VECTORS OF MALARIA AND FILARIASIS IN INDONESIA

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ABSTRACT

Malaria at present is still one of the important mosquito-borne diseases in Indonesia. The disease is widespread all over the country and involves nearly all islands.
Sixteen *Anopheles* species have been reconfirmed as malaria vectors. They were distributed geographically as follows:

Coastal areas and lagoons	-----	*An sundaicus* and *An.subpictus*
Cultivated ricefields and swampy areas	-----	*An.aconitus, An.barbirostris, An.nigerrimus* and *An.sinensis*
Forest inland areas in shaded temporary pools, muddy animal wallows and hoof-prints	-----	*An.balabacensis, An.bancrofti, An.farauti, An.koliensis* and *An.punctulatus*
Swamp forest edge in ditches with vegetation Hilly areas in seepages, streams and clear moving water	-----	*An.letifer* and *An.ludlowae*
	-----	*An.flavirostris, An.maculatus* and *An.minimus*.

The species (of most general importance is An.sundaicus, which is restricted) by its preference for brackish water and is prevalent in coastal areas of Java.

Their types in behaviour of An.sundaicus appear as follows :

1. *An.sundaicus* in South Coast of Java in general.
   This species is essentially anthropophilic, exophagic and rests outdoor. It shows susceptible to DDT.
2. *An.sundaicus* in Cilacap, Central Java.
   This mosquito is a pure anthropophilic form. It bites man in houses and outdoors, rests indoors and is known resistant to DDT.
3. *An.sundaicus* in Yogyakarta and Purworejo, Central Java.
   This mosquito is a strong zoophilic species. It rests and prefers to bite outdoors and shows tolerance to DDT.

Human filariasis in Indonesia is the result of infection by three endemic species, namely, *Wuchereria bancrofti, Brugia malayi,* and *Brugia timori.W.bancrofti* infection is found in both urban and rural areas. Twenty species of mosquitoes are confirmed as filariasis vectors. The urban type bancroftian filariasis is transmitted by *Culex quinquefasciatus*, whereas the rural type is transmitted mostly by *Anopheles spp.*, such as *An.aconitus* and *An.punctulatus* complex. The periodic species of Mansonia transmit the subperiodic noctural *B.malayi. B.timori* which is distributed in the Eastern part of Indonesia (East Nusa Tenggara), is transmitted by *An.barbirostris.*

Some filariasis vectors such as *An.aconitus* and the *An.puctulatus* complex may function both as filariasis vector and malaria vector as well.

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An.barbirostris with is confirmed as a vector of malaria in South Sulawesi, a vector of periodic nocturnal malayan filariasis in Central Sulawesi and as the only vector of timorian filariasis in Timor and Flores, has to be studied further as it has two types of behaviouristic appearance, namely :

1. *An.barbirostris* in Java
   This mosquito is an anthropozophilic species, feeds indoors and outdoors, and rest outdoors. None is found to transmit mosquitoborne disease.
2. *An.barbirostris* in Sulawesi and East Nusa Tenggara (outside Java).
   This mosquito is a zooanthropophilic form, endo and exophagic, and rests outdoors. It is confirmed as a vector of malaria, periodic noctural malayan filariasis and the only vector of timorian filariasis.

INTRODUCTION

Diseases transmitted to man by mosquito are well known. In Indonesia, such diseases of prime public health importance are malaria, filariasis, dengue hemorrhagic fever, and the less important ones are Japanese B Encephalitis and Chikungunya.

Malaria, which is due to the infection of *Plasmodium falciparum* and *Plasmodium vivax* occurs widely throughout Indonesia and comprises nearly all islands. High incidence is found among people in the rural agricultural districts and also fishermen along the coastal settlements.

Filariasis in Indonesia is caused by the infection of three endemic species of filarial worms, namely, *Wuchereria bancrofti, Brugia malayi* and *Brugia timori.*

Foci of bancroftian filariasis are found in coastal regions and inland at low altitudes, in both urban and rural areas, such as in Java (Jakarta and Semarang), Sumatra, Kalimantan, Sulawesi, Nusa Tenggara, Maluku and Irian Jaya.

Foci for *Brugia malayi* infections are found primarily in rural areas. The disease is broadly endemic in Sumatra, Sulawesi and Maluku.

