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Malaria in the Republic of the Philippines

A review

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Summary

Malaria in the Republic of the Philippines is caused principally by *P. falciparum* and *P. vivax,* with the former as predominant species. *P. malariae* is occasionally reported, while *P. ovale* is very rare and has been reported only in the island of Palawan.

Malaria is widespread in distribution with prevalence varying from one area to the other. In 1970, the malaria morbidity rate was reported to be 77.6 per 100,000 while the mortality rate was 1.8 per 100,000. Case detection activities revealed that, in 1973, the slide parasite rate was 7.2%, the annual parasite index was 6.1% and the annual blood examination rate was 8.4%.

The principal vector of malaria in the Philippines is *An. minimus flavirostris* which breeds in clear, fresh-water streams in foothills and mountain slopes. *An. mangyanus* and *An. maculatus* appear to play a secondary role. The vectorial capacity of the former appears to be confined only where conditions are primitive, while the latter is associated with malaria transmission in high altitudes. In the absence of fresh-water streams, the salt-water breeder mosquito, *An. litoralis,* assumes the vectorial role.

The epidemiology of malaria in the Philippines is discussed. Emergence of strains of *P. falciparum* with diminished sensitivity to the commonly used antimalarial drugs is reported in Palawan and Rizal provinces.

The development of malaria control activities in the Philippines are presented. As of 1972, Cagayan Valley, Palawan, Mindoro, Sulu and circumscribed areas in Mindanao are still considered hard-core malarious areas with on-going persistent transmission.

Key words: Malaria; Epidemiology; Philippines.

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Introduction

Malaria in the 1970's remains one of the unrelenting public health problems in the Philippines. It is the 7th most important disease of the 10 leading causes of morbidity.

It is indubitable that malaria exacts heavy toll in terms of economic losses. It has been estimated that the annual losses from malaria in pecuniary value come up to the staggering tune of Philipp. Pesos 100,000,000 to 750,000,000. Because of the telluric implications of malaria, the people in agriculturally productive areas bear the brunt of the disease. Efforts to open new lands for agricultural development have been met with dismal failure because of malaria; either they have to be abandoned or the population perish from malaria. Malaria, therefore, remains the bane of economic progress in most developing countries in the tropics, including the Philippines.

The causative agent

The 4 species of human plasmodia, viz. *Plasmodium falciparum, P. vivax, P. malariae,* and *P. ovale* are known to occur in the Philippines.

The predominating species changed from *P. vivax* historically to *P. falciparum* currently. Before World War II *P. vivax* was the predominant species being responsible for more than three-quarters of malaria infections. For instance, in a survey conducted in 1928 which covered 16 provinces, 75.5% of positive slides were *P. vivax* while 24.1% and 0.5% were *P. falciparum* and *P. malariae* respectively.

During World War II, *P. falciparum* reportedly became the predominating species as a result probably of the influx of infected soldiers who contracted the infection from the Pacific Region where *P. falciparum* is known to be predominant. But soon after the war and during the early stages of the malaria control program, *P. vivax* reasserted its dominance. As late as 1954, in various surveys conducted by the then Malaria Control Division, roughly two-thirds of the positive blood smears were *P. vivax* and one-third were *P. falciparum,* which is about the same proportion as reported by Russell in 1936 (Ejercito et al., 1954).

The picture, however, changed completely in 1957 when *P. falciparum* became the predominating species. For instance, of 1,092 malaria positive slides examined, 64.35% were *P. falciparum,* 34.29% were *P. vivax,* 0.72% mixed infection with *P. falciparum* and *P. vivax,* and 0.72% *P. malariae.* Again, from 1967 to 1971, out of 130,441 persons found positive for malaria, 63.29% had *P. falciparum,* 32.82% had *P. vivax,* and 0.58% had *P. malariae* and 1.8% had mixed *P. falciparum* and *P. vivax* infection.

As late as 1972, the parasite formula for the whole Philippines consisted of 65.17% *P. falciparum,* 32.82% *P. vivax,* 0.38% *P. malariae,* and 1.63% mixed infection. These findings indicate that, at present, *P. falciparum* is the predominating species in a considerable part of the malarious areas of the Philippines. *P. falciparum* is predominant in areas where conditions favorable for intense and persistent transmission exist, while *P. vivax* is higher in the low incidence areas. An exception to this, however, is Pangutaran island in the Sulu Archipelago where intense malaria transmission occurs and where the salt-water breeder *An. litoralis* is the principal vector. Here of 168 cases of malaria diagnosed, 83 were due to *P. vivax*, 79 were *P. falciparum*, 4 mixed *P. vivax* and *P. falciparum* and 2 were *P. malariae* (Cabrera et al., 1970).

