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EVALUATION REPORT
MALARIA ERADICATION PROGRAM
HAITI
January 17-27, 1972

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Malaria transmission in Haiti varies greatly from one year to another, from years of minor transmission to alarming situations when the atmospheric conditions are favorable to multiplication and longevity of vectors. The potential of transmission in rural areas has not changed since the years prior to the beginning of the program because the ecological conditions are the same both with regard to the vector and to the host so if the present attack measures were not carried out the incidence of 3 out of 1,000 inhabitants in 1971 could easily reach in many areas, 700 per 1,000 as it had been previously. Data indicate the necessity of a careful epidemiological study in order to determine (1) the number and timing of spraying cycles required in different areas, and (2) the (supplementary) attack measures to be used in the areas where transmission continues in spite of (1). Drugs are useful as an additional attack-measure given as presumptive treatment, radical cure, and for the elimination of active isolated foci and under special circumstances as mass drug administration. The evaluators made 25 recommendations including that special studies should be continued and expanded in order to determine the precise reasons for persistent transmission.

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At the request of the Government of Haiti (GOH) a meeting was convened in Port-au-Prince, Haiti, January 17-27, 1972 with the Representatives of WHO, AID, PHS and UNICEF to help in the review of Haiti's Program of Malaria Eradication (MEP).

This Committee was composed as follows:

Dr. G. Garcia Martin	- OSP/OMS Jefe del Departamento de Erradicación de la Malaria
Dr. Knud Lassen	- OSP/OMS - Jefe AMRO-0216
Mr. L. Gonzalez del Solar	- OSP/OMS - Consultor Administrativo Project AMRO-0203
Mr. Edgar A. Smith	- AID/Wash. D.C. Health Science Admin. (Malaria)
Mr. Gerald F. Gower	- AID/Wash., D.C. Office of Caribbean Affairs
Dr. Read Mc Gehee	- Assoc. Prof. Inf. Dis., Medical College of Virginia, USA Consultant M.E.B., C.D.C. Atlanta, Ga.
Mr. Albert J. Reynolds	- UNICEF/Representative
Mr. William Gelabert	- AID/Brazil - Observer

This Committee was assisted by:

Dr. Volvick Rémy Joseph	- Co-Director SNEM - Chairman
Dr. Isidro Pons	- Co-Director SNEM
Mr. Jalil S. Karam	- Chief Malaria Advisor
Mr. Kenneth E. Willey	- Acting Business Manager
Dr. Evariste Midy	- Chief Epidemiology Division - SNEM
Dr. Francisque Milord	- Chief Zone II - Secretary

and the members of the Staff of SNEM in Haiti

GENERAL COMMENTS

Since 1964 seven external teams of international experts have visited and reviewed the Haiti Malaria Program. These teams have included malariologists, epidemiologists, entomologists, parasitologists, administrators, management and logistic experts. The teams have spent periods varying from 4 to 12 days in the country. While it is true that some findings and recommendations are contradictory in nature, many of the same recommendations have been made by most of the teams. It must be remembered that an evaluation team can judge only on the basis of data provided with only limited time for study and analysis and very little opportunity for field checking. Considering the varied background and experience of the different teams, it is not surprising that previous recommendations have varied. However, in the final analysis, it is the National Director and his staff together with the advisors from the assisting agencies, who must on the basis of their intimate first hand knowledge of the program make the decisions on the adoption and implementation of the teams recommendations. A fair trial should be given to any reasonable recommendation unless there are over-riding practical or financial reasons for not doing so. In which case the decision should be officially recorded and the reason given.

In reviewing the past performance and present status of the National Malaria Program of Haiti, it appears that SNEM is operating within the framework and with the organization and techniques of a malaria eradication program, but with the results of a control program. Although it is impossible to predict numbers, it is obvious that without the spraying of 814,000 houses and the detection and treatment of 15,604 persons in the past year and the prompt reaction to emergency situations in certain areas,

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the total number of malaria cases would have been substantially greater and might well have been disastrous.

Since the strategy review of 1970, SNEM has made no further progress towards interruption of transmission of malaria in any part of the country in spite of three cycles of residual spraying. In fact during the past three years malaria has increased from 5,005 cases in 1,138 localities in 1969 to 10,658 cases in 1,920 localities in 1970 and 11,346 cases in 2,211 localities in 1971. Virtually every evaluation team has stated or implied that semestral spraying of DDT alone will not eradicate malaria in Haiti. The results of the past two years spray program tend to bear this out. It appears to be the consensus of previous reviews that residual spraying in combination with drug treatment will be required for many parts of the country, and that a special effort will be required for the problem areas including additional measures such as space spraying, larviciding, and source reduction as well as additional cycles or alternative insecticides if necessary.

ANTECEDENTS

GENERAL DESCRIPTION OF THE COUNTRY

TERRITORY

Haiti and the adjacent islands together have an area of 27,750 Km.² The country is mountainous, 40% of the territory being situated above 500 meters level: 30% between 300 and 500 meters, and only 30% below 300 meters level. It is situated between 18° and 20° north. The annual average temperature at sea level ranges between 25° and 29° C. (Annex 1)

There are considerable differences in the rainfall between one place and another. The annual average precipitation during the last 25 years varies from 600 mm. in the north western part to 2,600 mm. in the central part of the country. But in most of the malarious area the variations are between 1,000 and 1,400 mm. There are two well defined peaks in the rainfall: one in the beginning and another at the end of the rainy season (April-June and October-November). The dry season lasts from December to March (Rainfall Annex 2). The relative humidity varies between 63 and 75%.

POPULATION

The last census was carried out in 1950. It showed a population of 4,867,000 inhabitants (i.e. a population density of 165 inhabitants per Km.²). The estimated population in 1971 was 4,970,000 of which 83% lived in rural and 17% in urban areas (Incl. 3). Forty-eight percent of the population was less than 20 years old and only 3.3% were 55 years old or more. The expectancy of life at birth was 47,5 years in 1970 and the crude mortality rate 17,9 o/o (Incl. 4).

The economically active part amounts to 40% of the total population and is mainly constituted by the primary production sector (Incl. 5). The internal gross product per inhabitant in 1970 was \$74.20 of which 50% was contributed by the primary sector, particularly agriculture (Incl. 6-7).

MALARIA IN HAITI

For operational purposes the malarious area has been defined as the part of the country situated below 500 m. level. This covers about 19,100 Km.² i.e. 69% of the whole country, and has a population of about 3,660,000 inhabitants, or 73% of the total population. (Annex 1)

THE VECTOR

Anopheles albimanus is incriminated as being responsible for the transmission of malaria in Haiti, but even A. grahami, A. vestitipennis and A. crucians are found resting inside the houses in many places although their role is doubtful. A. albimanus is mainly anthropophilous and endophilous in Haiti but as a consequence of the habit of the people of spending the hours around the dusk on the veranda and in the peridomicilium, a certain amount of exophilism has been claimed. Maximum biting hours are between 5:30 and 9:00 pm.

Until now A. albimanus has remained susceptible to DDT except for the area of Cité Simone O. Duvalier, rural section ler. Varreux, close to Port-au-Prince, where resistance was found in 1970. During the second half of 1971 a certain degree of resistance was observed in the rural districts east of Jacmel.

THE AGENT

The principal parasite in Haiti is P. falciparum. In the past, 85%-95% of the cases of malaria were caused by this parasite. P. malariae was responsible for 5-10% of the cases and P. vivax for less than 1%. Now P. malariae and P. vivax must have almost entirely disappeared, since only P. falciparum is found by the laboratory.

THE EPIDEMIOLOGICAL CHARACTERISTICS

Because of the mountains, the rainfall pattern, and the characteristics of A. albimanus the malaria in Haiti is of the unstable type. In agreement with the instability, the incidence varies considerably, from month to month, year to year, and more or less well-defined outbreaks are common.

The variations in the degree of endemicity bring about similar variations in the immunity of the population, which both can be seen to have made their impact on the epidemiological development during the period when malaria eradication activities have been in progress, i.e. the last 8 years. (Annex 8). But in spite of the unstability of the malaria, it must be mentioned, that certain areas close to the coast seem to have perennial transmission.