Foci of timorian filariasis are also found in rural areas, however,the disease exists only in the eastern part of Indonesia, namely East Nusa Tenggara, such as in Alor, Flores and Timor.

Publications on malaria and filariasis vectors by many previous scientific workers are well documented [1,2,3,4,5,6,7].

VECTORS OF MALARIA

Hoedojo (1983) reviewed malaria vectors in Indonesia which had been studied by various workers from 1918-1957. Sixteen species of *Anopheles* were corfirmed. The same species of mosquitoes were also confirmed as malaria vectors in Indonesia by the Entomological Team of the Directorate General of Communicable Diseases Control, Department of Health, during the study on malaria vectors which had been carried out in 1975-1984[5].

The malarian vectors in Indonesia and their bionomics in brief are as follows :

1. *Anopheles aconitus* Donitz, 1902

This species is present in lowland as well as in mountainous areas. The larvae were found breeding in rice fields, irrigation channels and in swamps. It was confirmed as one of the main malaria vectors in Java.

2. *Anopheles balabacensis* Baisas, 1936

This mosquito is present in jungle and forested inland areas. It breeds in shaded temporary pools, muddy animal wallows and hoofprints. *An.balabacensis* was confirmed as the chief vector of malaria in Kalimantan.

3. *Anopheles bancrofti* Giles, 1902

This species is present in swamp forest edge and breeds in peaty water, wells and ditches with vegetation and fallen leaves. This mosquito was confirmed as one of the malaria vectors in Irian Jaya.

4. *Anopheles barbirostris* Van der Wulp, 1984

This mosquito is present in the same areas as *An.aconitus*. The larvae were found breeding in rice fields, ditches, ponds and wells with vegatation and shade. *An.barbirostris* was confirmed as a malaria vector in Sulawesi and Nusa Tenggara.

5. *Anopheles farauti* Laveran, 1902

This species is present in coastal swamps and low-lying riverine areas and is found in practically all types of water collections, brackish as well as fresh water, in the open or under shade. This mosquito was confirmed as one of the malaria vectors in West Irian.

6. *Anopheles flavirostris* Ludlow,1914

This mosquito is present in foothill and hilly areas. It breeds especially in the shaded grassy edges of clear slow-flowing streams. *An.flavirostris* was confirmed as a malaria vector in Sulawesi.

7. *Anopheles koliensis* Owen, 1945

This species is present in grassland and at the edge of the jungle. It breeds primarily in temporary pools. This mosquito was confirmed as one of the malaria vectors in Irian Jaya.

8. *Anopheles letifer* Gater, 1944

This mosquito is present in the flat coastal plain and swamp forest edge. It breeds in peaty water, wells, ditches with vegetation and fallen leaves. This species was confirmed as a vector of malaria in Sumatra and Kalimantan.

9. *Anopheles ludlowae* Theobland, 1903

This species is present in hilly areas. *An. ludlowae* breeds in fresh water river. It was confirmed as a malaria vector in Sulawesi.

10. *Anopheles maculatus* Theobald, 1901

This mosquito is present in hilly and mountainous areas. It breeds in sunlit streams and seepages. This species was confirmed as a malaria vector in Java and Sumatra.

11. *Anopheles minimus* Theobald, 1901

This species is present in foothill and hilly areas. It breeds in the shaded grassy edges of sunlit streams. This mosquito was confirmed as a malaria vector in Sulawesi.

12. *Anopheles nigerrimus* Gilles, 1900

This mosquito is present in lowland areas. It breeds in rice fields and swamps. It was confirmed as a malaria vector in Sumatra and Sulawesi.

13. *Anopheles punctulatus* Donitz, 1901

This species is present in the similar areas of *An.farauti* and *An.koliensis*. *An. punctulatus* breeds in temporary rain water pools. It was confirmed as a malaria vector in Irian Jaya.

14. *Anopheles sinensis* Wiedemann, 1828

This mosquito is present in the similar areas to *An.aconitus*. It breeds in rice fields, ponds and marshes. *An.sinensis* was confirmed as a malaria vector in Sulawesi.

15. *Anopheles subpictus* Grassi, 1899

This species is present in coastal, inland and mountainous areas. Its breeding sites are similar to the breeding places of *An.sundaicus* and *An.aconitus* as well. It was confirmed as a vector of malaria in Java and Sulawesi.