Cases of *P. malariae* have been reported in Sulu, Palawan, Mindanao and Luzon while the indigenous cases of *P. ovale* infection were reported in Palawan Island in 1969 (Malaria Eradication Project, Progress Report, 1972).

The morphology and pathogenicity of the 4 species of human plasmodia reported in the Philippines conform with the literature description of the classical type species. However, there is a morphological variation reported occasionally in local *P. vivax* which was described as the "tenue phase" (Pesigan, 1947).

P. falciparum, like in other countries, produces the most serious symptoms with highest mortality and morbidity. It is the species associated with reports of malignant or cerebral malaria.

The susceptibility of man to some species of monkey plasmodia has caused considerable stir on their implications with the attempts to eradicate human malaria. This is particularly true in the Philippines where monkeys abound in considerable numbers in sylvatic habitats frequented by man. Where an inter-transmissible plasmodium, monkeys, appropriate vector and man are found in the same habitat, the condition becomes critical. Two species of malaria have so far been reported in the Philippine monkeys *(Macacca irus): P. knowlesi* from monkeys originating from the island of Cebu (Lambrecht et al., 1961) and *P. inui* from monkeys originating from the island of Palawan (Howard and Cabrera, 1961).

Distribution and prevalence

Malaria has been known in the Philippines since time immemorial. It is reasonably certain that the disease was indigenous when Magellan discovered the island in 1521. The first authentic record of the extent and prevalence of malaria appeared in the Philippine Census of 1903. According to this report, 118,476 deaths were attributed to malaria in 1903 (Adan, 1954).

Prior to the initiation of any control measure, malaria was rampant all over the Philippines. It is found from the northernmost islands of Batanes to the southernmost islands of the Sulu Archipelago.

In 1954, a survey conducted revealed that in more than half of the provinces, malaria was hyperendemic in 1 or more areas. Of 4,505 barrios in which spleen surveys were conducted, 67 were hyperendemic (>50% positive), 317 were mesoendemic (10–50% positive) and 297 were hypoendemic (<10% posi-