The altitude is the most important factor for the determination of the endemicity. The decrease of temperature is about 0.7° C/100 m. In other words, the monthly averages at 300 m. level will vary between 23° C. and 27° C., and at 500 meter level the figures will be around $21,5^{\circ}$ - $25,5^{\circ}$ C. Since the minimum temperature required for the extrinsic cycle of the P. falciparum is 19° C. it is understood that the unstability of malaria will become more pronounced the higher the altitude and at very high altitudes transmission is only possible when the local conditions favours it.

EARLIER MALARIOMETRIC INFORMATION

The reports of the American MDs working in the country from 1917 to 1930 show that before reaching adult age 100% of the haitian population had already had malaria, and among the american military population, the rate of hospitalization was higher than 700 x 1.000 per year.

The statistics of the National Public Hygiene Service in 1923 - 1924 reported 549 deaths caused by malaria, and the figure in 1925 was 513.

In 1928 a survey made by Dr. Carl Wilson revealed 23,5% of malaria among the workers and 50,5% among children below 14 years old.

In 1929 the number of patients admitted in the hospitals for malaria was 494 and the number of sick days in hospital because of malaria 6,277, while for the preceding year there were 428 admissions and 5,953 hospitalization days. The mortality rate due to this disease was 4.6% according to the records of the hospitals. The external departments received 7,696 ambulatory patients suffering from malaria during the year. Moreover, 44,161 patients were treated for malaria in the rural dispensaries and the rural clinics.

In 1940 and 1942, the Rockefeller Foundation carried out extensive parasitologic surveys and found a positivity rate of 31%.

In 1950 surveys made among school children during the CCI campaign gave an average positivity rate of 18%, and in the late fifties other surveys were made during the "first eradication campaign" showing on the average of positivity rate of 12%.

ESTABLISHMENT AND DEVELOPMENT OF ANTI-MALARIA ACTIVITIES

It was of great importance that the Haitian Government in 1958 by decree, recognized malaria as an "urgent national problem". However, before this date, there existed already a campaign of control named "CCI" or "Campaign Contra Insects". Immediately after the Decree of 1958, a "first campaign" of malaria eradication was initiated but unfortunately it stopped in the beginning of 1960 due to economic shortcomings.

In November 1960, the Government was obliged to start a program of malaria control "CCM" which was a kind of pre-eradication project. The Memorandum of Understanding signed conjointly in February 1961 by the Haitian Government, the World Health Organization (OMS), the Agency for International Development of the United States (USAID) and the United Nations for Children's

Fund (UNICEF) marked the end of CCM and the beginning of the actual National Malaria Eradication Service (SNEM) with the purpose of eliminating malaria from the country.

The fact that malaria was an "Urgent National Problem" in 1958 still remains true today. In order to realize this it suffices to consider the number of cases registered, which although reduced still remains considerable, the high potential of transmission, and the risk of epidemics. For the same reason, the "Comité de Planification du Programme de Lutte Contre les Maladies Transmissibles" (Planning Committee for Fighting Against Communicable Diseases), Department of Public Health and Population, considered malaria as a problem of first priority on which all efforts should be concentrated. In the case that this had not been done, morbidity and mortality rates due to malaria would soon seriously interfere with the socioeconomic development of the country.

The Government of Haiti has firmly supported the strategy and recommendations brought forward by WHO concerning the interruption of malaria transmission in all areas, where it is possible, by usual primary attack measures. In foci where malaria is refractory, it is necessary to investigate the causes in order to apply appropriate complementary or additional attack measures to eliminate the transmission or at least reduce the incidence in such foci to such a level that they do not affect the progress of the E.C. Eradication Campaign or the general economical development, until complete elimination of the transmission can be achieved.

THE DEVELOPMENT OF THE EPIDEMIOLOGICAL SITUATION DURING THE LAST YEARS

It is seen in Graph Ann. 8 - which shows the total number of cases as well as the API 1964-70 that there is an increase in the transmission about every five years (paraquinquennial epidemic wave). The same phenomenon has been observed in other Latin American countries, even more accentuated than in Haiti. It is believed to be at least partially due to a cyclical increment in the rainfall which increase the number of breeding places and favours anopheline longevity because of high relative humidity. When attack measures (e.g. spraying) are efficient, they accentuate the downward trend that follows the paraquinquennial exacerbation and prevent the subsequent epidemic wave which otherwise would come about 5 years later.

In this connection it is interesting to observe that the number of cases dropped from 1964 thorough 1968, although not completely as much as one might have expected: The attack measures in 1962 and 1965 reduced the positivity rate (an increase of cases was noted because of improved case detection), but after the 1962 outbreak caused by Hurricane Flora, the attack measures failed to interrupt the malaria transmission locally despite of a natural diminution of transmission in the rest of the country.

From 1965 to 1968, the attack measures included spraying with DDT and mass-drug distribution.

The drug program was carried out on a large scale but coverage was not simultaneous. While some rural sections were submitted to MDD others were not and vice versa. Consequently the treated Sections Rurales (SR) which had become free of malaria were re-infected by carriers coming from untreated areas. Moreover, the drug acceptance rate decreased to the point where it became ineffective.

Spraying coverage was insufficient and not carried out at appropriate times. In 1966-67 and 68, only one cycle of DDT was carried out per year and complete coverage was not obtained (partial coverage of 78% in 1966 was achieved, 25% in 1967 and 64% in 1968).

This explains why the decrease in the number of cases (and of the reservoir) was not optimum during the favourable 1965-68 period.

In 1970, there was an increase in the number of cases which was maintained throughout 1971. However, it must be said that there exists a certain focalization of the problem. In 1971, the 3,4% of the population of the malarious area accounted for 53% of the malaria cases in the whole country.

The situation in 1970-71 is probably due to:

- a) improvement of natural conditions for transmission (considerable increase in rainfall).
- b) insufficiency of attack measures to counter attack the natural trend of transmission.

Two cycles of DDT spraying operations per year have been recommended. In 1968 and 1969 only one took place and covered only about 52% of the houses in the malarious area. In 1970 two cycles were carried out but only 58% of the houses were protected in the first round and 78% in the second. In 1971 the coverage amounted to 85% of what has been recommended.

- c) The spraying operations were not applied at the right time, due to administrative problems. The cycle of 1969, the two of 1970 and the second of 1971 were applied after the peak of transmission.

SUMMARY

Summing-up one can say that malaria transmission in Haiti varies greatly from one year to another, from years of minor transmission to alarming situations when the atmospherical conditions are favourable to multiplication and longevity of vectors. The potential of transmission in rural areas has not changed since the years prior to the beginning of the program because the ecological conditions are the same both with regard to the vector and to the host (and the population has increased), so if the present attack measures were not carried out, the incidence of 3 out of 1,000 inhabitants in 1971 could easily reach in many areas, 700 per 1,000 as it had been previously.

REVIEW OF PREVIOUS RECOMMENDATIONS

The most dominant recommendations are:

1. Program Planning

A three year plan of operations (July '70 to June '73) should be prepared with detailed annual budgets.

A three year plan was developed but was not officially accepted by all agencies. Only first year of plan has detailed budget.

2. Finance

Timely funding and availability of funds by GRIP immediately after 1st July 1970 is required for a continued consistency in program operations and application of attack measures before transmission season.

Total amount of money programmed for SNEM was always received but not on a timely basis.

Due to variations in time of availability and amount of annual contributions by assisting agencies some members of the committee strongly suggested that GCH immediately investigate means of solving the long range funding problems of the program. Such means might include:

- a - Continued grant funding by USAID with commitments to support the technical requirement of the 3 year plan. This in part is done on a yearly basis.
- b - Negotiating of a loan from a bilateral or international organization. Not done.
- c - A combination of grant and loan funding. Not done.
- d - Additional contribution from GOH. Not done.
4. Should it become apparent that financial requirements cannot be met, a Committee should be convened in 1971 by GOH in cooperation with the assisting agencies to determine the future course of the program. Not considered necessary
5. Program Operations
- Plan of attack as proposed by SRC to be followed and continued pending evaluation. This being done now.
6. If availability of funding limits or restricts adherence to plan the priority of operation should be:
- a. Spraying Done

- b. **Passive Case Detection** Done
- c. **Supplementary attack measures in
Petit-Goâve, Gros Morne and Trois
Bâbs.** Used radical treatment.
- d. **Focal attacks, mass drug distri-
bution and ACD are not recommended.** Done.

