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BIONOMICS OF ANOPHELES SUNDAICUS AND OTHER ANOPHELINES ASSOCIATED WITH MALARIA IN COASTAL AREAS OF BALI, INDONESIA

by

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ABSTRACT

In two villages on the north coast of the island of Bali, Indonesia, among the known malaria vectors, Anopheles sundaicus predominated in outdoor catches, but was completely absent from indoor nocturnal landing catches. This species was also most prevalent in lagoons, especially during the dry season. In morning indoor resting catches, as well as in cattle shelters, An. subpictus outnumbered all other species in two coastal villages and one rice-growing village. In the inland village, about 3 km from brackish water impoundments, neither An. sundaicus nor malaria was recorded, but An. aconitus occurred throughout the year, along with An. subpictus. However, monthly malaria rates were high in villages in the coastal areas in the proximity of rice-fields where the three malaria vectors were concurrently present throughout the year. In the dry season, high adult and larval densities of both An. sundaicus and An. subpictus usually began to decline in June to July after DDT house spraying, but further reduction depended upon weekly larviciding with diesel oil. DDT residual spraying toward the end of the rainy season appears to be more effective if intensive weekly larviciding with diesel oil is concurrently carried out.

1. INTRODUCTION

In the coastal areas of many islands of Indonesia, including Java and Bali, Anopheles sundaicus is known to be the main vector of malaria. It breeds in lagoons and brackish water impoundments, especially during the dry season, as they become suitable breeding sites due to sand banks created by the action of waves and/or high tide (Sundararaman et al., 1957). In some of the coastal areas, artificial fish ponds are also common in which An. sundaicus and An. subpictus breed concurrently.

Along the coastal regions in the province of Bali, malaria is patchy in distribution and prevalence. The monthly incidence of malaria does not appear to be closely related to seasonal rainfall as there are more cases of malaria at the end of the rainy season though some occur throughout the year. This seasonal peak needs explanation, in view of the fact that An. sundaicus is known to be more abundant during the dry months. There is very little

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rain in most of the coastal areas from May to September and the number of malaria cases is approximately 40-50% of that during the rainy months. It was realized that field studies were needed on the ecology of lagoon-breeding vector species as related to malaria transmission, and on the impact of the application of larvicidal oil as practised in the national malaria control programmes (Arwati & Kesavalu, 1980).

In view of the above, field studies were carried out[1] over a 13-month period, starting in April 1980, in three villages sprayed with a 75% DDT water-dispersible powder (wdp) formulation and where anti-larval oil was applied. The purpose was to determine the geographical distribution and seasonal abundance of anopheline vectors and to relate this to malaria transmission.

2. EVALUATION AREA

The three villages selected for evaluation are in the Buleleng regency, province of Bali (8°05'S - 115°00'E), and are located in the northern coast of the island (Fig. 1). The majority of the population are of the Bali Hindu religion, and their main occupations are agriculture and fishing. Nearly 10% of the land in the regency is used for rice cultivation. The climate is tropical with a dry season usually lasting from May to October (Fig. 2).

As in other parts of Bali, an antimalaria control programme has been operating since 1960, including focal DDT residual spraying twice a year, along with the application of diesel oil in lagoons and other brackish water impoundments (Fig. 2). There are about 85 active lagoons in the regency, nearly 40% of a total of 225 on the island. Annual use of anti-larval oil during 1979 to 1981 amounted to 2-300 000 l, whereas DDT[2] consumption was about 10 tons (approximately 40% of total used in the province) to cover only about 10% of the total number of houses. During 1978 to 1980, over 30% of all malaria cases in Bali occurred in the Buleleng regency and slide positive rates (SPR) have been the highest, ranging from 1.4% in 1977 to 3.1% in 1980. The susceptibility of An. sundaicus or An. subpictus to insecticides has not been determined in Bali, though in Java these same vector species are reported to be highly resistant to DDT and dieldrin (Soerono et al., 1965).

The three villages evaluated were the following:

(a) Sanih. The village is located 18 km east of the Buleleng regency capital, Singaradja. It is situated on the coast with many lagoons, but there are no nearby rice-fields.

(b) Kalibukbuk. The village is about 9 km west of Singaradja. It is also situated on the coast, but there are irrigated rice-fields as well as lagoons in the area.

(c) Ringdikit. This village is about 25 km west of Singaradja and 3 km inland from the coast at an elevation of about 100 m. The area is hilly with irrigated and terraced rice-fields.

3. METHODS

In each of the three selected villages, routine entomological collections were carried out twice a month for 13 months (April 1980 to April 1981) as follows:

(a) indoor and outdoor landing catches for each of two fixed houses by two collectors, each exposed from 18:00 to 22:00 h;

(b) collection of mosquitos resting in and around three cattle shelters by one scout, 15 minutes per hour from 18:00 to 22:00 h;

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[1] In collaboration with the Provincial Health Services of Bali.

