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EVALUATION OF PIT SHELTERS AS A MONITORING DEVICE FOR OUTDOOR RESTING POPULATIONS OF MALARIA VECTOR *ANOPHELES ACONITUS* DONITZ

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ABSTRACT

Penelitian kepadatan populasi vektor malaria Anopheles aconitus Donitz yang hinggap di luar rumah pada siang hari dengan menggunakan lubang buatan telah dilakukan di Jawa Tengah. Dalam waktu yang bersamaan dilakukan pula penangkapan nyamuk yang hinggap di habitat aslinya (pada tebing sungai, di bawah batu-batuan sepanjang sungai dan pada vegetasi di sepanjang saluran pengairan) untuk perbandingan.

Hasil penelitian selama lebih dari dua tahun menunjukkan bahwa rata-rata padat populasi An. aconitus tiap bulan di lubang buatan (65,60 tiap orang per jam) hampir sama dengan yang di habitat aslinya (60,70 tiap orang per jam). Tetapi fluktuasi padat populasi tiap minggu yang dirata-ratakan tiap bulan tidak ada korelasi yang nyata di antara dua cara penilaian tersebut. Pada musim kemarau padat populasi An. aconitus di lubang buatan adalah tinggi (81,45 tiap orang per jam) dan pada musim hujan adalah rendah (49,70 tiap orang per jam), sedang di habitat aslinya menunjukkan keadaan yang berkebalikan (45,70 tiap orang per jam pada musim kemarau dan 75,70 pada musim hujan). Hal tersebut menunjukkan bahwa penangkapan nyamuk di lubang buatan tidak dapat digunakan untuk mengganti penangkapan nyamuk di habitat aslinya, karena hasilnya berlawanan.

INTRODUCTION

An. aconitus Donitz is the most important malaria vector on the island of Java and breeds mainly in terraced rice fields, and to a lesser degree, irrigation canals and margin of streams (Joshi *et al.*, 1977). Adult mosquitoes are found throughout the year and the population densities are influenced by rainfall and stages of rice growth. Peak densities occur at different times in different areas and depend on the rice planting and harvesting time. In Central Java there are two peaks, the primary peak occuring from January to April and secondary peak from July to September. The distribution of this species is from the coastal plains at sea level to the central plateaus up to an altitude of about 1,000 meters (Sundararman *et al*, 1975).

Estimation of population density is important to be studied, conditions for deciding the proper time of control intervention measures. Various methods have been used to estimate the population density indices of this species, such as night collection in cattle shelters, morning collections in houses and searching in the natural outdoor diurnal resting places along stream banks and irrigation canals (Joshi *et al.*, 1977).

It was thought that pit shelters would perhaps be effective as a diurnal collection method for this species because it is exophilic and largely rests in moist, shady places, such as stream banks. Further, since the pit traps are inexpensive and the mosquitoes can be easily and rapidly removed, it was felt that they offered a promising method as an economical suplementary, or alternative, collection method for monitoring mosquito densities

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in natural outdoor resting places.

DESCRIPTION OF AREA

The evaluation of pit traps was carried out in Kaligading, Subdistrict Boja, Kendal Regency, Central Java. The village is located 32 km southwest of Semarang, at an elevation of about 390 m. The main season of rice planting in this area is April to May and October to November, although some rice is planted throughout the year because irrigation is available all the time in most of the areas.

The climate is warm with a monthly mean temperature ranging from 23° to 32° C and the relative humidity ranging from 61 to 85 % during the day (07.00–18.00 h). The five-year (1977–1981) average rainfall was 215 mm to 715 mm. Days with rain per month ranged from 2 to 27. In general, the main rainy season extends from November through April with an average humidity of 81 %, and the dry season from May to October with an average humidity of 72 %.

MATERIALS AND METHODS

Pit shelters were made according to WHO standard methods (Anonymous, 1975) by digging a hole in the ground with 1.5 meter long, 1.0 meter wide and 1.5 meter deep. In each side-wall, 50 cm from the bottom, a hole of 20 x 20 cm and 30 cm depth was made. A thatch roof of 1.5 meter high at the center and 1.0 meter at the lower sides was built over the pit to protect it from rain and to provide shade.

Eight pit shelters were constructed in scattered locations throughout the village in places where run-off could not fill the pit during rains and which were protected by vegetation. The pit as well as the roof were maintained regularly by removing any mosquito predators such as frogs and spiders, cleaning of debris and replacing the roof thatch as needed.