16. *Anopheles sundaicus* Rodenwaldt, 1925

This mosquito is present in coastal areas. It breeds primarily in brackish water, marine fish ponds and lagoons. A fresh water form was found breeding in fresh water ponds in Sumatra. *An sundaicus* was confirmed as a malaria vector in Java, Sumatra, Sulawesi and Nusa Tenggara.

The distribution of malaria vectors in Indonesia based on the studies which had been carried out by previous workers are shown in table 1.

Among the sixteen species of malaria vectors, *An.sundaicus*, which is prevalent in the coastal areas in Java, has to be studied further as it has variations in behaviour. Three types in behaviour of this species of mosquito appear as follows :

1. *An.sundaicus* in the South Coast of Java in general, is highly anthropophylic as it shows its preference for human blood up to 86%[6]. It rests by day on vegetation outdoors, and is known susceptible to DDT.
2. *An.sundaicus* in Kampung village, Cilacap, Central Java, is a pure anthropophylic form. It feeds only on man as there is no cattle present in this area. This mosquito bites man both indoors and outdoors; and is an endophylic species which is found resting on hanging clothing, mosquito-curtains and walls. This mosquito is known resistant to DDT.
3. *An.sundaicus* in Yogyakarta and Purworejo, Central Java is a strongly zoophilic species with a human blood index of 1.3%[5]. It feeds and rests outdoors, and this mosquito is known tolerant to DDT.

CONFIRMED MALARIA VECTORS

1. *An.aconitus*
2. *An-balabacensis*
3. *An-bancrofti*
4. *An.barbirostris*
5. *An.farauti*
6. *An-flavirostris*
7. *An-koliensis*
8. *An-letner*
9. *An-ludlowe*
10. *An-maculatus*
11. *An-minimus*
12. *An-migerrimus*
13. *An-punctulatus*
14. *An-sinensis*
15. *An-subpicus*
16. *An-sundaicus*

VECTOR OF FILARIASIS

Lim Boo Liat (1986) reviewed mosquito vectors of filariasis in Indonesia which were reported by various workers. Twenty species of mosquitoes comprising of 8 *Anopheles* spp., 6 *Mansonia* spp., 3 *Culex* spp. and one each of *Aedes, Armigeres* and *Coquillettidia* were incriminated as filariasis vectors and these were :

Table 1. Distribution of malaria vectors in Indonesia

Locality (islands and towns)	Species of *Anopheles*	Number of mos-*quitoes* dissected	Number of sporozoites *and sporo* - zoite rate in %		*Reference*
JAVA	*An.aconitus*				
Malang		1069	7	0.7	Venhuis, 1942a[11]
Purworejo		9944	9	0.1	Sundararaman et al., 1957.[12]
Cihea		902	24	2.6	Mangkoewinoto, 1923[13] Adhyatma.,1985[5] (confirmed in 1954, 1978, 1980, 1982)
BALI		36	2	5.5	Smalt,1937[14]
KALIMANTAN	*An.balabacensis*				
Kp.Muara Pa-ngean		13	1	7.7	Goelarso, 1934[15] Adhyatma,W.,1985[5] (confirmed in 1981, 1982)
WEST IRIAN	*An.bancrofti*				
Tanah Merah		982	2	0.2	Metselaar,1957[16]
SULAWESI	*An.barbirostris*				
Jeneponto		30	1	3.4	Van Hell, 1952[17]
Kendari		79	1	1.3	Van Hell, 1952[17]
NUSA TENGGARA					Adhyatma.,1985 (Confirmed in 1980)
IRIAN JAYA	*An.farauti*				
Danau Sentasi		261	1	0.4	Metselaar, 1957[15]
Lembah Nimboran		126	3	2.4	Metselaar, 1957[15]
SULAWESI	*An.flavirostris*				
Kendari		30	1	3.4	Van Hell, 1952[17]
WEST IRIAN	*An.koliensis*				
Kotabaru		138	2	1.4	Toffaleti and King, 1947[18]
Lembah Himboran		268	3	1.1	Metselaar, 1957[15]
SUMATRA	*An.letifer*				
Belawan		28	1	3.6	Swellengrebel and[19] S-de Graaf, 1919c
KALIMANTAN					Adhyatma.,1985 (confirmed in 1984)
SULAWESI	*An.ludlowae*				
Margosuko		99	12	12.1	Van Hell,1952[17]
Malili		23	1	1	Van Hell,1952[17]