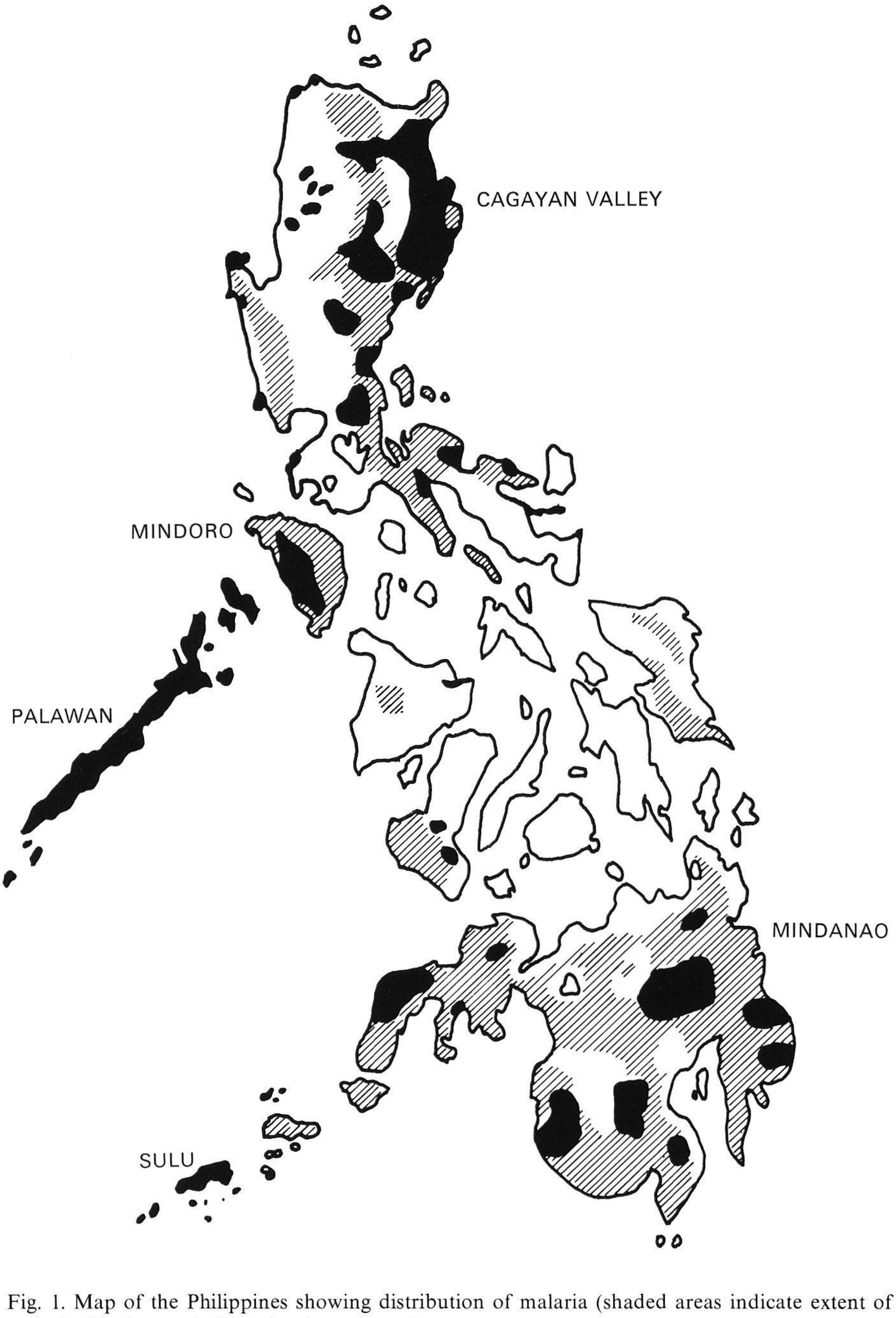

Fig. 1. Map of the Philippines showing distribution of malaria (shaded areas indicate extent of malaria; black areas indicate hard-core areas).

Table 1. Malaria morbidity and mortality reported by the Disease Intelligence Center of the Department of Health from 1946 to 1970

Year	Population	Morbidity		Mortality	
		No.	Rate	No.	Rate
1946	18,434,400	184,482	1000.7	16,783	91.0
1947	18,785,700	119,395	635.6	12,070	64.3
1948	19,143,800	85,732	447.8	10,558	55.2
1949	19,689,800	70,283	357.0	8,801	44.7
1950	20,315,800	63,075	310.5	7,778	38.3
1951	20,962,800	54,142	258.3	7,721	38.8
1952	21,628,300	54,591	252.4	7,170	33.2
1953	22,316,000	54,119	242.5	6,720	30.1
1954*	23,025,500	71,363	309.9	5,236	22.7
1955	23,747,600	79,707	335.5	3,714	15.6
1956	24,513,000	73,560	300.1	2,804	11.4
1957	25,292,400	60,029	237.3	2,376	9.4
1958**	26,096,600	71,666	274.6	2,253	8.6
1959	26,926,400	61,645	228.9	1,763	6.6
1960	27,792,000	55,252	198.8	1,587	5.7
1961	28,727,000	44,546	155.1	1,373	4.8
1962	29,698,000	40,342	135.8	1,273	4.3
1963	30,709,000	36,295	118.2	1,114	3.6
1964	31,270,000	40,854	130.6	976	3.1
1965	32,345,000	28,988	89.6	1,015	3.1
1966	33,477,000	33,737	100.8	1,373	4.1
1967	34,656,000	31,441	90.7	1,147	3.3
1968	35,883,000	28,354	79.0	1,061	3.0
1969	37,158,000	31,756	85.5	860	2.3
1970	36,849,000	28,594	77.6	666	1.8

* 1954–1957: Malaria control
** 1958–1970: Eradication

tive) (Ejercito et al., 1954). While the extent of malaria endemic areas has receded considerably as a result of the combined effects of urbanization, agricultural development and control, still highly malarious areas in the Philippines exist today. These are the foothills of Cagayan Valley (from Bayombong to Aparri), the whole island of Palawan, circumscribed areas in Mindanao, Mindoro Occidental, and the Sulu Archipelago (Fig. 1).

In hard-core malarious areas, like Mindoro for instance, the infant parasite rate is as high as 32% while the spleen rate in children of pre-school and school-age is about 50% (Adan, 1954).

In 1935, malaria was reported to be responsible for 10,000 to 20,000 deaths and at least 2,000,000 clinical cases annually. At that time the Philippine population was estimated to be only 13,000,000 (Russell, 1936). Malaria rates in-

Table 2. Results of malaria case detection activities showing slide parasite rate (SPR), annual parasite incidence (API) and annual blood examination rate (ABER) of the Department of Health from 1953 to 1974