Mosquitoes were collected weekly by one or two collectors from four or eight shelters in the morning between 07.00 and 09.00 hours, using sucking tube. A short ladder was used to facilitate going in and out of the pit. The shelters were searched for up to 15 minutes per shelter and although somewhat less time was required when there were few or no mosquitoes, the results in number per man-hour were calculated on this basis. For comparison, during the same period four collectors searched natural outdoor resting places, along stream banks in eroded hollows, under rocks with moist and dark conditions and on vegetation lining irrigation canals.

Rainfall data for 1977 to 1981 are collected from the Semarang Observatory of the Meteorological and Geophysical Service of The Department of Communication at the Semarang airport.

RESULTS AND DISCUSSION

The average population density of *An. aconitus* was 16.4 per pit or 65.6 per man-hour in the pit shelters and 60.7 per man-hour in natural outdoor resting places (Tabel 1), indicating that the overall catch by both methods were about the same. However, the monthly fluctuation of density in pit shelters was different from the fluctuation of density at natural outdoor resting places.

The dry season (May to October) produced higher densities in the pit shelters and, conversely, lower densities in wet periods (November to April) when compared with natural outdoor places (Figure 1). The average monthly density during dry periods was 81.45 per man-hour in the pit shelters and 45.7 per man-hour at natural outdoor places, while during the rainy season it was 49.7 per man-hour in pit shelters and 75.7 per man-hour at natural outdoor resting places. The difference in both catching methods during the rainy periods was significant ($t = 2.892 > t_{.05(22)} = 2.07$ in pit shelters and $t = 2.361 > t_{.05(22)} = 2.07$ at natural outdoor resting places). This agrees with the conclusion of Service (1976) regarding resting populations, who states: "In fact during periods of dry weather mosquito popula-

Tabel 1. Monthly data of *An. aconitus* density, rain-fall and rainy days (October 1979 – September 1981), Kendal, Central Java.

Month/ Year	Pit shelter		Nat. outdoor (man-hour)	Rain-fall (mm)	Rainy days
	per-pit	man-hour			
Oct. '79	5.5	20.2	6.0	–	–
Nov.	2.9	11.6	11.8	198	16
Dec.	5.8	23.2	33.2	226	23
Jan. '80	9.0	36.0	72.6	345	27
Feb.	14.5	58.0	71.5	161	17
Mar.	15.0	60.0	64.7	317	12
Apr.	7.1	28.4	56.1	133	19
May	20.2	80.0	36.7	141	9
Jun.	24.0	96.0	25.0	26	6
Jul.	20.0	80.0	28.7	88	11
Aug.	19.9	79.6	33.9	164	7
Sept.	19.1	76.4	31.7	48	4
Oct.	17.4	69.2	17.8	78	9
Nov.	14.8	59.2	76.8	217	15
Dec.	16.0	64.0	125.1	369	22
Jan. '81	9.6	38.4	77.5	715	26
Feb.	9.8	39.2	114.9	533	20
Mar.	22.4	89.6	110.2	173	17
Apr.	20.9	83.4	94.5	413	18
May	14.1	56.4	54.8	150	6
Jun.	34.6	138.4	112.6	92	10
Jul.	24.7	98.8	66.4	165	8
Aug.	30.1	120.4	70.1	43	9
Sept.	16.7	66.8	64.3	146	10
Total	394.1	1574.4	1456.9	4951	
Mean	16.4	65.6	60.7	215	

tions may be greatly reduced, but because of the reduction of suitable outdoor resting sites greater numbers of mosquitoes may seek refuge in artificial shelters". Precipitation and relative humidity in the rainy season, which is higher (mean 81 %) than in the dry season (mean 60 %), will change the microclimate and the microhabitat of the mosquitoes. Because the microclimate as well as the local weather conditions were very much influenced by the macroclimate, consequently the conditions and the changes occurred were more or less

