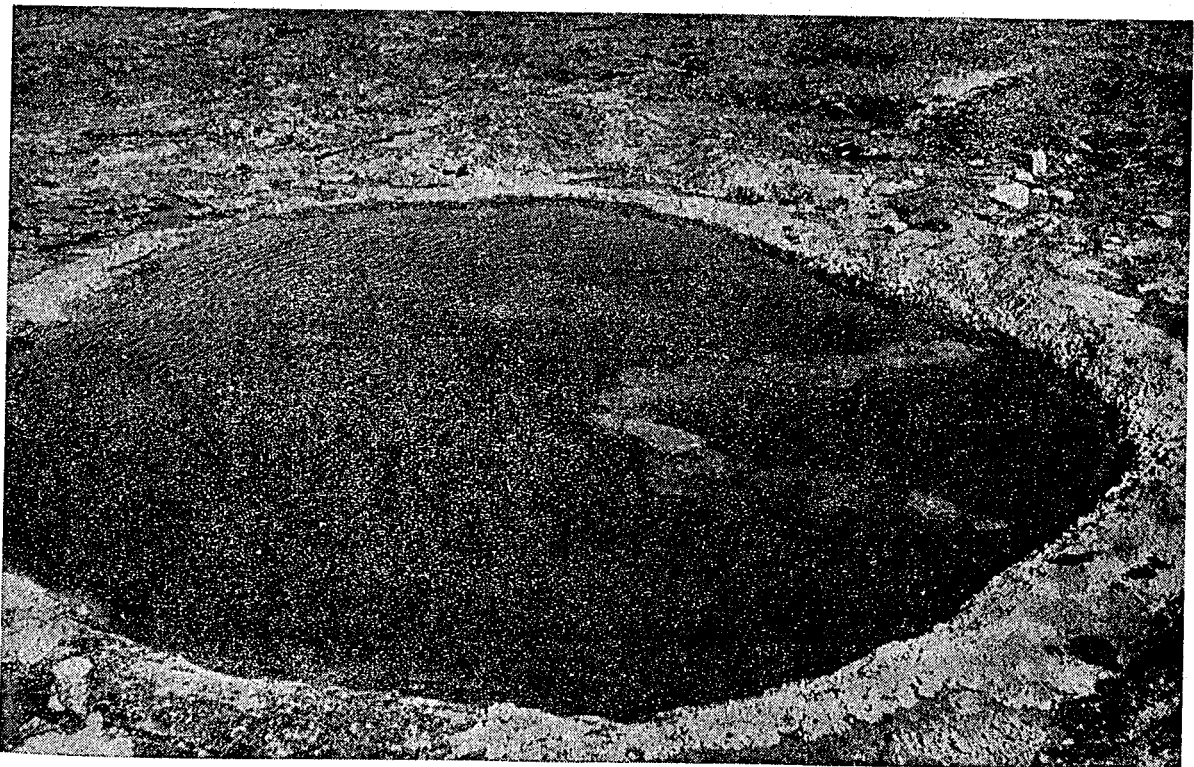
NORSEMAN — Muddy roadside pool
Aedes sagax — *Culex pipiens australicus*