[2] 75% water-dispersible powder (wdp).

(c) indoor resting catches in 10 fixed houses by one scout, 15 minutes/house, during morning hours between 08:00 and 10:00 h;

(d) larval dipping in at least two lagoons and/or rice-fields, 50 dips/area. Samples of collected larvae and pupae were reared to the adult stage for identification since in their immature stages An. sundaicus and An. subpictus cannot be readily distinguished morphologically.

To determine the flight range of An. sundaicus from their breeding habitats, seven collection sites (houses and cattle shelters) were selected at distances of 50, 150, 250, 350, 450, 550 and 750 m along the upper stream of a river adjoining the Sanih lagoon. During the months of December 1980 through August 1981, 12-25 routine night outdoor landing, night and morning resting collections were carried out at these transect sites.

The malaria SPRs used in the present evaluation were those determined from both active and passive case detections by provincial malaria control programmes, about two-thirds of the slides being from the former. Approximately 90% of the cases were infected with Plasmodium vivax and the remainder with P. falciparum.

4. RESULTS

4.1 Distribution of anopheline species

During a period of 12 months (May 1980 to April 1981), a total of 10 anopheline species were identified from the three evaluation villages; numbers of each species caught varied with each village and collection method (Table 1). More species were collected from the coastal village with rice-fields (Kalibukbuk) than in the other two localities, and by nocturnal resting collections in cattle shelters than in the nocturnal landing or indoor morning resting catches in houses. In the two coastal villages (Sanih and Kalibukbuk), An. sundaicus predominated among malaria vectors in the nocturnal landing collections, whereas in both the night and morning resting catches An. subpictus was most numerous. In the inland village (Ringdikit) An. aconitus was the most abundant species in the night landing catches, followed by An. vagus which also predominated in the nocturnal resting catches in cattle shelters.

Table 1 also shows the results of larval and pupal collections made by dipping methods. As in the adult distribution, An. sundaicus was limited to coastal areas and An. subpictus was collected in both the lagoon and rice-field areas. Throughout the period of evaluation, larval densities of Anopheles were consistently higher in Sanih (35/dip) than in Kalibukbuk (26/dip) and Ringdikit (21/dip). Anophelines comprised nearly 80% of the total immatures collected from the Sanih and Kalibukbuk lagoons, compared to 68% in rice-fields in Ringdikit. On the average, there were 0.7-0.9 pupa per dip. The proportion of pupae collected in lagoons was less than 2% of total immatures as compared to nearly 3% in rice-fields.

4.2 Flight distance

In all collection methods, more anopheline mosquitos were caught at the site (50 m) nearest to the breeding lagoon (Table 2). There was no An. sundaicus present at 750 m except in the morning indoor resting collections. The numbers collected at the five sites between 150 and 550 m were almost the same, but much lower than at sites near the lagoon. In outdoor landing catches, the number of An. sundaicus exceeded that of An. subpictus at all transect collection sites extending from the lagoon to 550 m. At 750 m, the number of An. subpictus was also considerably lower than that collected at sites nearer the lagoon, but differences between those at the near-lagoon sites and adjacent sites (150-550 m) were not as marked in An. sundaicus.

4.3 Seasonal prevalence

Sanih. Fig. 3 shows the comparison between monthly adult and larval densities of An. sundaicus, the effect of rainfall and the use of diesel oil. The larval densities were much higher throughout the dry months even with the use of oil (Fig. 3A). The average larval density of An. sundaicus for three dry months (May-July 1980) without the application of oil was 58 larvae/dip, approximately 76% higher than that for four dry months (August-November 1980) when oil was used (33 larvae/dip). The dipping indices began to decline as the rainy season started in November. Larval densities of An. subpictus were not sufficiently high for monthly comparison.

Seasonal changes in the number of adult mosquitos collected followed closely the larval indices (Fig. 3B). However, the seasonal decline in the number of adults began much earlier than the decline in larval densities, starting from middle of the dry season (August 1980) and was most probably due to DDT residual spraying carried out in July to August. The lower densities continued to April 1981, which appeared to be due to rainfall and the DDT spraying in December 1980 to January 1981, followed by the increased use of larvicidal oil. The seasonal change in An. subpictus densities was found to be the same as for An. sundaicus, except that the former species was present at a lower level throughout the rainy season.

Seasonal changes in adult densities of An. sundaicus and An. subpictus were reflected in the monthly malaria slide positive rate, i.e. a higher SPR (11.7%) in the early dry season (May 1980), and then gradually falling to 0.65% in November as densities continued to decline (Fig. 2). At the onset of the rainy season in the later part of November, the SPR increased to 2.52% in December and continued to be high throughout the 1981 rainy months, during which the average female density of An. sundaicus did not exceed one-third of that in the dry months (Table 3).