Year	Target population	No. of slides examined	No. positive	% positive (SPR)	API	ABER
1953		48,785				
1954		8,627*				
1955		144,756				
1956		106,489				
1957	6,825,051	661,287	15,343	2.32	2.25	9.7
1958	6,825,051	492,464	20,609	4.18	3.01	7.2
1959	7,787,851	970,054	40,041	4.13	5.14	12.4
1960	8,054,761	762,326	42,110	5.52	5.22	9.5
1961	8,303,191	987,082	31,225	8.16	3.76	11.9
1962	8,261,175	1,069,283	37,931	3.55	4.59	12.9
1963	6,603,797	852,809	20,368	2.39	3.08	12.9
1964	6,766,398	1,197,392	27,910	2.33	4.12	17.7
1965	8,049,708	860,818	26,502	3.08	3.29	10.7
1966	8,540,832	694,601	15,932	2.29	1.86	8.1
1967	5,893,388	207,880	18,808	9.04	3.29	3.5
1968	8,390,341	376,244	18,717	4.97	2.23	4.5
1969	10,538,069	562,685	20,117	3.57	1.90	5.6
1970	11,062,460	1,314,685	35,686	2.71	3.22	11.9
1971	11,433,109	1,220,083	37,113	3.04	3.24	10.7
1972	11,575,121	825,794	27,748	3.30	2.40	7.1
1973	11,857,517	1,001,627	72,422	7.20	6.10	8.4
1974	11,157,908	568,547(½)	41,729(½)	7.33	7.47	10.2

* partial report

creased during World War II, and, during the Japanese occupation, it was estimated that there were more than 4,000,000 cases annually (Smith, 1950).

The recession of the frontier of malaria endemic areas is reflected in the continuous decline of the morbidity and mortality rates from malaria as reported by the Disease Intelligence Center of the National Department of Health. For instance, in 1946, the morbidity rate was reported at 1000.7 per 100,000 while mortality rate was 91.0 per 100,000. In 1970, the morbidity rate was 77.6 per 100,000 while the mortality rate was 1.8 per 100,000 (Table 1).

Despite the decrease in malaria morbidity and mortality, the annual parasite incidence rate (API), the slide positivity rate (SPR) and annual blood examination rate (ABER) as gathered by case-detection activities have remained fairly constant. For instance, in 1957, the SPR was 2.32% while the API was 2.25% and ABER was 9.7%. In 1972, the SPR was 3.30% while the API was 2.40% and ABER was 7.1%. There was even a tendency for those figures to go up as shown in 1973 and part of 1974 surveys (Table 2).

Mosquito vectors and their bionomics

Anopheles minimus flavirostris (Ludlow) has been incriminated as the most important vector of human malaria in the Philippines (Manalang, 1931; King, 1932). It belongs to group *Myzomyia* of subgenus *Myzomyia* which includes 3 other species found locally: *An. filipinae* and *An. mangyanus* (Baisas, 1957).

An. m. flavirostris is widespread in distribution. It is an extremely ubiquitous species, found practically in all places where suitable breeding places exist as in foothills and mountain slopes. This mosquito breeds along the shaded margins of clear, cool, slow-flowing streams where bamboo shoots, grasses and similar materials intercept the water surface (Ejercito, 1952). *An. m. flavirostris* has been occasionally reported in altitudes as high or even higher than 3200 feet above sea level; as in Kiangan (3200 ft.) and Trinidad (4500 ft.) in the Mountain Province, also in the vicinity of Lake Lanao (2300–2500 ft.) and in Bukidnon plateau (2000 ft.) in Mindanao (Villanueva and Kalaw, 1957).

During daytime, *An. m. flavirostris* adults rest outdoors and indoors. Outdoors, they rest in cool, moist, dark harborages such as under overhanging banks and vegetations of the streams in which they breed. Those that are found inside houses early in the morning remain there for the rest of the day unless disturbed. Inside houses, 70% rests on the surfaces of walls, posts, furniture, etc., while 30% alight on objects such as pillows, blankets, mosquito nets, clothes, etc. (Baisas, 1957). Indoors *An. m. flavirostris* are usually found on vertical surfaces within 1 foot of the floor level and rarely seen resting more than 5 ft. above the floor level (Baisas, 1953).

The population density of *An. m. flavirostris* varies depending on rainfall. Prolonged or delayed rainy season shifts the peak density accordingly. In general, peak densities are from September to December; often with a secondary peak in June and July.

Dusk appears to stimulate the activity of *An. m. flavirostris* becoming active and leaving their resting places a few moments after sunset. The females bite readily outdoors, and they do not enter houses immediately in quest of blood meal in the early evening. They are principally zoophilic, being attracted more readily to domestic animals particularly carabaos (domestic water buffaloes, *Bubalus carabanensis*) and cattle. They could fly for at least 2 km, but their effective flight range is generally 1 km (Russell, 1936).