BURRACOPPIN AREA — Muddy roadside pool, typical habitat of
Aedes sagax

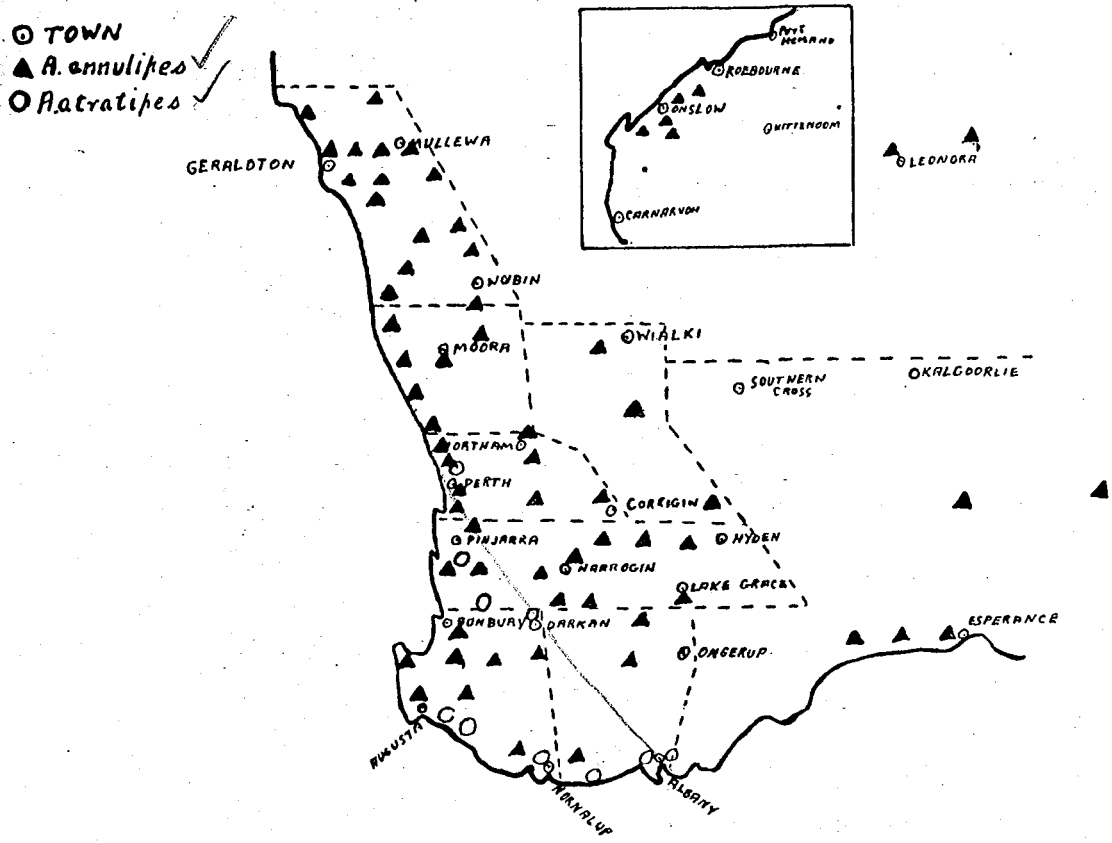


MERREDIN – Freshwater culvert pool
Aedes alboannulatus

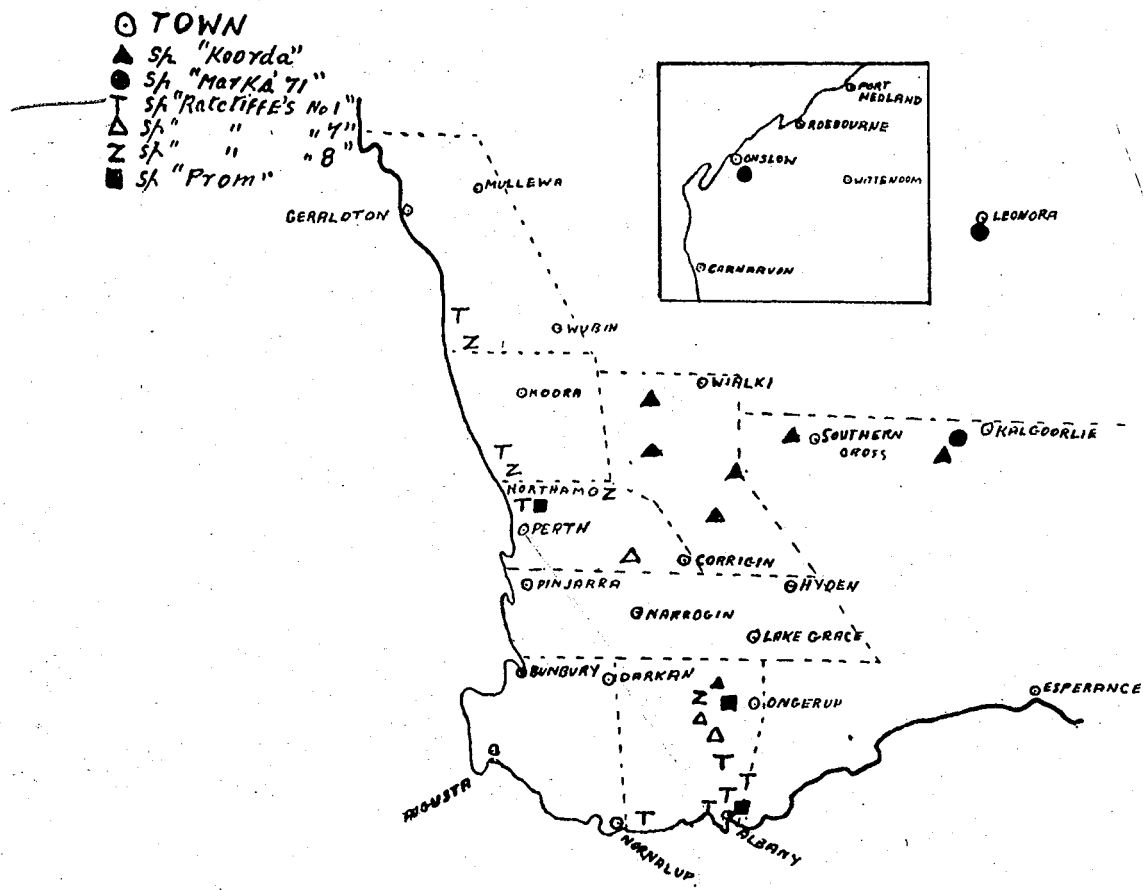


BRUCE ROCK – Fresh pool on Kulbullikin Rock, typical habitat of
Aedes occidentalis