Kalibukbuk. Unlike in the Sanih lagoon area, An. sundaicus was almost absent in the wet season, but there was no difference in the nocturnal catches of An. subpictus between the dry and wet seasons (Table 3), probably due to the breeding of this species in adjacent irrigated rice-fields. In the dry months (April to October), however, the average larval index for An. sundaicus was about six times higher than for An. subpictus; compared to Sanih, it was seven times higher. In contrast, An. subpictus outnumbered An. sundaicus in all the adult collections. Larval densities of An. sundaicus were more directly related to the dry season than in the case of An. subpictus, and were more affected by the use of oil (Fig. 4). As in Sanih, the resting catches (morning and night) of both An. sundaicus and An. subpictus were reduced gradually after DDT spraying in July to August 1980 (Fig. 4A). However, reduction of the An. subpictus population lasted only about two to three months until the rainy season started. The population declined again as the use of oil increased and DDT was sprayed in January to February 1981. Likewise, the monthly SPR declined from 16.7% in September to 6.5% in November and to 1.8% in January 1981. Thereafter, the SPR was zero following the DDT treatment in January to February though An. subpictus densities continued to be rather high (Fig. 4A). The average SPR for six dry months (May to October) was nearly 6.7%, about 4.8 times higher than in the six wet months as compared to 1.8 times in Sanih (Table 3). The average dry season density of An. aconitus resting in cattle shelters was also high (3.4 females/man-hour), about five times higher than for the wet months. During the rainy season, the An. aconitus population was less than one female/man-hour in all the adult catches.

Ringdikit. In this inland village, the wet season was two months longer than the dry season (Table 3). A DDT residual spraying was carried out only once in August 1980, and no oil was used. The larvae of both An. aconitus and An. subpictus were present in irrigation ditches throughout the 13-month evaluation period. The average index for An. aconitus was less than 0.5 larva/dip, the same for the dry and wet seasons, whereas that for An. subpictus (3.6 larvae/dip) for the wet months was four times higher than for the dry months (Table 3).

In all the adult catches, the numbers of An. subpictus and An. aconitus were much higher than in Kalibukbuk (Table 1). The nocturnal landing rates for An. aconitus were about five times (20 females/man-hour) higher than for An. subpictus but the numbers were insufficient for seasonal comparison (Table 3). Resting densities of both An. aconitus and An. subpictus show two peaks: one during the early dry season (May to July) and the other in December for An. subpictus and January for An. aconitus (Fig. 5). It appears that the lower densities observed during August to November were due to the DDT treatment while the decline during February to March 1981 was the result of heavy rainfall which began in December 1980. In Ringdikit, there were no malaria-positive slides out of 291 examined during the evaluation period as compared to 3.35% (18/538) in Kalibukbuk and 2.66% (79/2967) in Sanih.

5. DISCUSSION

Among malaria vectors identified in the two coastal villages studied, An. sundaicus predominated in the nocturnal outdoor landing collections, followed by An. subpictus (Table 3). An. sundaicus was limited to coastal areas, whereas An. subpictus has a wider distribution extending to inland rice-field areas (Table 1). An. sundaicus is the primary vector of malaria in vast coastal areas of South-East Asia from the state of Orissa, India, to the east coast of former Indochina and eastward to Timor Island, Indonesia (Soerono et al., 1965), an area with a human population of roughly 15-20 million. Earlier studies show that in Java the sporozoite rate in this species was sometimes unusually high (Gandahusada & Sumarlan, 1978), ranging from 46.4% in Brengkok, East Java, in 1934, to 0.26% in Purworedjo regency (Sundararaman et al., 1957). In a locality of South Sulawesi, the sporozoite rate was 0.07% and the parasite rate among children (two to nine years old) was 34% (Collins et al., 1979).

In the Sanih lagoon village, An. sundaicus was highly anthropophilic but completely absent in indoor landing collections carried out in several houses by two collectors for three dry months. Chow (1970) reported that in Malaysia and Cambodia[1] An. sundaicus biting takes place more often outdoors than indoors, with a ratio of 2.5:1.0. The ratio observed in 1960 in Semarang, Central Java, was 1.6:1.0 (Soerono & Muir, 1962). In Sanih village, the average indoor resting density for the dry months was 13.4 females/man-hour, which is as high as that found at night in cattle shelters (Table 3), and similar to that in unsprayed villages in the south coast of Central Java in 1955-1956 (Sundararaman et al., 1957). This marked exophagic behaviour on the coastline of Bali does not support the hypothesis of a repellent effect from DDT spraying (Soerono et al., 1965), nor do the considerably high indoor resting indices (Table 1). Of 263 indoor resting females collected from Sanih, 70.3% were parous as compared to 66.7% in Kalibukbuk.