An. mangyanus (Banks) and *An. maculatus* (Theobald) are considered secondary vectors of malaria in the Philippines (Smith, 1950). The vectorial capacity of *An. mangyanus*, however, is confined only to places where conditions are primitive such as what exist in Mangyan communities in certain sections of Mindoro. This anopheline is a domestic species, and rests both indoors and outdoors during the day. It is not particularly attracted by either man or domestic animals. It has a spotty distribution, being absent from certain islands like Palawan and from nearly all of Mindanao (Baisas, 1957).

An. maculatus appears to be the mosquito responsible for malaria transmission at high altitudes (Baisas et al., 1950). Female *An. maculatus* has been shown positive for malaria cysts or sporozoites but once (Ejercito, 1934). Since then, attempts to demonstrate malarial parasites in this anopheline species have failed. It has not caused malaria outbreaks even in places where it is found and where gametocyte carriers are also present. Nevertheless *An. maculatus* is considered a potential malaria vector under Philippine conditions. The only factor which prevents it from being one is the unfavorable environmental conditions (Catangui, 1969).

An. litoralis King has also been incriminated as a vector of malaria in places where suitable breeding places for *An. m. flavirostris* are absent, such as in the islands of Antig and Tatalan (Catangui et al., 1969) and Pangutaran (Cabrera et al., 1970) in the Sulu Archipelago. *An. litoralis* breeds in salt and brackish waters both in urban and rural areas with salinity of 1% or 10,000 ppm (Gonzales, 1970). It breeds in water accumulations in rock holes and/or depressions on coral reefs (Cabrera et al., 1970).

Epidemiology

Malarious areas in the Philippines are located in the more mountainous areas and in the hilly and foothill countrysides. The highest level of transmission is usually found in these areas where available breeding places for the principal malaria vector, *An. m. flavirostris*, abound. Malaria decreases as one moves into the larger central and coastal plains. But in certain areas, as in some small islands of the Sulu Archipelago, the coastal areas are likewise malarious. Here malaria transmission is taken over by the salt water breeder anopheline, *An. litoralis.*

Malaria in the Philippines is principally a rural disease with telluric implications. It is most prevalent in barrios with population of less than 1000. As areas evolve from rural to become urban, *An. m. flavirostris* generally disappears presumably due to clearing, pollution, and other changes in the stream in which it breeds. This does not hold true in all circumstances. In 1931, for instance, *An. m. flavirostris* was found breeding in the northern parts of Manila (Baisas et al., 1950). In 1947, or 16 years later, larvae, pupae and adults were collected in the streams in the same area (Dy and del Rosario, 1948).

The annual distribution of malaria in the Philippines varies depending on the rainfall. In regions with distinct wet and dry season, breeding of *An. m. flavirostris* may be interrupted during the dry season when the small streams become dried. During the wet season, the torrential rains will flush the breeding sites of the vector. There may be 2 seasons of transmission: at the beginning and at the end of the dry season (Baisas, 1957). But in regions where there are no marked wet or dry season, malaria is perennial (Russell, 1936) (Fig. 2).