7. Evaluation

SNEM should arrange for a statistical consultant for the purpose of designing the program of selected, randomized surveys. Not considered necessary.

8. Epidemiological and Entomological
Investigations

Field investigations in areas of high transmission should be conducted to determine causes of persistence of transmission. Entomological done
Epidemiological done but by
mid year stopped.

9. Expansion of SNEM activities in
Health Program

a. SNEM should cooperate with other agencies of GOH in developing an expanded program in vital statistics. Not done. SNEM was not asked.

- b. Committee of PH administrators communicable diseases specialist and malaricologist be convened by GOH in 1972 to develop plans for the gradual and eventual integration of services. Considered.

SUGGESTIONS AND RECOMMENDATIONS - OPERATIONAL RESEARCH

The Committee felt that more research is needed to guide the operations of the MEP. The following fields are suggested:

- 1) Epidemiologic and entomological studies in areas of persistent transmission. Done partially.
- 2) Delimitation of the geographical area of resistance to insecticide where and when this occurs. Done partially.
- 3) Determination of the spectrum of susceptibility of the resistant vector. Done
- 4) Use of various formulations of different larvicides such as: Abate, Paris Green or other appropriate material in those areas where neither drainage nor planting of trees is feasible. Not done.
- 5) Monitoring the susceptibility of the parasite to the drugs used in the program. Done.
- 6) Feasibility of manufacturing and distributing medicated salt should the need occur for such measures at the end of attack phase or during consolidation phase. Not necessary

- 7) Determination of the reasons for refusing drugs in areas where this occurred on a large scale. People tired of the 3-weekly inconvenience of taking drugs and by slight side effect.
- 8) Planting of eucalyptus trees in marshy areas where drainage is too costly or not completely effective by itself alone. Not practical.
- 9) Epidemiological investigations of all cases detected above 300 meters and in rural sections below 500 meters that have not been included in the sprayed areas. Done up to July 1971.

PRESENT STATUS OF PROGRAM

EPIDEMIOLOGY - EVALUATION

Definition of a case.

This is based on a positive thick smear for malaria parasites. The laboratory has been found to be very adequate and hence there is no known problem in this aspect.

Since 1962 the epidemiological figures have been reported according to the date when the slides are read in the laboratory. This makes it somewhat difficult to relate the cases to climatic conditions, drug and insecticide applications, and other important factors. A compilation of the positive slides according to the date of acquisition exists too but is from its very nature subject to a certain delay.

Annexes 9 - 13 illustrate the results of 1971 from the indicator districts which are all situated some distance from the respective zone offices. Differences are noted between the curves based on the date of acquisition and those based on the date of slide examination. The curves can be compared with the ones from an area near Port-au-Prince, Annex 14. In this area there are fewer delays in transporting the slides to the laboratory which is reflected in the coincidence of the curves during the epidemic.

CASE FINDING

Case finding methods have changed almost yearly from the inception of the program. The present system is as follows:

1) VOLUNTARY COLLABORATORS - A nation wide system of passive case detection relies on individuals, clinics and hospitals as vehicles to report cases, make slides, and dispense medicine. The collaborators are given an incentive of \$1.00 for each positive slide. The numbers of slides collected and cases found by these collaborators have remained relatively stable in the past nine years (9). (Annex 15).

2) EVALUATORS - An evaluator is assigned a certain number of houses to visit daily - usually 40 to 60. He records his visit on a common card with spraying dates which remains in the house. He inquires about fever or other symptoms suggesting malaria. If there is any suspicion he then takes a slide. The number of evaluators has varied greatly and at a time when drug distributors were used these also acted as evaluators. Consequently, the numbers of cases or the case-slide ratios for any two years cannot be readily compared.

3) SPECIAL SURVEY TEAMS - were used rather widely for several years (e.g. for mass-blood-sampling in connection with focal attack activities around known positive cases) resulting in additional slides and positive cases to those produced by the mechanism mentioned in paragraph 1) and 2).

The committee analyzed the reasons for taking slides as recorded by the evaluators and found that symptoms suggesting malaria were not present in a substantial number. Annex 16. Evaluators from non indicator areas take a great number of slides from cases without fever. The evaluators in the indicator districts (i.e. the majority) are reporting a much higher percentage of fever cases. In addition they take smears from persons reporting non specific symptoms that to their judgement suggest the possibility of malaria infection.

EPIDEMIOLOGICAL PATTERNS

Apparently there has been a resurgence of malaria in Haiti in 1970. Annex 17. The low numbers of detected cases in 1967 and 1968 were in part a result of the mass drug distribution. An increase in the transmission occurred in many areas after the termination of the drug program.

In 1968 a total of 1,169,359 slides were examined and 2,559 found positives. In 1971 the figures were 270,695 slides and 11,347 positives.

These data are somewhat misleading because in 1971 a relatively large number of the slides were taken in areas of high incidence, especially the problem areas (indicator districts), and consequently the epidemiological development in the areas of lesser endemicity is masked. There are large areas which have a low parasite index.

The positivity varies greatly within the country. Mapping of the annual parasite indices shows a concentration of the disease in certain low lying coastal areas and low indices at higher elevations. It will be seen that the high incidence areas comprise only a small part of the country and they constitute, too, a relatively small part of the sprayed area. (Annex 18-19).

The concentration of cases is shown in Annex 20 and 21 where the epidemiological figures have been compiled for the areas of highest incidence. In Annex 20 are listed all the areas with an API above 25 in 1971. It is seen that over 50% of the cases are found in areas inhabited by 3,4% of the total population. The percentage of the population harboring malaria is further tabulated in Annex 21. These figures underline the fact that a

small segment of the population is the source of most of the cases. The converse of this pattern is apparent. That is, 63.5% of the population harbors only 0.3% of the total malaria (The API values used as criteria for the selection of the different groups of areas, shown in Annex 20 and 21 are chosen arbitrarily).

INDICATOR DISTRICTS

At present the six indicator districts are not as the name suggests, representative for the malarious area of the country. They are, for the most part, areas where malaria has been refractory to the eradication campaign.

The first indicator district, La Coma, a coastal area in northern peninsula, 16,000 inhabitants, 6,000 houses had 114 positive cases in 1967, 1 in 1968, 160 in 1969, 638 in 1970, and 486 in 1971. Annex 9 shows the periods of spraying and the number of malaria cases. It indicates that the effect of DDT spraying only lasts for about 2-3 months. This is in agreement with the results of wall bio-assay tests. Annex 28-29 but the interpretation should take the rainfall data for the month of March 1971 into account. At that time many houses were partially or totally destroyed.

The second indicator district, Artibonite, interior or rice-growing valley, 48,000 inhabitants, 23,000 houses, shows a relatively low number of cases compared with the other districts, i.e. 35 in 1967, 63 in 1968, 73 in 1969, 442 in 1970 and 232 in 1971. (Annex 10).

The "Trois Bébés" district, low marshy, coastal area, just to the north of Port-au-Prince, 16,000 inhabitants, 4,000 houses had 4 cases of malaria.

in 1967, 249 in 1968, 1,232 in 1969, 81 in 1970 and 16 cases in 1971. The outbreak has been effectively checked with drainage and fortnightly application of larvicides (Anopheles resistance to DDT had been demonstrated).

Petit-Goâve - Miragoâne indicator district low coastal plain and inland plain around the lake of Miragoâne, with 46,000 inhabitants and 18,000 houses, has been considered as one of the most malarious areas of the country. In 1967, 494 cases of malaria were detected, 189 cases were found in 1968, 1,482 in 1969, 1,982 in 1970 and 2,983 in 1971. Annex 12 showing the DDT spraying and the positive cases in 1971 indicates that the spraying has not interrupted transmission. The steady increase of the number of positive cases in May through October, in spite of the spraying, leads one to believe that other attack measures must be used.