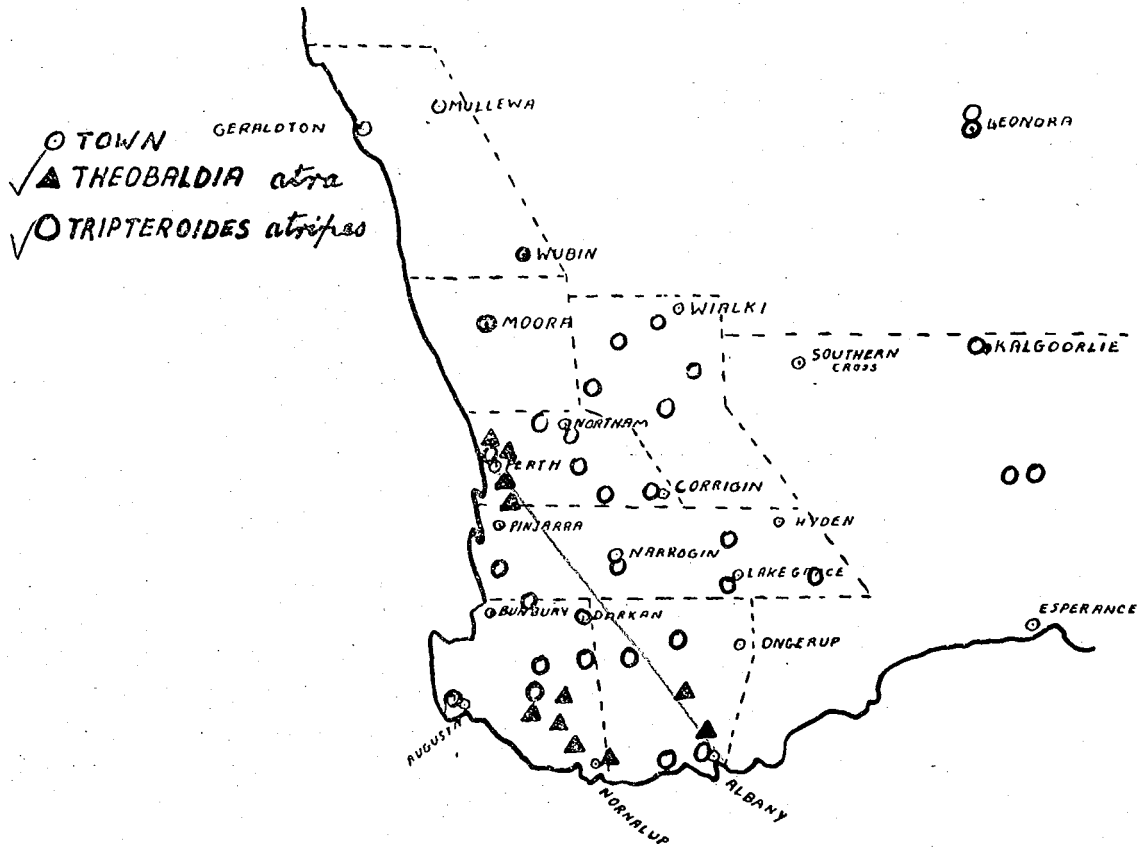
DISTRIBUTION OF ANOPHELES SPECIES IN THE SOUTH-WEST OF WESTERN AUSTRALIA



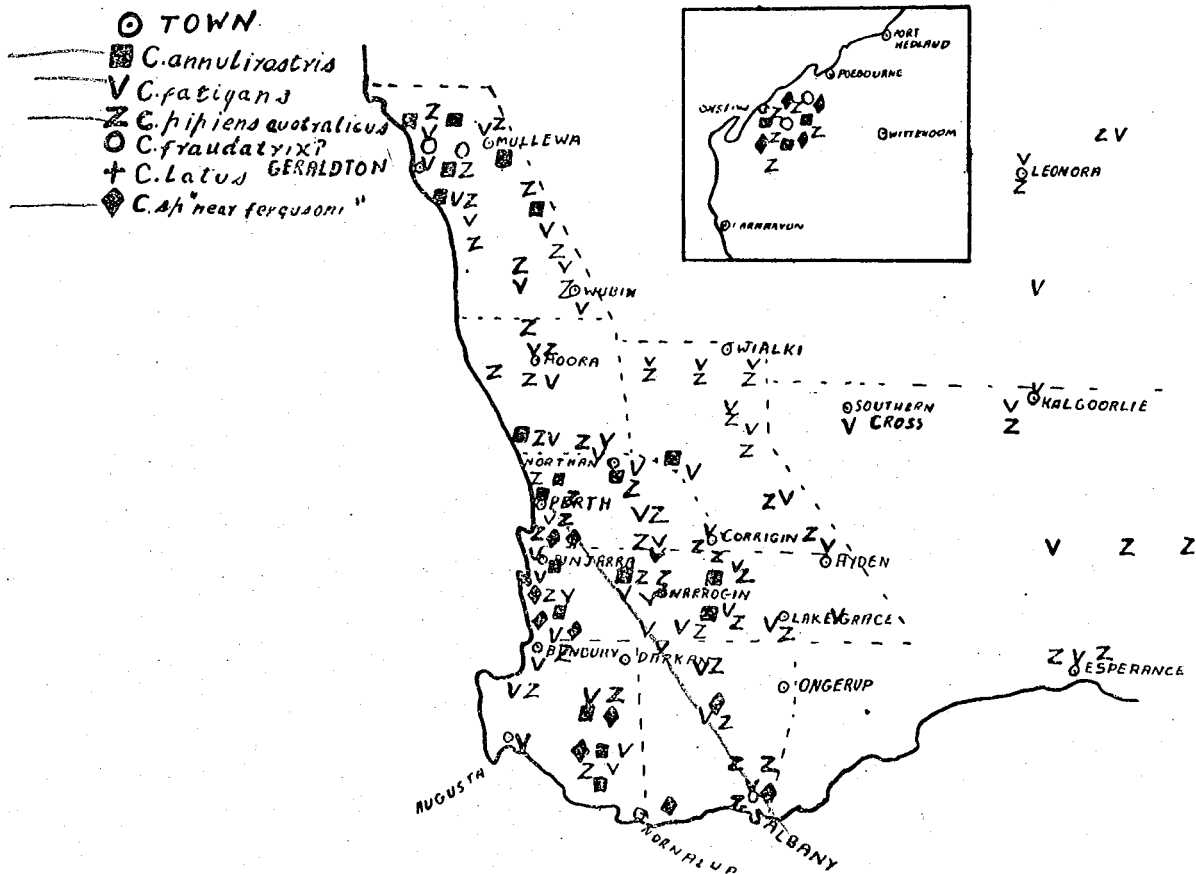
DISTRIBUTION OF NEW AND UNDESCRIBED Aedes SPECIES IN THE SOUTH-WEST OF WESTERN AUSTRALIA



DISTRIBUTION OF THEOBALDIA AND TRIPTEROIDES SPECIES
IN THE SOUTH-WEST OF WESTERN AUSTRALIA



DISTRIBUTION OF SOME CULEX SPECIES IN THE SOUTH-WEST
OF WESTERN AUSTRALIA



*F. Abbott
Comd*

WESTERN AUSTRALIA

REPORT

of the

COMMISSIONER

of

PUBLIC HEALTH

for the year 1956

Presented to both Houses of Parliament.

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