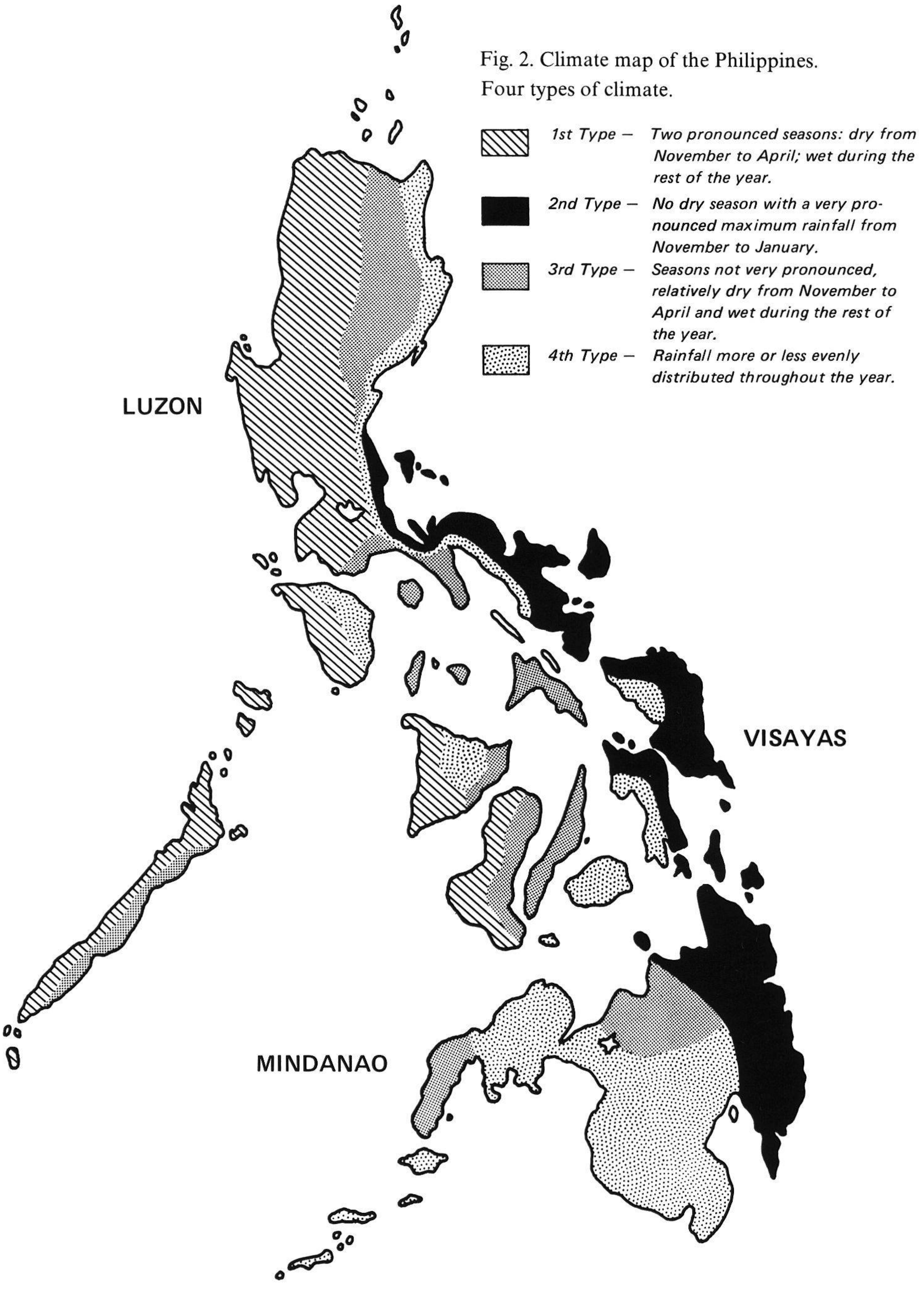

Fig. 2. Climate map of the Philippines.
Four types of climate.

Although malaria is generally claimed to occur only in lowland areas where the anopheline vectors are able to breed, outbreaks have also been reported to occur in high altitudes. For instance, outbreaks of malaria were reported in Lanao province bordering Lake Lanao with altitudes of 2150 to 2700 feet above sea level. This region was distinctly malaria free until the outbreak of World War II. It was noted during the war that the density of *An. m. flavirostris* was too low under ordinary conditions to maintain transmission and eventually produce an epidemic. Ostensibly, this deficiency was counterbalanced by the accumulation of gametocyte carriers and the increase susceptibility of the population due to the stress of war (Villanueva and Kalaw, 1957).

The presence of minority groups, many of them with elusive habits, and the mobility of the population particularly in unsettled areas ("kaingins") maintain the endemicity of malaria in some areas. Malaria transmission occurs mostly at the fringes of forests where settlers move in to open new frontiers. In unsettled areas there are few susceptibles that would support intense malaria transmission, but when less immune settlers move in, malaria flourishes. Eventually, malaria in this area would decrease as the ecology is changed by agricultural development; the area is cleared, population stabilized, and accessibility improved. This is not the case though with the nomadic minority group.

In general, the ecologic attributes of the Philippines, like all tropical countries, are conducive to malaria transmission. For instance, the atmospheric temperature is perennially adequate for transmission of both *P. vivax* and *P. falciparum.*

Drug resistant strains of *P. falciparum*

Strains of *P. falciparum* with diminished sensitivity to the commonly used anti-malarial drugs have emerged in some malarious areas of the Philippines.

As early as 1968, reports in the decreased sensitivity of *P. falciparum* to camoquine (amodiaquine) have been made (Malaria Eradication Project, 1972).

In 1971, the emergence of a chloroquine and other anti-malarial drug resistant strains of *P. falciparum* was reported for the first time in the island of Palawan, one of the hard-core malarious areas in this country (Ramos et al., 1971). RI and RII grade chloroquine resistant strains of *P. falciparum* were observed among persons with naturally acquired and blood-induced infections.

The existence of *P. falciparum* strains exhibiting resistance to antimalarial drugs belonging to the same or different groups have also been reported. For instance, chloroquine resistant strains of the parasite exhibit resistance also to amodiaquine. Both chloroquine and amodiaquine belong to the same 4-aminoquinoline group of anti-malarials. Similarly, the same cross-resistant strains exhibit fastness to combine pyrimethamine and primaquine which belong to a different group of anti-malarials. Furthermore, there is indication that some species of *P. falciparum* also exhibit reduced sensitivity to quinine.