Aquin - This indicator area is situated in the interior and in the south coast of the southern peninsula opposite to the Miragoâne - Petit-Goâve district. It has about 14,500 houses and 38,500 inhabitants. 55 cases of malaria were detected there in 1967, 9 only in 1968, 222 in 1969 and 1,784 in 1970, while 1,220 in 1971. Although the trend throughout 1971 seems a little more favourable than that of Petit-Goâve, it does not necessarily follow that DDT will be effective. (Annex 11)

The last indicator district, Jacmel, is also situated on the south coast of the southern peninsula. It has about 29,000 inhabitants and 9,000 houses. 26 cases were found in 1967, 116 in 1968, 129 in 1969, 166 in 1970 and 224 in 1971. Annex 13. The majority of the cases of 1971 were found during the last months of the year. A comparatively low susceptibility of A. albimanus was detected at the same time (mortality of 7% at 60 min. exposure on 4% paper).

For a better understanding of the duration of effectiveness of the insecticide under the local conditions, a compilation was made of the spraying data and case-data for several other localities. The impression obtained is that there exists generally a beneficial effect of DDT spraying for about four months but in several parts of the southern peninsula this seems to be doubtful (e.g. Grand-Goáve, Gerar, etc.). It would be safer to consider the use of other attack measures. (See Annexes 22 - 27).

SUMMARY

The data indicate the necessity of a careful epidemiological study in order to determine (1) the number and timing of spraying cycles required in different areas, and (2) the (supplementary) attack-measures to be used in the areas where transmission continues in spite of (1).

FIELD OPERATIONS

GEOGRAPHICAL RECONNAISSANCE

Previous Evaluation Teams have emphasized that SNEM must complete, refine and keep up to date the geographical reconnaissance. This continues as an important requirement particularly in light of the large number of new houses constructed each year. Inspection of house-maps to determine their up-to-date accuracy and to insure their proper use should be a routine part of the supervision of house-spraying.

SPRAYING OPERATIONS

Since the strategy review of May 1970, three cycles of DDT spraying have been completed. These cycles did not reach total coverage of the houses planned and were not conducted as scheduled.

During this period the total number of cases increased from 5,005 in 1969 to 10,658 in 1970 and 11,347 in 1971.

A careful analysis of the spray records is necessary to determine the significance of this increase in cases in relation to the spraying. Spraying records of SNEM show unusually low refusal rates. However, the locked houses, houses not sprayed for legitimate reasons and new houses not previously sprayed add up to a higher missed houses rate not shown in the normal records. Actual missed house rate by sector varies from 3% to 35.4% with an overall average of 7%.

The general timing of the spray cycle in relation to the peak transmission season indicates a slight delay in the start of the spraying and a continuation for a longer period than planned. But it can be

seen that in many localities the spray protection is preceded by a build-up of cases. This is partially due to the other factor involved in the lack of success of the residual spraying, i.e. the high degree of attrition of sprayed surfaces during the six month period between cycles and the loss of effectiveness of the DDT in the same period, both reported by SNEH.

A final factor reported by SNEH and several consultants is the probability of a certain amount of outdoor transmission due to the exophily and exophagy of the vector and the outdoor living habits of the people.

In order to determine the extent to which each of these factors is responsible for the failure to stop transmission, the recommendation of the Strategy Review Committee that operational research should be conducted to determine the causes of persistent transmission should be implemented without further delay.

USE OF DRUGS

Drugs were used extensively during the years 1951 to 1958 as mass drug administration and succeeded in lowering the malarial incidence considerably but not in eradicating malaria.

The use of mass drug administration as a primary method of attack is contraindicated by the following factors:

- a) The widespread distribution of persons with parasitemia and the great mobility of these would call for a simultaneous coverage of the whole country, which practically cannot be achieved.

In areas where mass drug administration has been applied for long periods, the population become reluctant to accept it, and the participation rate falls after some months to about 50%, which is not sufficient to obtain satisfactory results. A prolongation of the mass drug administration usually leads to further decrease in the participation rate.

On the other hand, mass drug administration is useful for the rapid elimination of small residual foci, and may be so too when used as a secondary attack measure to protect specially exposed population groups in areas where malaria transmission has already become satisfactorily reduced by a primary attack measure when the above mentioned factors (a) and (b) are taken into account.

Another use of drugs is the presumptive treatment administered to all fever cases from whom a blood smear is taken, by Voluntary Collaborators Posts or Evaluators.

Finally there is the radical cure of the detected cases which is indicated in areas of low incidence.

Recently the susceptibility of P. falciparum to drugs has been investigated in this country. It was found to be very susceptible to the quinoline series and showed resistance to pyrimethamine. For this reason, pyrimethamine should be eliminated and chloroquine be employed. The combination of chloroquine-primaquine could be considered after a careful study.

SUMMARY

Drugs are useful as an additional attack-measure given as presumptive treatment, radical cure, and for the elimination of active isolated foci and under special circumstances as mass drug administration.

OTHER SUPPLEMENTARY MEASURES

a) Larviciding should be used in problem areas wherever appropriate i.e. where the mosquito sources affecting a given population are fixed, limited in scope and accessible. Larvicidal oils, Paris Green or a pesticide such as e.g. ABATE may be used.

b) Adulticiding (space spray) by Ultra Low Volume applied by air. An ULV spray trial in the Petit-Goâve area was proposed several years ago and was also suggested by the Strategy Review Committee in 1970. A specific proposal has now been made by CDC including a preliminary trial in the Spring of 1972 to determine the appropriate dosage and evaluate its effectiveness in vector control and a larger scale trial to be carried out in the Fall in order to determine the effectiveness in reducing transmission in the area.

Although the ULV spraying cannot be considered as an alternative to routine malaria eradication measures, it is well worth carrying out these trials to evaluate the usefulness of ULV for the purpose of possible later use as an additional attack measure in special problem areas like Petit-Goâve or for emergency use to counter epidemics in connection with tropical storms and similar natural disasters.

c) Source Reduction is a supplementary measure with long range benefits. It should be considered for use in problem areas for the purpose of reducing the general mosquito density to the point where the usual attack

measures become fully effective in interrupting the transmission. According to the 1970 Strategy Review, the Petit-Goâve/Miragoâne area lends itself particularly to this approach. The feasibility of this project should be determined as soon as possible. The feasibility study should include estimates of the costs and of the impact of such a project on the local farming and on the health conditions in general, apart from taking engineering aspects into consideration. Other source reduction measures such as use of tide gates, filling, water-management, etc., should be considered for use where applicable.

ADMINISTRATION

PROGRAMMING AND FINANCING

Since the inception of MEP, its financing in almost its totality (96,0%) has been supported by cooperating international agencies, USAID contributing 76,6% of this support.

Financial resources so obtained have not been regular from one year to another, and often the funds have not been received in time.

This situation restricted the annual programming of MEP activities to authorized budgets, and reduced or paralysed operations at times.

At present, MEP financial resources for the year 1972 and following years are unknown making the programming of activities at this time unrealistic. The fact that the USA Government Fiscal Year (July - June) the Haitian Government (October - September) and the MEP Calendar Work Year do not coincide, leads to confusion in regard to financial resources for the present period of work in advance.

On the other hand, it is noted that there is a gradual decrease in the funds allotted for MEP local expenses in connection with the number of inhabitants protected by this sanitary campaign. In 1971, expenditures represented 57,3% of 1966 expenses per inhabitant of the malarious area, while the malaria figures increased (from 8,356 positives to 11,347).

The Report of the Malaria Eradication Strategy Review Committee of May 1970 recognized the importance and interrelation of sound financial planning to the successful execution of any technically feasible malaria eradication program. That committee noted several historic problems in this

regard and recommended sustained contributions by national, international and bilateral assisting funding organizations at a high level and on a timely basis for a minimum of three additional years. The report further suggested that the Government of Haiti immediately investigate means of solving the long range funding problem of loan financing from bilateral or international sources and increased contributions from the Government.