Table 1. Distribution of malaria vectors in Indonesia (confirmed)

Locality (islands and towns)	Species of *Anopheles*	Number of mosquitoes dissected	Number of sporozoites and sporozoite rate in %		Reference
SUMATRA	*An.maculatus*				
Kisaran		130	1	0.8	Doorenhos, 1927[10]
JAVA					
Wonosobo		130	1	0.8	Sundararaman et. al.,1957[11]
Kediri		136	2	1.5	Venhuis, 1941,[21]
SULAWESI	*An.minimus*				
Kalili		18	1	5.6	Van Hell,1952[16]
SUMATRA	*An.nigerrimus*				
Palembang		182	3	1.6	Overbeek, 1940b[22]
SULAWESI					
Kolaka		21	2	10.0	Van Hell, 1952[16]
WEST IRIAN	*An.punctulatus*				
Lembah Nimboran		2157	24	1.1	Metselaar,1957[15]
Biak		17	1	5.9	Metselaar,1957[15]
SULAWESI	*An.sinensis*				
Benteng		587	8	1.4	Van Hell, 1952[16]
JAVA					
Pamanukan		386	3	0.8	Soesilo, 1935a[23]
JAVA	*An.subpictus*				
Pantai Selatan Jawa Timur		22896	13	0.06	Sundararaman,[11] et.al.,1957 Adhyatma,M.,1985[5] (confirmed in 1982)
SULAWESI					
Ujung Pandang		228	9	0.4	Rodenwaldt,1924[24]
Bolukumba		74	1	1.4	Van Hell, 1952[16]
JAVA	*An.sundaicus*				
Merak		31	1	3.2	Mangkoewinoto,1918[25]
Pantai Selatan Jateng		38164	100	0.3	Sundararaman, et.al.,1957[11]
SULAWESI					
Bajang		4	2	50.0	Van Hell, 1952[16]
SUMATRA,EAST NUSA TENGGARA					Confirmed in 1982,1979 (Adhyatma.,1985)

An. Aconitus
An. Bancrofti
An. barbirostris
An. farauti
An. koliensis
An. nigerrimus
An. punctulatus
An. subpictus

Ma. annulata
Ma. annulifera
Ma. bonneae
Ma. dives
Ma. indiana
Ma. uniformis

Cx. annulirostris
Cx. bitaeniorhynchus
Cx. quinguefasciatus

The Non - Anopheline mosquitoes as filariasis vectors in Indonesia and their bionomics in brief are as follows :

1. Culex quincuefasciatus Say, 1823

This species is abundant in harbour towns and cities. It breeds primarily in polluted ditches and ground pools[8]. Cx. guinguefasciatus was recognized as the only urban bancroftian filariasis vector in Java (Jakarta and Semarang).

2. Culex annulirostris Skuse, 1889

This mosquito was found breeding in puddles, ditches and swamps (Bonne-Wepster, 1954). The larvae often share the breeding sites with An.punctulatus complex. This species was incriminated as a rural bancroftian filariasis vector in West Irian.

Brugian vectors	Bancroftian vectors
1. *Ma.bonneae*	11. *An.subpicius*
2. *Ma.dives*	12. *An.bancrofti*
3. *Ma.annulala*	13. *An.koliensis*
4. *Ma.indiana*	14. *An.larauti*
5. *Ma.uniformis*	15. *An. punctulatus*
6. *Ma.annulifera*	16. *Cx.latigans*
7. *An.barbirostris*	17. *Cx.annulirostris*
8. *An.nigerimus*	18. *Cx.bilaeniorrhynchus*
9. *Ca.crassipes*	19. *Ae.kochi*
10. *An.aconitus*	20. *Ar.obsturbana*

Brugia malayi	*Wuchereria bancrofti*
Brugia timori	

3. *Culex bitaeniorhynchus* Giles, 1901

This species breeds in earthen-lined fresh water collections such as in marshes with low shrubs, unshaded stagnant or slow-running water, and in pools with green algae[9]. It is an anthropozoophylic species and was incriminated as a rural bancroftian filariasis vector in West Irian.

4. *Aedes kochi* Donitz, 1901

This mosquito breeds in leaf axils of several species of plants (banana, pine apple) and was reported as a common pest species in Irian Jaya (Bonne-Wepster, 1954). It was incriminated as a rural bancroftian filariasis vector in West Irian.