Because of these findings, efforts are presently being intensified to uncover other areas with anti-malaria resistant *P. falciparum.* In addition to Palawan, emergence of chloroquine resistant strains of *P. falciparum* has been reported also in some parts of the province of Rizal and possibly in other parts of the country.

Malaria control and malaria eradication

Prior and up to the mid-1920's, there was no organized program for the control of malaria in the Philippines. It was only in November, 1926 that the Philippine Health Service, with the assistance of the International Health Board of the Rockefeller Foundation, decided to wage a formal combat against malaria by creating a Malaria Control Section. Control was initiated in certain highly malarious areas using larviciding methods (paris green and improvement of various mechanical and naturalistic methods) and chemotherapy with quinine, totaquine, and plasmochin. These measures kept malaria at bay until the outbreak of World War II (Malaria Eradication Project, 1974).

Control was resumed in 1946, a year after the end of the war. Until 1950 the malaria control program concentrated on mechanical and naturalistic methods directed against the larval stage using DDT-treated saw dust. Sanitoagronomic methods directed to control malaria on agricultural lands eliminated malariogenic waters and opened up areas for cultivation. In certain regions, the use of sanito-agronomic methods resulted in increased food production and improvement of rural life (Ejercito, 1951).

In 1952, the Philippine Department of Health, WHO, and USAID jointly established a Malaria Pilot Project in Mindoro to evaluate the efficacy of DDT residual spraying for malaria control. Riding high on the success of the pilot project, which caused marked reduction in spleen and parasite rates barely after a year, the Government was prompted to formulate in 1959 the 6-year Philippine-American Plan of Malaria Control for the Philippines. In 1956, the program was shifted to high gear from mere control to malaria eradication.

The original contingency plan was beset by a number of drawbacks resulting in the steady decline of operations and an inexorable increase in malaria cases. This prompted the Philippine Congress in 1966 to enact the Malaria Eradication Act (R. A. 4832) which provided among others the consolidation of all functions under a central body and the allocation of adequate funds for the implementation of the project.

The program adopted by the Philippines is patterned after that recommended by the WHO (1957) which, significantly, consists of residual spraying with DDT at the dose of 2 g/m^2 twice a year. Table 3 shows the spraying operations conducted by the Malaria Eradication Service of the Department of Health.

Table 3. Residual spraying operations conducted by the Malaria Eradication Service of the Department of Health from 1953 to 1974

Year	Target houses		No. houses encountered		No. houses sprayed		% accomplished	
	1st cycle	2nd cycle	1st cycle	2nd cycle	1st cycle	2nd cycle	1st cycle	2nd cycle
1953	Experimental only				149,879			
1954	1,260,000				1,260,694			
1955	1,260,000				1,260,478			
1956	1,260,000				1,429,314			
1957	1,260,000				1,519,857			
1958	600,000				426,763			
1959					467,692	105,897		
1960	542,300	510,037			689,915	149,268		
1961	511,751	574,708			535,162	64,473		
1962	207,537	514,725			668,504	234,442		
1963	200,097	456,890			574,487	371,311		
1964	690,134				623,901	354,210	90.4	51.3
1965	800,790				588,789	646,242	74.0	81.0
1966	986,811				676,215		68.5	
1967	Containing action			1,183,231		1,019,866		86.2
1968	1,528,718	1,528,718	365,066	763,235	276,527	647,292	75.7	84.3
1969	1,612,608	1,022,557	1,069,492	1,080,528	866,233	910,991	82.9	84.3
1970	1,003,239	491,975	1,052,708	477,128	876,887	396,525	83.2	83.1
1971	292,455	270,630	277,969	281,973	234,934	233,694	84.5	82.8
1972	283,630	435,200	282,205	388,415	233,094	304,533	82.5	78.4
1973	345,756	453,039	244,265	375,284	201,934	345,467	83.0	93.0
1974	445,805		362,794		333,978		92.0	