In Kalibukbuk village, surrounded by rice-fields along with lagoons, the dry season (six months) was one month shorter than in Sanih, and monthly SPRs were higher during the dry months (Table 3). In this coastal village, adult and larval densities of An. subpictus and An. aconitus were considerably higher than those of An. sundaicus (Fig. 4). In the inland village of Ringdikit, both An. subpictus and An. aconitus were more abundant (Table 1) but no malaria was recorded nor An. sundaicus collected during the entire evaluation period (Table 3). Although An. sundaicus is known to fly as far as 6 km (Gandahusada & Sumarlan, 1978), the most common dispersal range appears to be within 1 km from the breeding habitat (Table 2). In the present study, no An. sundaicus were caught in nocturnal outdoor landing collections at 750 m from the lagoon in Sanih.

It was not possible to accurately determine seasonal prevalence of malaria vectors in the present studies as they were carried out in two coastal and one inland village with different environs and where different anti-anopheline measures were applied for malaria control (Fig. 1). In general, both adult and larval densities usually increased at the beginning of the dry season (Figs. 3 and 4). The seasonal decline also occurred usually after DDT spraying, as, for example, in Sanih in 1980, where both adult and larval densities of An. sundaicus were reduced by nearly 100% (Fig. 3), followed by over a 90% reduction of the SPR (Fig. 2). However, when weekly application of oil was not intensively carried out, as in Kalibukbuk in 1980, larval densities of An. sundaicus were slightly affected and consequently the SPR increased after a temporary reduction due to DDT spraying (Fig. 4B). When DDT

[1] Former name for Democratic Kampuchea.

spraying and weekly oil application were made concurrently towards the end of the rainy season in January to February 1981, there was no seasonal increase in the anopheline population and SPR, unlike that which occurred at the beginning of the 1980 dry season (Figs. 3 and 4).

In the three evaluation villages, An. subpictus was an ubiquitous species. Larvae were found in brackish water as well as in clear unshaded irrigation channels. While primarily zoophilic, it bites man, especially when there is a large number of An. subpictus in the absence of cattle. Recently, this species was recorded as an important vector of malaria on Flores Island where the sporozoite rate was about 0.38% of 2916 An. subpictus dissected from February 1981 to February 1982 (V. H. Lee, personal communication, 1983). Along the coastal area of south-eastern India, this species is the most prevalent anopheline species collected in indoor night landing and resting catches (P. K. Rajagopalan, personal communication, 1982). During the malaria epidemic in coastal villages near Pondicherry in 1981, oocysts (0.85%) and sporozoites (0.07%) were found in 6133 dissected An. subpictus.

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REFERENCES

Arwati, S. & Kesavalu, P. G. (1980) Report on the malaria control programme, Indonesia. Paper presented at the 7th Asian Malaria Conference and 10th International Congress of Tropical Medicine and Malaria, Manila, 3-7 November 1980

Chow, C. Y. (1970) Bionomics of malaria vectors in the Western Pacific Region, Southeast Asia J. Trop. Med. Pub. Hlth, 1, 40-57

Collins, R. T., Jung, R. K., Hasan Anoez, Sutrisno, R. H. & Putut, D. (1979) A study of the coastal malaria vectors, Anopheles sundaicus (Rodenwaldt) and Anopheles subpictus Grassi, in South Sulawesi, Indonesia, WHO unpublished document WHO/MAL/79.913

Gandahusada, S. & Sumarlan (1978) A review on malaria in Indonesia. Paper presented at Lokakarya Penelitian Pengambangan Kesehatan, Jakarta, 24-27 April 1978

Soerono, M. & Muir, D. A. (1962) Insecticide resistance and prospects of the use of new insecticides in Indonesia. Paper presented at the 4th Asian Malaria Conference, Manila, 1962

Soerono, M., Davidson, G. & Muir, D. A. (1965) The development and trend of insecticide-resistance in Anopheles aconitus Donitz and Anopheles sundaicus (Rodenwaldt), Bull. Wld Hlth Org., 32, 161-168

Sundararaman, S., Soeroto, R. M. & Siran, M. (1957) Vectors of malaria in Mid-Java, Indian J. Mal., 11, 321-338

TABLE 1. ADULT AND LARVAL DENSITIES OF SEVERAL MOSQUITO SPECIES DETERMINED BY DIFFERENT METHODS OF COLLECTION IN THREE VILLAGES IN SINGARADJA, BALI, INDONESIA (MEAN NO./MAN-HOUR FOR 28 COLLECTIONS FROM APRIL 1980 TO APRIL 1981)