The present Evaluation Committee reviewed the financial experiences of SNEM since the Strategy Report and concluded that while some improvements were realized in the regulation of contributions from all sources during this period, problems still remain and little progress has been achieved in securing more permanent solutions to the financing problem. As provision of adequate financial resources for the program is an integral part in the determination of the feasibility of malaria eradication, the Evaluation Committee recommends the Government of Haiti to give urgent consideration to the alternative recommendations for assuring the financial requirements of the program which are contained in the Strategy Report, since UNICEF will cease its participation in the program as of June 30, 1973, as has been indicated and since future grant funding from the U.S. cannot be assured.

ORGANIZATION

SNEM organization and procedures in general are good and the Service enjoys an adequate autonomy which is necessary for its proper functioning. However, it is considered that the cost of administrative services is high (11,8% of the functioning budget) and some procedures could be adjusted, especially those related to purchases and supply. Also it is estimated that several routine activities now centralized in the Co-Direction could be delegated, thus expediting action.

The internal organization of the Central Administrative Division could be simplified by grouping into 5 sections from the present 9 sections, without prejudice to essential control and freedom of action, and with a reduction of expense.

RECOMMENDATIONS

1. Special studies should be continued and expanded in order to determine the precise reasons for persistent transmission. A short term consultant should be made available to assist in such studies.
2. Residual spray treatment of the houses will continue to be the primary method of attack, supplemented by selective mass drug treatment, larviciding, space spraying by ULV and source reduction where appropriate.
3. The residual spray operations should be conducted with greater flexibility both in timing and in length of cycle in order to get the spray on the walls immediately prior to the peak build-up of vectors leading to the peak transmission season. This flexibility should extend to the Sectors and even to groups of localities if there are demonstrable differences in the build-up of vectors and the consequent peak transmission from area to area.
4. Field trials of all available supplementary attack measures should be carried out in the problem areas to determine their usefulness under Haitian conditions.
5. The use of mop-up spray teams should be considered as a means of extending protection to new houses and houses missed in the regular cycle.
6. In those areas of proven vector resistant to DDT and/or where timely total coverage spraying has failed to reduce malaria, alternative insecticides should be used. BHC (BCH), Malathion, OMS-33 or Lindrin may be used.

7. A plan should be prepared to provide for progressive reduction of spraying as areas meet the criteria for consolidation. The criteria laid down in Reports of the WHO Expert Committee on Malaria should be used for establishment of the active surveillance system, withdrawal of spraying, and application of remedial measures. The minimum size unit (population and area or political sub-division) to be considered for consolidation should be determined by SNEM on the basis of epidemiological analysis, physiography and practicality.
8. The evaluators or House Visitors should be considered as future Basic Health Workers and should have suitable qualifications. Their training from the beginning should also reflect this. Since vital statistics is also of considerable value to the Malaria Program, it should be included as a part of their duties from the beginning.
9. The tabulation of cases based on the date of slide acquisition should continue to be kept up to date and should be used for planning of field operations.
10. Even greater efforts should be made to speed up delivery of slides to the laboratory in order to identify areas of rapidly changing transmission.
11. A monitoring system should be established to make sure that in the routine house visits slides are taken from actual or recent fever cases.
12. The overall value of active case detection in areas of high incidence in problem areas is doubtful.

It is recommended that a system of malarimetric surveys in Indicator Districts be developed to keep track of changes in the malaria situation in the Indicator Districts.

It is further recommended that active case detection should be concentrated in areas of low transmission where it will facilitate epidemiological investigation of cases and serve the useful purpose of finding and treating cases and implementing remedial measures.

13. It is recommended that immediate steps should be taken to obtain support for a study of the feasibility of draining the lakes in the Petit-Goâve/Miragoâne area. The study should include agricultural and sociological implications as well as engineering aspects and costs.
14. It is recommended that the ULV space spraying trial be carried out in the Petit-Goâve/Miragoâne area.
15. It is recommended that drugs should be used as complementary measures of attack for presumptive treatment, radical cure and mass drug distribution to eliminate active isolated foci. In this respect the use of 4-aminoquinolines is recommended.
16. It is recommended that arrangements be made that the high level field personnel will be stable and not liable to cyclical dismissal. This is of paramount importance in order to maintain their interest in the program and their efficiency.
17. In consideration of the fact that the Memorandum of Understanding was executed in 1963 and in view of the changing requirements of the program it is recommended that the Memorandum of Understanding be renegotiated in order to make it consistent with the present realities of the situation.

18. It is recommended that the Government of Haiti review its present and future external technical advisory needs and give serious consideration to recruiting and training national professional personnel to provide for future needs and reduce dependence on external advisory assistance.
19. A three year plan of operations should be prepared by SNEM based on the recommendations proposed by the Evaluation Team. The plan should include detailed annual budget and plan of action for each of the three years.
20. It is recommended that the Government of Haiti give due consideration to paragraph 7.2.6.2 of the Strategy Review Committee Report in order to accelerate the establishment of the study groups for the formation of a basic health infrastructure for the integration of the campaign with the health service system at the appropriate time. The first step could be the formation of a multi-disciplinary group to take an inventory of available resources and prepare the basic data required for the planning of the proposed infrastructure.
21. It is considered essential that the Government of Haiti and the operating agencies study the possibility of securing MEP financing on bases which permit:
 - a) Adequate programming and regular execution of activities, with sufficient resources and timely delivery of funds.
 - b) Adaptation of the budget to annual MEP activities, in order to ensure anticipated programming of work plans.

22. Regrouping of the 9 present central administrative sections into the following ones:

1. Accounting
2. Personnel
3. General Services
4. Transports
5. Audit

This reorganization should result in better direct control and less expenses.

23. Define by MEP activity all general expenses mentioned, in view of establishing the real cost, by type of activity, and coordinate this information with the rate of output by the technical sections.
24. Updating of existing material and equipment levels for Zones and Sectors, to adapt supply to present work plan and speeding re-supply.
25. Retention of experienced field personnel during periods in which for financial reasons field employees are laid off.

LIST OF ANNEXES

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2	AVERAGE ANNUAL RAINFALL (MAP No. 2)
3	POPULATION DISTRIBUTION BY GROUP OF LOCALITY (TABLE No. 3)
4	GENERAL MORTALITY AND SPECIFIC MORTALITY RATES (TABLE No. 7)
5	ECONOMICALLY ACTIVE POPULATION BY PRODUCT AND SERVICES SECTOR (TABLE No. 4) - 1968
6	NATIONAL GROSS PRODUCT PER HABITANT, DURING THE PERIOD 1966 - 1970.
7	STRUCTURE OF THE NATIONAL GROSS PRODUCT BY PRODUCTION AND SERVICES SECTORS (TABLE No. 6) - 1969
8	EPIDEMIOLOGICAL-OPERATIONAL GRAPH SHOWING 1962-71 CASES, SPR, API AND DDT/YEAR.
9	INDICATOR ZONE 1 (FIGURE 1)
10	INDICATOR ZONE 2 (FIGURE 2)
11	ZONE III INDICATOR DISTRICT (FIGURE 3)
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16	REASON GIVEN BY EVALUATORS FOR TAKING SLIDES SAMPLES FROM ZONE II (TABLE II)
17	CASES OF MALARIA - HAITI 1967 - 1971 (TABLE III)
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19	ANNUAL PARASITE INDEX IN 1971
20	RURAL SECTORS OF HAITI WITH PARASITIC INDEX GREATER THAN 25 - 1

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Title

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- 22 NUMBER OF POSITIVE CASES - 1971 "CITERNE REMY, BAIE DE HENNE"
- 23 NUMBER OF POSITIVE CASES - 1971 "LA GONAIVE"
- 24 NUMBER OF POSITIVE CASES - 1971 "PT. RIV. DE NIPPES"
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- 26 NUMBER OF POSITIVE CASES - 1971 "GERARD, GRAND GOAVE"
- 27 NUMBER OF POSITIVE CASES - 1971 "LES IROIS, ANSE D'HAINAULT ET
DAME MARIE"
- 28 BIOASSAY TEST (WHO METHODOLOGY) - "SOURCE PINAUD" LOCALITY
- 29 BIOASSAY TEST (WHO METHODOLOGY) - "FORT LIBERTE" LOCALITY