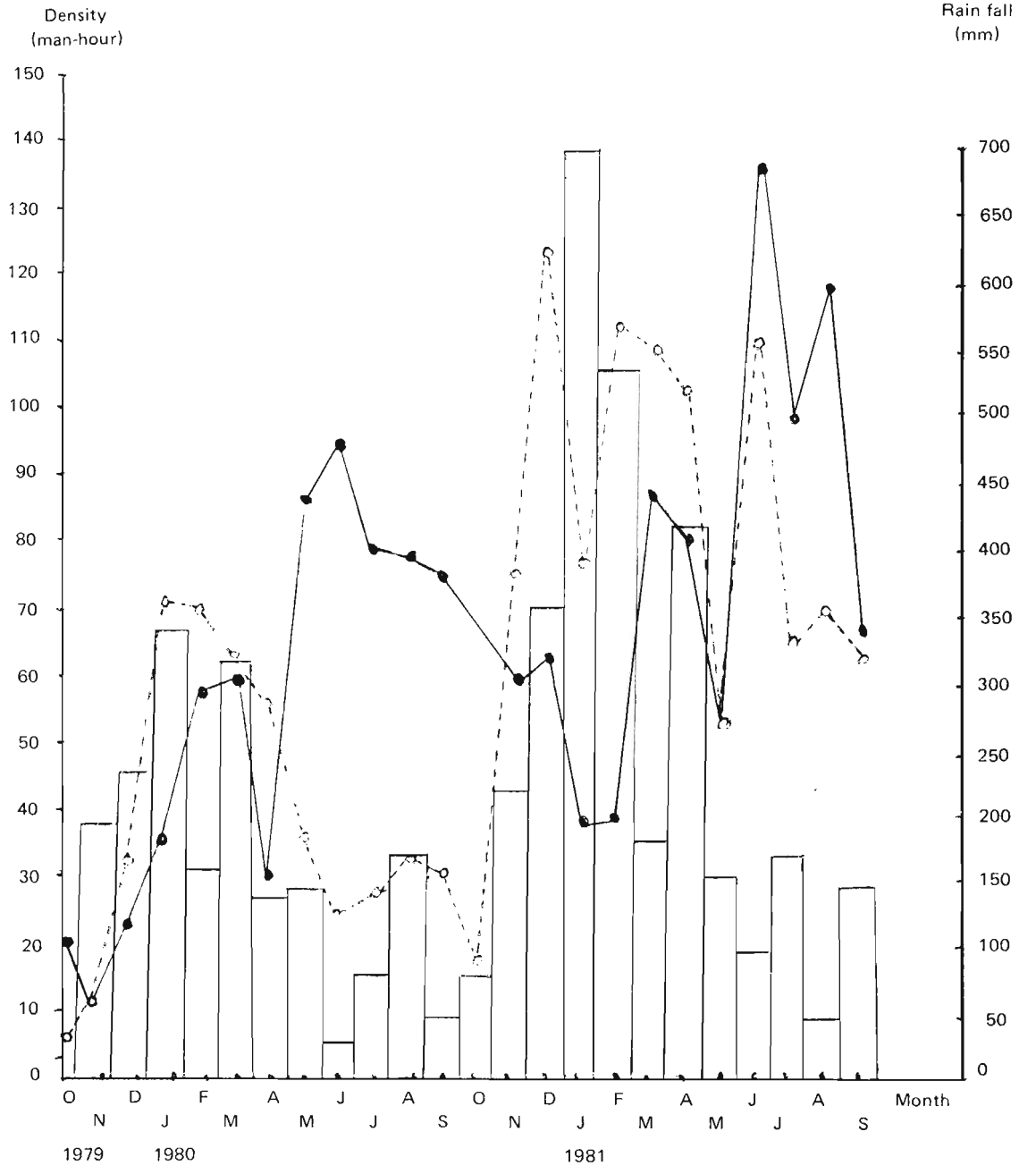

Fig. 1. A monthly density of *An. aconitus* in pit shelter (•—o— • —•) and at natural outdoor resting places (- - -o- - -o- - -) and monthly rainfall (histogram) Kendal, Central Java, 1979 – 1981.

parallel (Sunjaya, 1970). During the rainy season river banks, canals and other places were moist and sufficiently closed by dense vegetation, so that the mosquitoes do not have to seek other resting places. In the dry season however, vegetation is less dense, causing river and canal banks to be less sheltered. While the pit always provides shelter during the rainy as well as the dry season.

Rainfall and monthly densities of *An. aconitus* from pit shelters showed a significantly negative correlation ($r = -0.46$ and $t = 3.00 > t_{.05(21)} = 2.08$), while at natural outdoor resting places there was a significantly positive correlation ($r = +0.48$ and $t = 2.85 > t_{.05(21)} = 2.08$).

CONCLUSIONS

These results indicate that pit shelters do not give an accurate seasonal index of *An. aconitus* populations under the prevailing condition in Central Java because, in comparison with the natural outdoor resting places, they overestimate the population during the dry season. However, the use of pit shelters has shown to be an easy and productive collection method, since they are a good source of mosquitoes for purposes other than as population indices, especially during the dry season.

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