Species	Sanih				Kalibukbuk				Ringdikit			
	Night landing[a]	Night resting[b]	Indoor resting[c]	Larvae[d]	Night landing[a]	Night resting[b]	Indoor resting[c]	Larvae[d]	Night landing[a]	Night resting[b]	Indoor resting[c]	Larvae[d]
An. sundaicus	83.2	7.8	7.2	26.0	4.3	0.7	0.3	11.4	0	0	0	0
An. subpictus	1.4	24.4	8.5	3.9	0.9	48.8	12.5	1.9	4.8	155.8	27.8	2.6
An. aconitus	0	0	0	0	1.4	1.9	0.2	0	21.6	47.1	0.6	0.6
An. indefinitus	0.4	8.5	1.6	0.9	0.4	14.1	2.7	0.9	3.3	30.0	3.6	1.4
An. vagus	0	34.7	1.5	4.8	0.9	232.0	3.2	10.2	17.3	388.5	0.5	9.0
An. annularis	0.9	3.1	0	0.2	5.3	33.8	0.1	1.1	1.4	94.1	0	4.9
An. tesselatus	0	3.3	0	0	0	8.9	0.1	0.3	0.9	12.5	0.1	0.1
An. kochi	0	0.7	0	0.1	0	3.9	0.1	0.1	0.9	8.1	0	0.3
An. barbirostris	0	0.1	0	0	0	4.0	0.1	0.2	0.4	7.4	0.1	2.2
An. m. flavirostris	0	0	0.2	0	0.4	0.9	0.1	0.1	1.4	3.4	0	0

[a] Outdoor landing collections made from 18:00 to 22:00 h; mean No. female/100 man-hours.

[b] Night resting collections made in cattle shelter from 18:00 to 22:00 h; No. female/man-hour.

[c] Morning resting collections made in 10 houses of each village from 08:00 to 10:00 h; No. female/man-hour.

[d] Biweekly dippings; mean No. larvae/dip; 50 dips, twice/month. (Larvae derived from reared adults.)

TABLE 2. NUMBERS OF FEMALE AN. SUNDAICUS AND AN. SUBPICTUS COLLECTED AT SEVEN DIFFERENT SITES IN TRANSECT FROM THE SANIH LAGOON[a]

Collection method	Anopheles species	Sites in transect from lagoon[b]						
		50	150	250	350	450	550	750
Night landing (outdoors)	sundaicus	0.7	0.1	0.4	0	0.2	0.1	0
	subpictus	0.1	0.1	0.1	0.1	0.1	0	0
Morning resting (indoors)	sundaicus	17.2	0.4	0.4	0.3	0.6	1.2	0.7
	subpictus	8.6	6.2	6.2	5.2	9.6	8.2	3.0
Night resting in cattle shelters	sundaicus	4.1	0.2	1.7	0	0.7	0.4	0
	subpictus	31.3	7.7	29.6	18.4	24.2	15.6	1.2

[a] Mean for 12-32 collections made from December 1980 through August 1981.

[b] Distance of site from lagoon expressed in m.

TABLE 3. COMPARISON OF ADULT AND LARVAL DENSITIES OF THREE MALARIA VECTOR SPECIES AND SLIDE POSITIVE RATES BETWEEN THE DRY AND RAINY SEASON IN THREE VILLAGES

Village	Season[a]	*Anopheles sundaicus* (No./man-hour)				*Anopheles subpictus* (No./man-hour)				SPR (%)
		Night landing	Night resting	Morning resting	Larvae dipping	Night landing	Night resting	Morning resting	Larvae dipping	
Sanih	Dry months: 7 May-November	2.5	13.4	13.4	43.1	0.1	35.6	10.7	4.1	3.04
	Wet months: 5 December-April	0.8	1.4	2.1	20.7	0.1	12.9	9.6	3.1	1.70
Kalibukbuk	Dry months: 6 April-October	0.2	1.4	0.5	34.7	0.1	53.2	20.0	4.7	6.69
	Wet months: 6 November-March	0	0.1	0	0	0.1	52.5	6.8	1.5	1.39
Ringdikit	Dry months: 5 May-September	0.3[b]	50.7[b]	0.3[b]	0.2[b]	0	194.3	27.2	0.9	0
	Wet months: 7 October-April	0.6[b]	51.0[b]	0.8[b]	0.3[b]	0.2	149.4	33.3	3.6	0

[a] Dry month with monthly rainfall less than 50 mm.

[b] *An. aconitus*.