5. *Armigered obturbans* Walker, 1860

This species was found breeding in artificial or vegetable breeding sites such as old barrels, tins, rain water receptacles, and fallen coconuts[9]. The water in the breeding sites is often extremely dirty containing decomposed organic matter. *Ar.obturbans* was incrinated as a rural bancroftian filariasis vector in West Irian.

6. *Coquillettidia crassipes* Van der Wulp, 1892

This species was found breeding in a small lake with *Ipomoes* plantations[10]. It breeds usually in fringe habitats of forested areas[6]. Ca.crassipes was incriminated as a rural bacroftian filariasis vector in West Irian.

7. *Mansonia* spp.

These mosquitoes were found breeding in swampy areas with water plantations such as *Eichorrnia crassipes, Pistia stratiotes, Salvinia natans,* and *Ipomoea aquatica.* They were incriminated as the nocturnal subperiodic malayan filariasis vectors in :

Java *(Ma.uniformis, Ma.indiana)*
Sumatra *(Ma.bonneae, Ma.dives, Ma.annulata, Ma.indiana and Ma.uniformis)*
Kalimantan *(Ma.annulata, Ma.uniformis)*
Sulawesi *(Ma.bonneae, Ma.dives, Ma.uniformis)*
Maluku *(Ma.uniformis)*

Eight species of Anopheles incriminated as filariasis vectors were as follows :

1. An.aconitus
2. An.subpictus
3. An.bancrofti
4. An.farauti
5. An.koliensis
6. An.punctulatus
7. An.nigerrimus
8. An.barbirostris

An.aconitus and *An.subpictus* were incrinated as the transmitters of the rural of bancroftian filariasis in Flores.

An.bancrofti, An.farauti, An.koliensis, and *An.punctulatus* were reported as the rural bancroftian filariasis vectors in West Irian, while *An.nigerrimus* and *An.barbirostris* were incriminated as the periodic malayan filariasis vectors in Sulawesi.

An.barbirostris in Nusa Tenggara was incriminated as vector of timorian filariasis.

It is apparent from the above mentioned data, that some species of *Anopheles* may function both as the vectors of malaria and the vector of filariasis as well.

Particular attention should be paid to An.barbirostris, which was incriminated as the vectors of :

1. malaria in South Sulawesi and Nusa Tenggara.
2. periodic type of malayan filariasis in Central Sulawesi and Nusa Tenggara.
3. timorian filariasis in East Nusa Tenggara (Timor and Flores).

An.barbirostris should be studied further as it has two types of behaviouristic appearance, namely :

1. *An.barbirostris* in Java and Sumatra.

This mosquito is an anthropozoophylic form, feeds indoors and outdoors, and rests outdoors, None is found to transmit mosquito-borne disease.

2. *An.barbirostris* in Sulawesi, East Nusa Tenggara, and East Timor.

This mosquito is a zooanthropophylic form, endo- and exophagic, and rests outdoors. It was recognized as the transmitter of the diseases caused by malaria and filarial worms *(B.malayi and B.timori).*

REFERENCES

1. Lie,K.J. and D.M. Rees. (1958). Filariasis in Indonesia : distributon, incidence and vectors. Proceedings of the International Congress of Medicine and Malaria, Lisbon, **11**:360.