MAP OF THE REPUBLIC OF HAITI

-  1,400 ISOHYETS IN mm.
-  ALLUVIAL DEPOSITS
-  LIMESTONE FORMATIONS OR DEPOSITS
-  AREA OVER 500 METERS



AVERAGE ANNUAL RAINFALL

ISONYETS IN mm OF RAINFALL

MAP No. 2

ANNEX 2

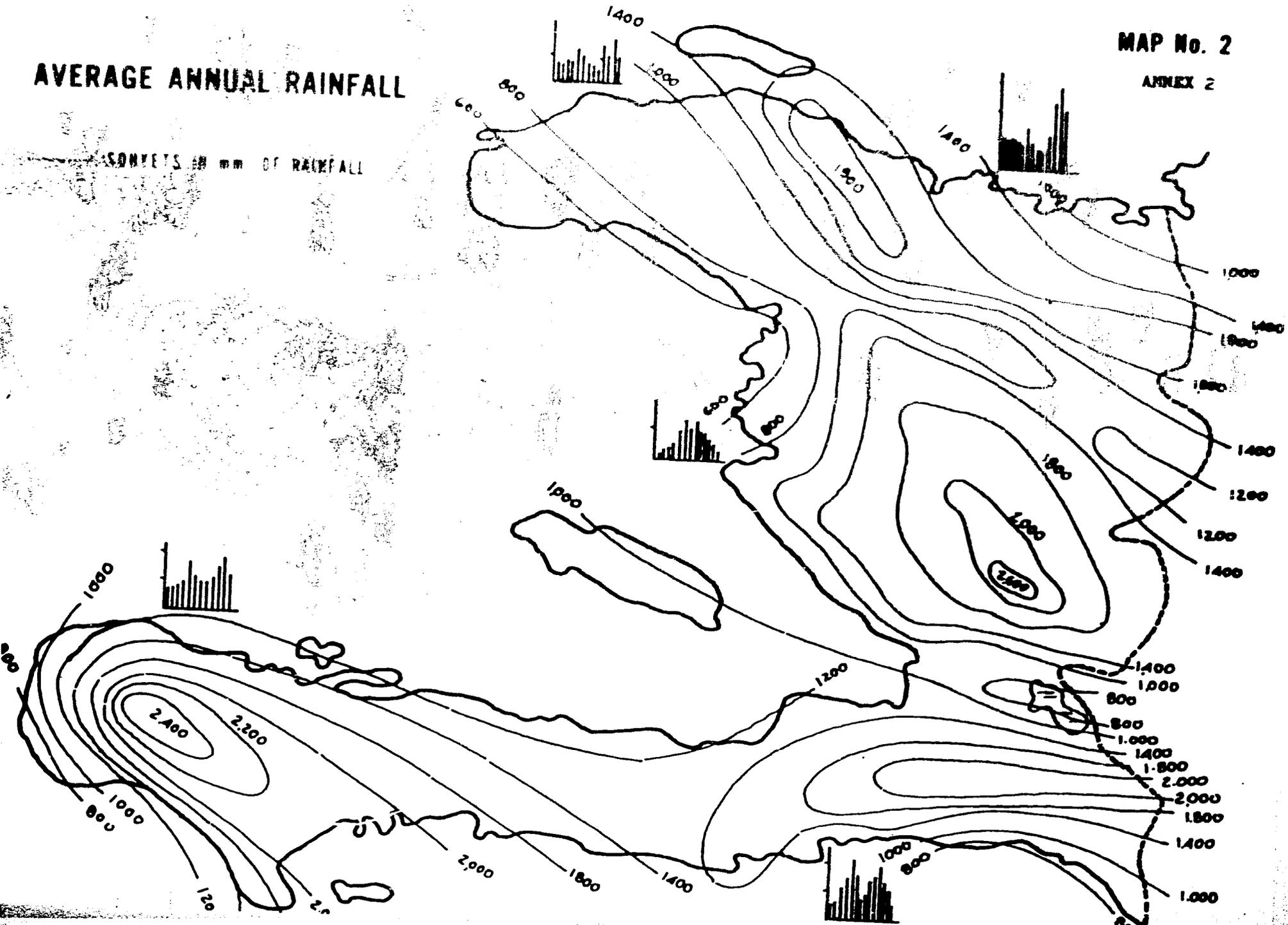


TABLE III

POPULATION DISTRIBUTION BY GROUP OF LOCALITIES
 1968 Estimate (1)

GROUPS OF LOCALITIES (No. of Inhabitants)	NUMBER OF LOCALITIES	POPULATION	
		NUMBER (In Thousands)	%
100,000 +	1	340	7.3
25,000 - 99,999	5	233	5.0
10,000 - 24,999	6	101	2.2
5,000 - 9,999	31	239	5.1
1,000 - 4,999	95	399	8.5
500 - 999	88	68	1.5
Less than 500	165	64	1.4
Dispersed population	-	3,226	69.0
TOTAL	391	4,670	100.0

(1) Source: Haiti Institute of Statistics

TABLE No. 2

GENERAL MORTALITY AND SPECIFIC MORTALITY RATES
1970 (1)

MORTALITY CATEGORIES	POPULATION	DECEASED	RATE
General	4,867,190	82,450	16.94 ⁽³⁾
Maternal	(2)	(2)	(2)
- 28 days	(2)	(2)	(2)
- 1 year	181,448 ⁽⁴⁾	26,585	146.51 ⁽⁵⁾
1 - 4 years	638,676 ⁽⁶⁾	21,090	33.02 ⁽⁷⁾
- 5 years	820,124 ⁽⁶⁾	47,670	58.13 ⁽⁷⁾

- (1) Source: Haiti Institute of Statistics
- (2) Data not available
- (3) Per 1,000 population
- (4) Number of live births
- (5) Per 1,000 live births
- (6) Population by age groups
- (7) Specific rate by age groups

TABLE No. 4**ECONOMICALLY ACTIVE POPULATION BY PRODUCT AND SERVICES SECTOR
1968 (1)**

SECTORS	POPULATION	
	NUMBER (Thousands)	%
Primary (2)	1,461.7	85.4
Secondary (3)	96.4	5.6
Tertiary (4)	185.0	8.7
TOTAL	1,747.2	100.0

- (1) Source: Haiti Institute of Statistics
- (2) Agriculture and animal husbandry, mines and quarries, and other branches.
- (3) Manufacturers and other branches.
- (4) Industrial

TABLE No. 5

NATIONAL GROSS PRODUCT PER HABITANT, DURING THE PERIOD

1966 - 1970 (1)

YEAR	Pop. (Thous.)	Equiv. of US \$ in Gourdes	Gross National Product		
			Gourdes (Thousands)	Dollars (Thousands)	Dollars per habit.
1966	4.490.0	155	1.682.100	336.420	74.93
1967	4.580.9	125	1.705.200	341.040	74.44
1968	4.674.1	125	1.727.400	345.480	73.91
1969	4.769.5	125	1.767.130	353.426	74.10
1970	4.860.0	125	1.770.585	354.117	74.20

(1) Source: Quadriennial Projections 1972-1975 (July 1971)

(2) Sale price.