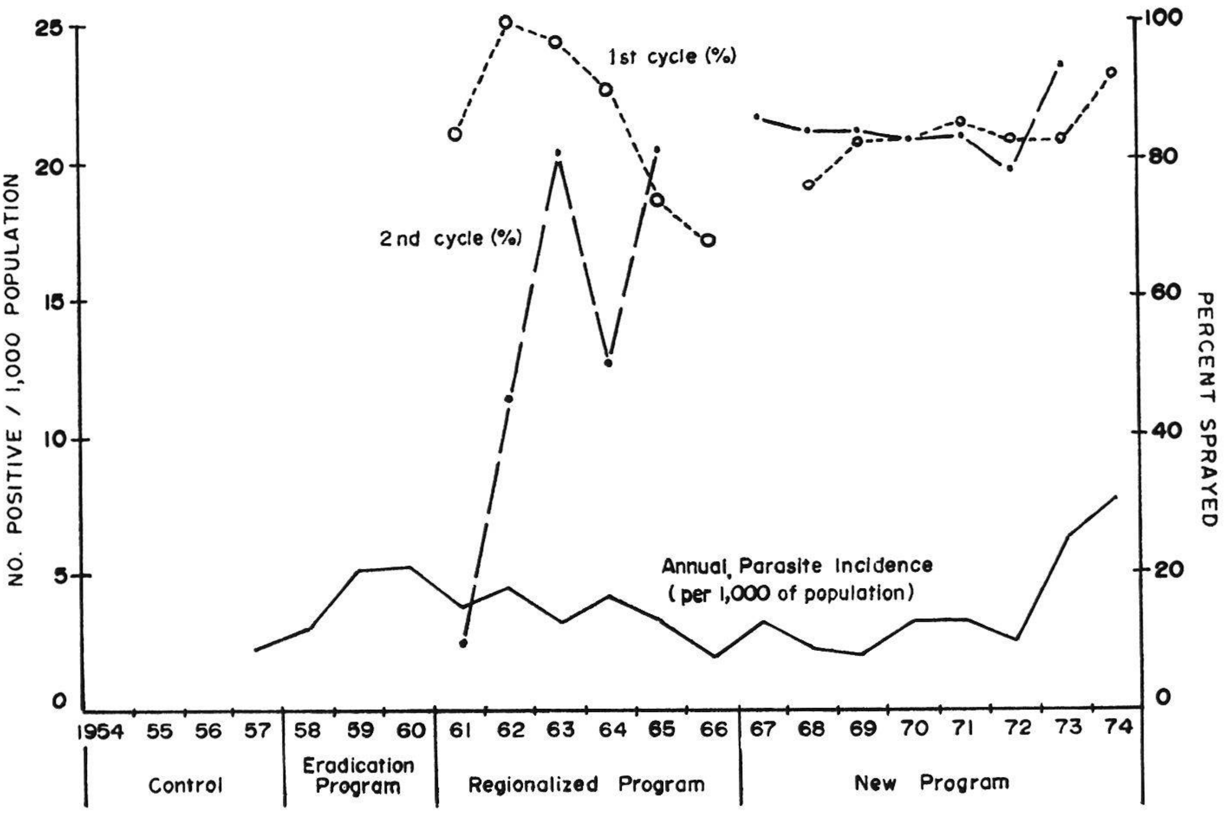

Fig. 3. Annual parasite incidence and two-cycle spraying operations in malarious areas in the Philippines during the different phases of control and eradication activities from 1954 to 1974.

This is augmented by case finding and the use of anti-malarial drugs. Table 2 shows the results of malaria case detection conducted by the Malaria Eradication Service – the implementing arm of the malaria eradication program.

Malaria eradication in the Philippines is attended by a number of problems, which include: ruggedness of terrain and widely scattered population in isolated communities; difficulty of communication particularly during rainy season; mobility of population; flimsiness and temporary nature of dwellings; presence of minority groups with elusive habits; changes in behaviour of vector species from endophily to exophily in the presence of suitable outdoor resting places; emergence of resistance or diminished sensitivity of *B. falciparum* to classical anti-malarials; law and order situation which interfere with the continuity of anti-malaria operations; and refusal to house spraying and rubbing off or washing off of sprayed surfaces. Nevertheless, solutions and/or remedial measures have been applied to overcome these problems (Malaria Eradication Project, 1974).

Fig. 3 shows the annual parasite incidence and 2-cycle spraying operations in malarious areas in the Philippines during the various phases of control and eradication activities (1954–1974).

Present status

As of 1972, approximately two-thirds of people living in malarious localities dwell in areas classified as belonging to category "C" where only vigilance is needed and no regular attack measures are necessary. About one-fifth of the malarious areas are classified as belonging to category "B" where only surveillance is necessary with occasional attack measures applied as recrudescences occur. The remaining malarious areas where less than one-fifth of the population dwell is considered belonging; to category "A" where regular measures are still required. Areas considered under category "A" include Cagayan Valley, Palawan, Mindoro, Sulu and a few scattered parts of the country (Gutierrez, 1970).

Categories of malarious areas:
"A" = hard-core areas with persistent transmission
"B" = low transmission areas with sporadic transmission only
"C" = pre-maintenance areas.

In 1973 and 1974 the annual parasite incidence showed a definite increasing trend.

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