2. Gandahusada, S.and Sumarlan (1978). Malaria in Indonesia (A Review Literature). Lokakarya Penelitian dan Pengembangan Kesehatan. Jakarta, 57 pp.
3. Sustriayu, N. (1978). Review on diseases vectors and animal reservoirs. Lokakarya Penelitian dan Pengembangan Kesehatan, Jakarta, 29 pp.
4. Hoedojo,(1983). Vektor malaria di Indonesia. Seminar Nasional Parasitologi ke-3, Bandung, Indonesia, 16 pp.
5. Adhyatma,K.(1985). Vektor malaria di Indonesia. Dit.jen. PPM dan PLP, Departemen Kesehatan Republik Indonesia, 37 pp.
6. Kimowardoyo, S.(1985). Status of malaria vectors in Indonesia. South East Asian J. Trop. Med. Pub. Hlth., **16** (1): 129-132.
7. Lim, B.L.(1986). Filariasis in Indonesia : a summary of published information form 1970-1984. Tropical Biomedicine **3**: 193-210.
8. Hoedojo,(1962). The biology of Culex guinquefasciatus Say in Jakarta, Indonesia. Thesis for the M.Sc.degree, University of Utah, USA, 68 pp.
9. Wijono, K.(1962). The Culicine Mosquito Fauna of Jakarta, Indonesia. Thesis for the M.Sc. degree, University of Utah, USA, 61 pp.
10. Bonne-Wepster, J.(1954). Synopsis of a Hundred Common Non-anopheline Mosquitoes of the Greater and Lesser Sundas, the Molluccas and New Guinea. Elsevier Publishing Company, Amsterdam, 147 pp.
11. Venhuis, W.G. (1942a). Anopheles aconitus aan kaliwanden. Geneesk. Tijdschr. Ned. Ind., **82**: 99-112.
12. Sundararaman,S.,R.M. Soeroto, and M. Siran, (1957). Vectors of malaria in Mid Java. Indian J. Malariology, **11**: 321- 338.
13. Mangkoewinoto,R.M.M. (1923). Assaineering der Tjihea vlakte. Med. Burg. Geneesk. Dienst. Ned. Ind. **12**: 237-275.
14. Smalt, F.H.(1937). Periodieke drooglegging van sawahs ter bestrijding van malaria. Med. Dienst. Ned. Ind., **26**: 285-299.
15. Goelarso (1934). The importance of An.leucosphyrus. Trans. Roy. Soc. Trop. Med. Hyg., **44**: 683-694.
16. Metselaar, D.(1957). A pilot project of residual insecticide spraying in Netherlands New Guinea, contribution to the knowledge of holo-endemic malaria. Acta Leidensia, **27**: 1-128.
17. Hell, J.C. van (1952). The anopheline fauna and malaria vectors in South Celebes. Doc. Med. Hyg., **44**: 683-694.
18. Toffaletti, J.P. and M.V., King (1947). Some records of mosquito dissections in Northern New Guinea. Trop. Dis. Bull.**43**: 958-959.
19. Swellengrebel, N.H. and J.M.H. Swellengrebel-de-Graaf, (1919c). Onderzoekingen over de verspreiding der anophelinen in verband met die der malaria in eenige stations van Java en Sumatra. Med. Burg. Gen. Dienst. Ned. Ind. **8**. (X): 1-67.
20. Doorenbos, W.B. (1927). Zijn de muskieten die malaria onderhouden abnormal levende exemplaren ? Geneesk. Tjidchr. Ned. Ind., **67** : 21-27.
21. Venhuis, W.G.(1941). De vindplaatsen van geinfecteerde Anopheles maculatus tijdens een epidemie in Oast Java. Geneesk. Tijdschr. Ned. Ind., **81**: 2178-2188.
22. Overbeek,J.G. (1940b). Malaria onderzoek in de kolonisatie Belitang (Res.Palembang) in April 1940. Geneesk. Tijdschr. Ned. Ind., **80**: 2166-2177.
23. Soesilo,R.(1935a). The hyrcanus (sinensis) problem in Java (Preliminary report). Med. Dienst. Volksgez. Ned. Ind.,**24**: 68-71.
24. Rodenwaldt, E.(1924). Speciesassanierung. Arch. Schiffs. Trop. Hyg., **28**: 313-334.
25. Mangkoewinoto, R.M.M.(1918). Anophelinen van West Java. Geneesk. Tijdschr. Ned. Ind., **28**: 462-498.

QUESTIONS AND ANSWERS :

1. Question: Is *An.nigerrinum* a vector of periodic B.malayi ?

   Answer : That is true according to the team of the Directorate of Communicable Diseases Centre, Department of Health.

2. Question: In which part of South Kalimantan is Cq. crassipes a vector of B.malayi. Dissection of thousands specimens show the presence of L_3 of Cardiofilaria, not B.malayi.

   Answer : According to Dr. Lim B.L. it is found in South Kalimantan and from more than 8.000 mosquitoes dissected, 0,05 % were infected naturally.

3. Question: Where does An.ludlowae exist ? And who has the specimen ? The species does not exist anymore.

   Answer : In Sulawesi according to Van Hell (1952). It is found in Malili. 23 mosquitoes dissected: 1 positive with sporozoites.