FIG. 1. AREAS EVALUATED IN THE PROVINCE OF BALI

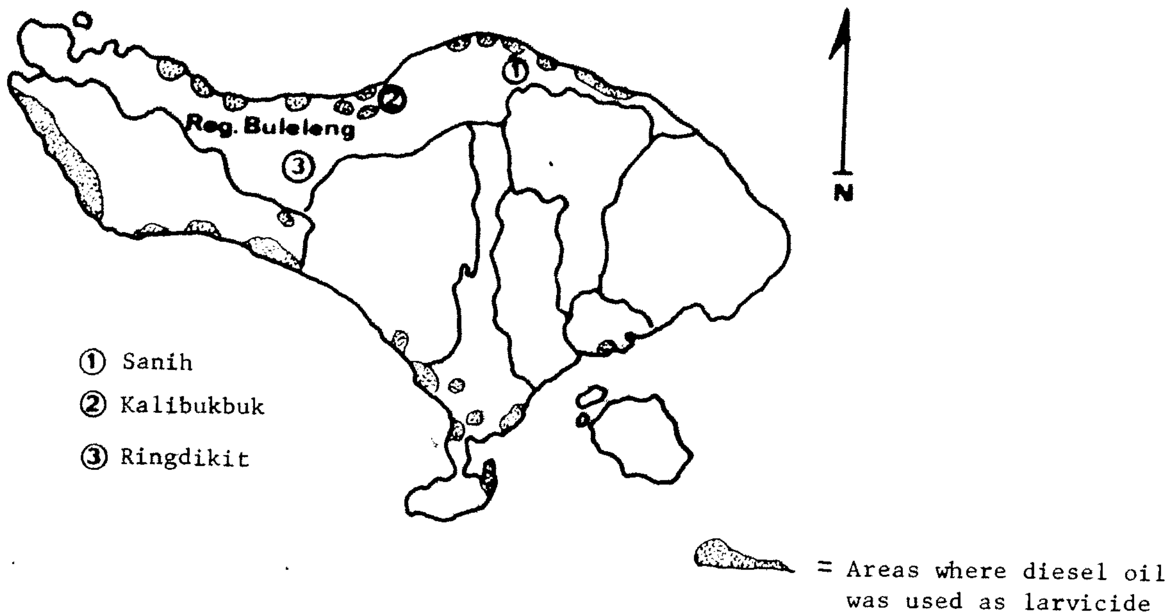


FIG. 2. SLIDE POSITIVE RATES IN RELATION TO RAINFALL, USE OF DIESEL OIL AND DDT SPRAYING, SANIH

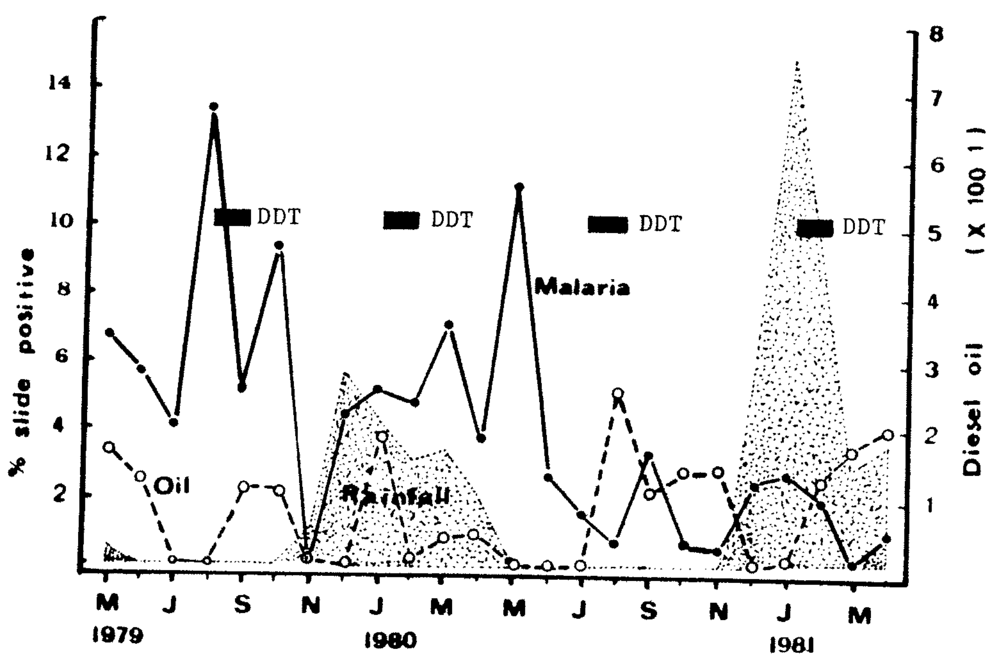


FIG. 3. SEASONAL CHANGES IN ADULT AND LARVAL DENSITIES OF <u>ANOPHELES SUNDAICUS</u> IN RELATION TO RAINFALL AND USE OF DIESEL OIL IN LAGOONS, SANIH