TABLE No. 6

STRUCTURE OF THE NATIONAL GROSS PRODUCT BY
PRODUCTION AND SERVICES SECTORS

1969⁽¹⁾

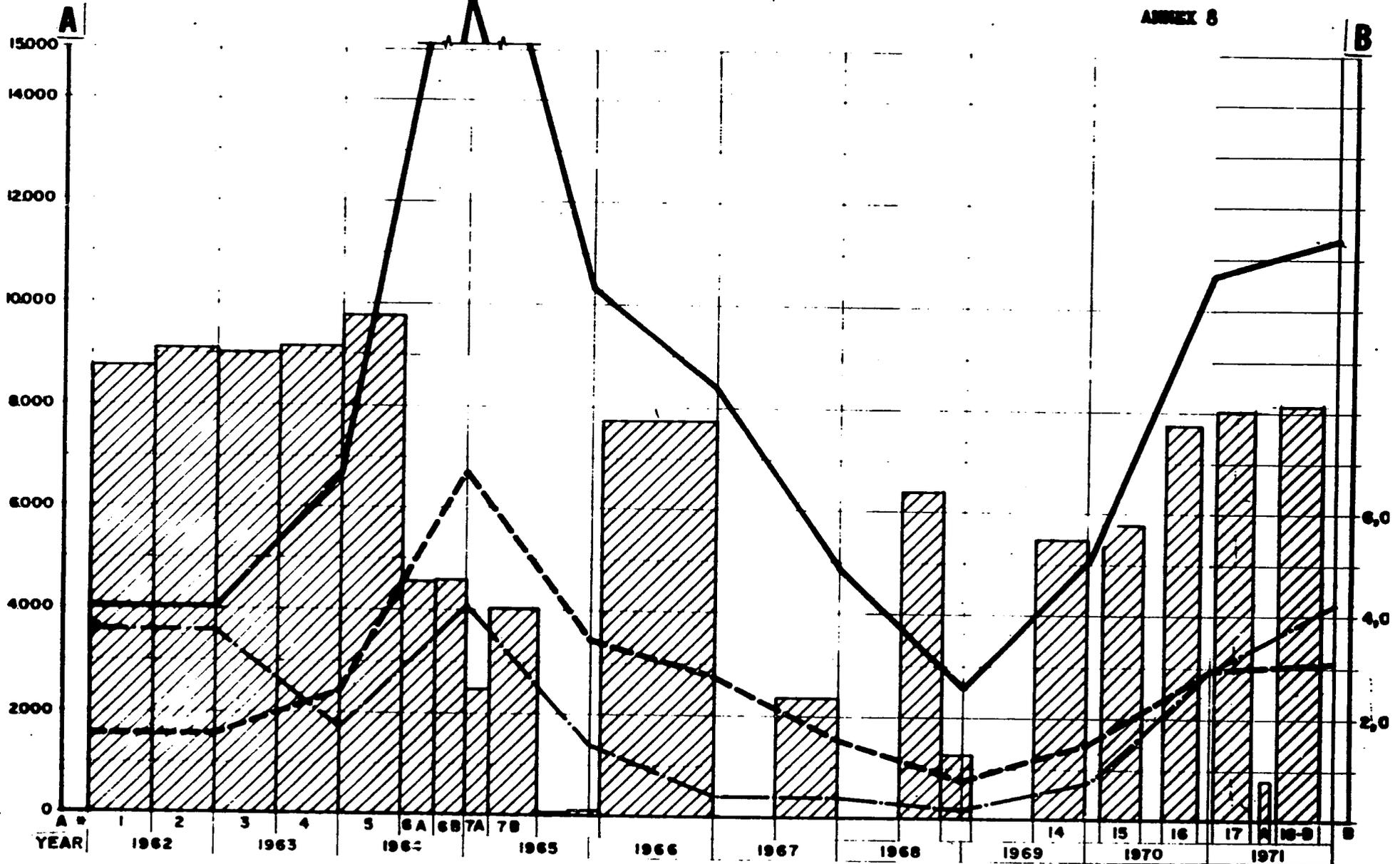
SECTORS	Internal Gross Product		
	\$ Gourdes (Thousands)	Dollars (Thousands)	Percentage
PRIMARY:	<u>882.700</u>	<u>176.540</u>	<u>52.0</u>
Agriculture and Animal Husbandry	848.500	169.700	
Mines and quarries	34.200	6.840	
SECONDARY:	<u>221.400</u>	<u>44.280</u>	<u>13.0</u>
Manufacturers	168.300	33.660	
Other branches	53.100	10.620	
TERCIARY:	<u>592.100</u>	<u>118.420</u>	<u>35.0</u>
TOTAL	1.696.200	339.240	100.0

(1) Source: Haiti Institute of Statistics.

HUJ70

HAITI

ANNEX 8



HOUSES SPRAYED (SCALE A x 100)



MALARIA CASES (SCALE A)



SLIDE POSITIVITY RATE (SCALE B %)



ANNUAL PARASITE INCIDENCE (SCALE B %)

* CYCLE

INDICATOR ZONE I, LA COMA-1971 (Pop.11,025)