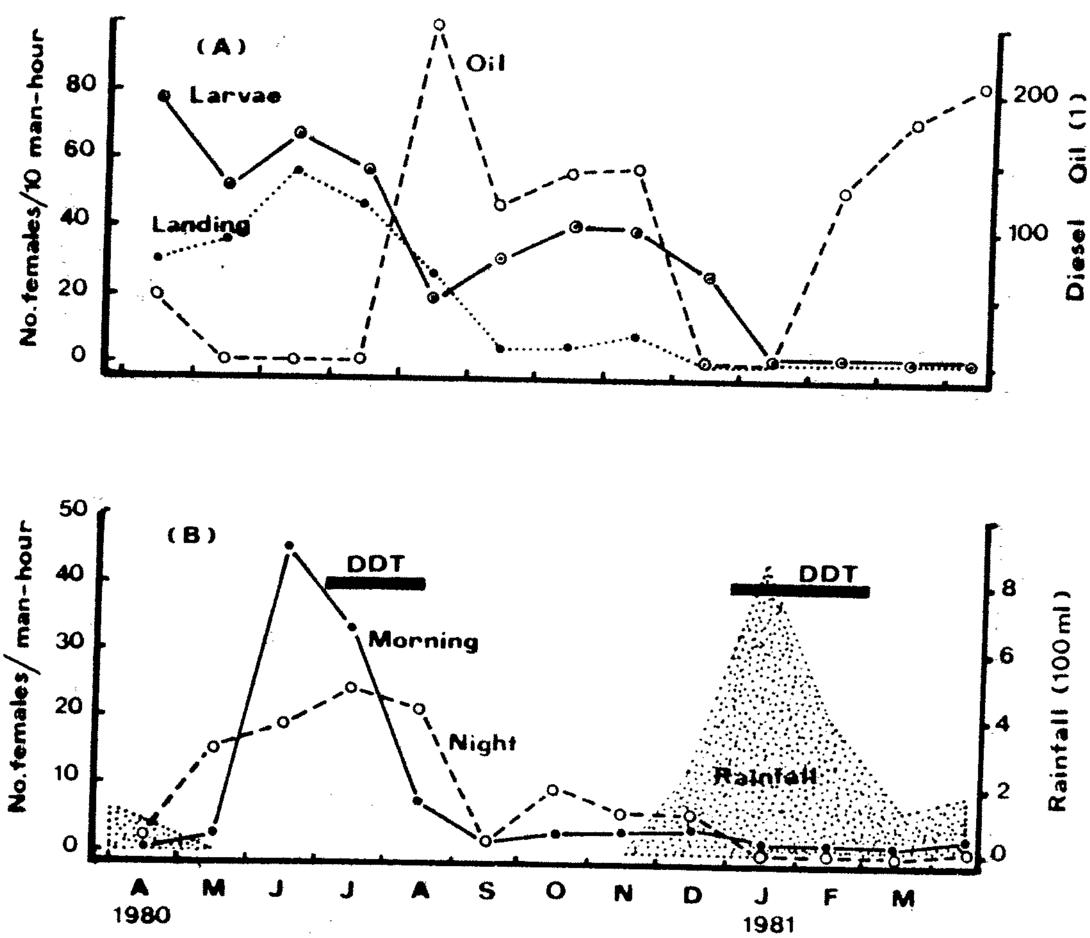


FIG. 4. MONTHLY DENSITIES OF ADULTS AND LARVAE OF AN. SUBPICTUS AND OF LARVAE OF AN. SUNDAICUS IN RELATION TO RAINFALL, USE OF DIESEL OIL AND SLIDE POSITIVE RATE, KALIBUKBUK

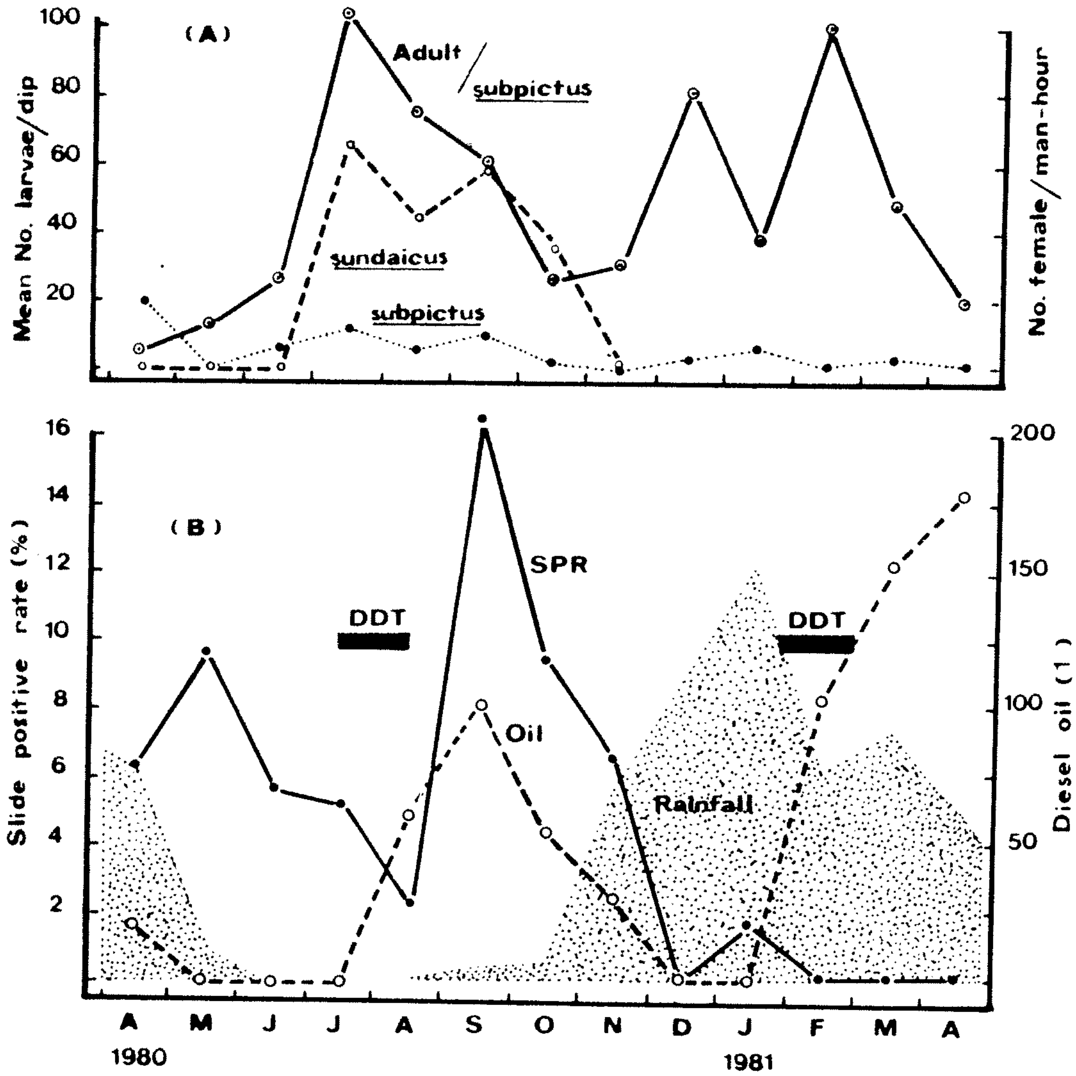
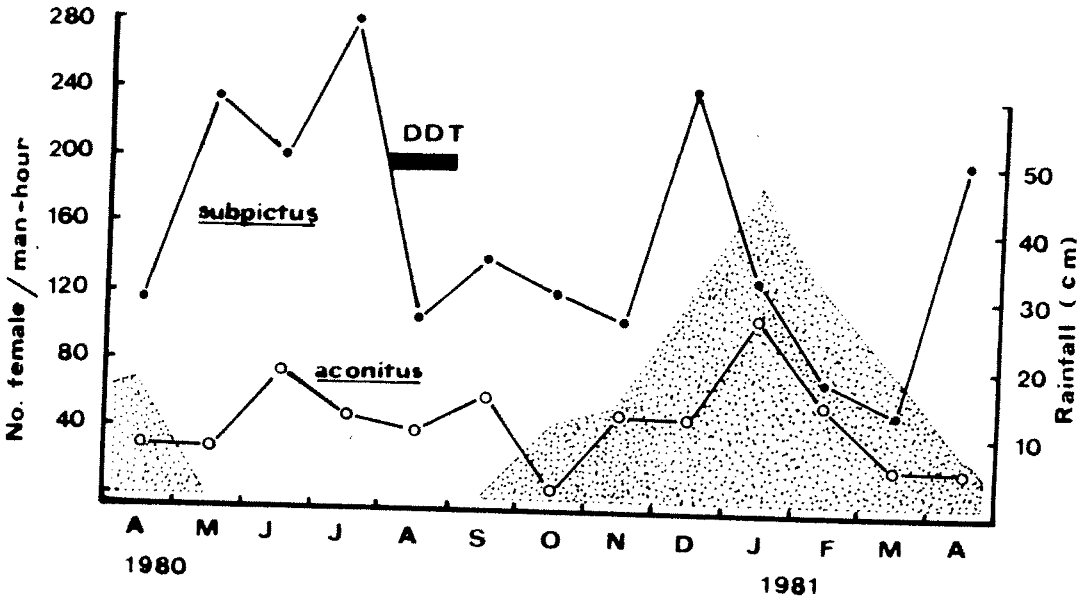


FIG. 5. MONTHLY DENSITIES OF AN. SUBPICTUS AND AN. ACONITUS RESTING IN CATTLE SHELTERS, RINGDIKIT



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