Date of slide collection —————

Date of slide examination - - - - -



DDT Spraying

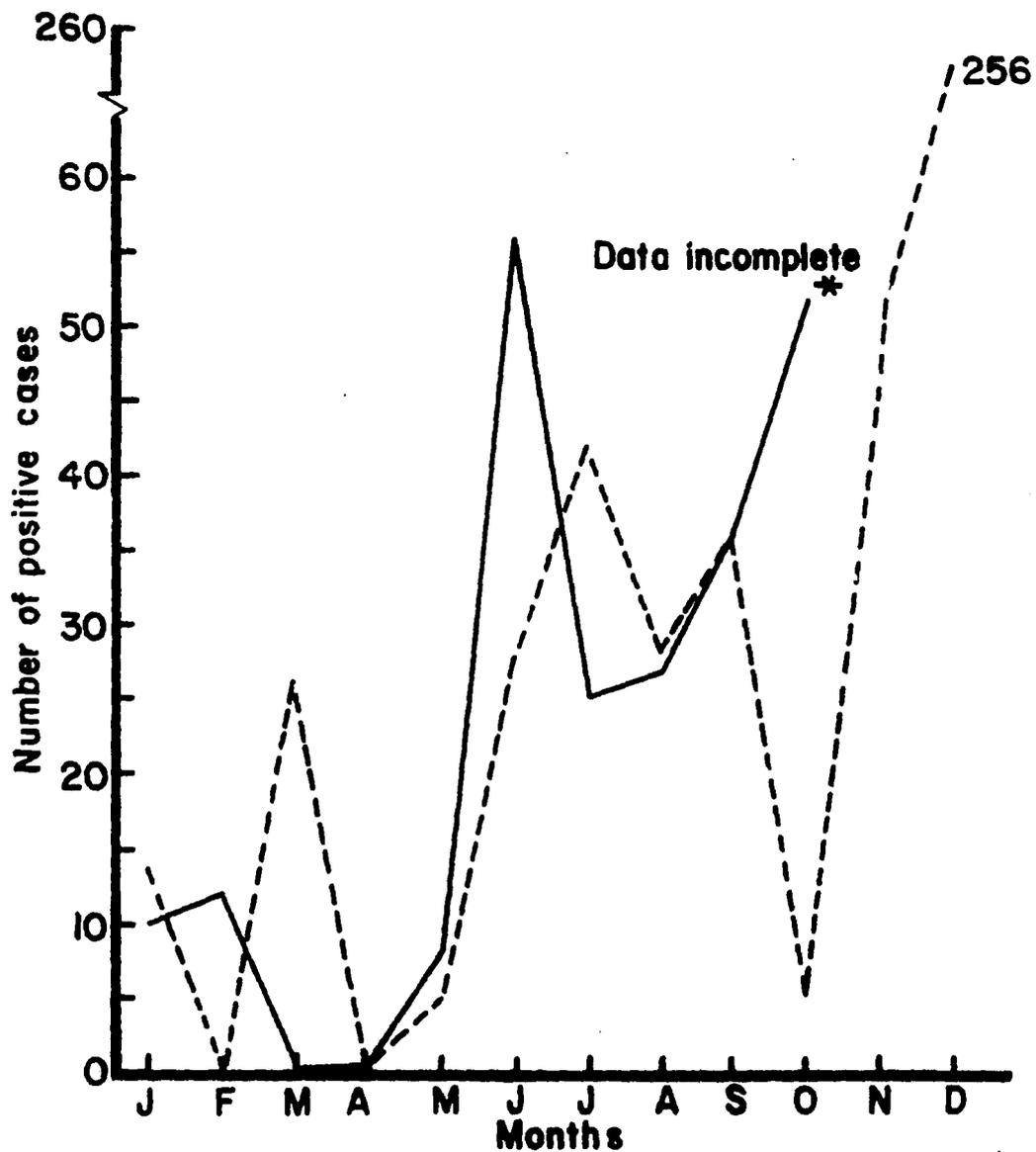
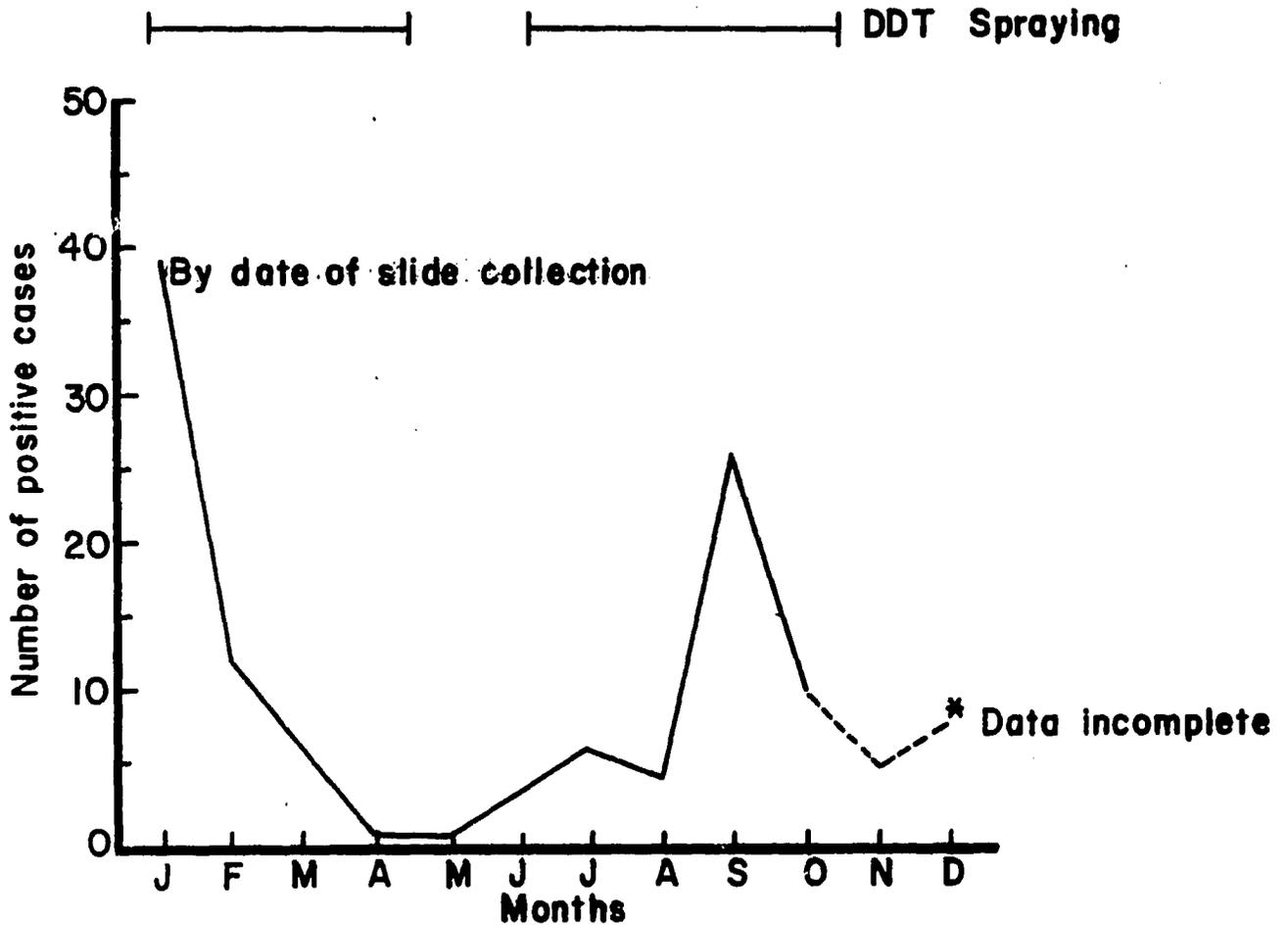


FIGURE 2
ANNEX No. 10

INDICATOR ZONE II, ARTIBONITE - 1971 (Pop. 50,527)



ZONE III, INDICATOR DISTRICT, AQUIN - 1971 (Pop. 8,627)

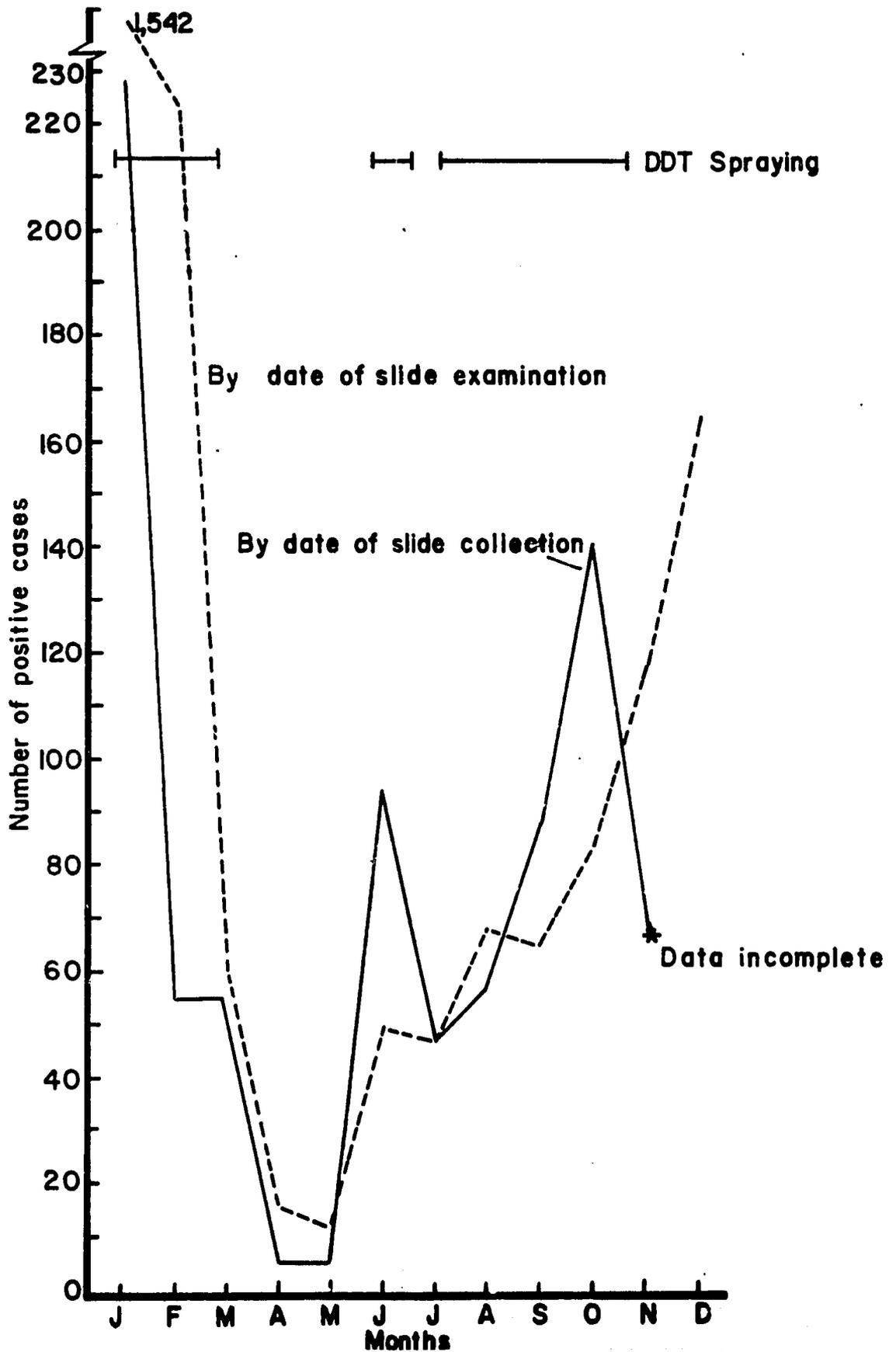
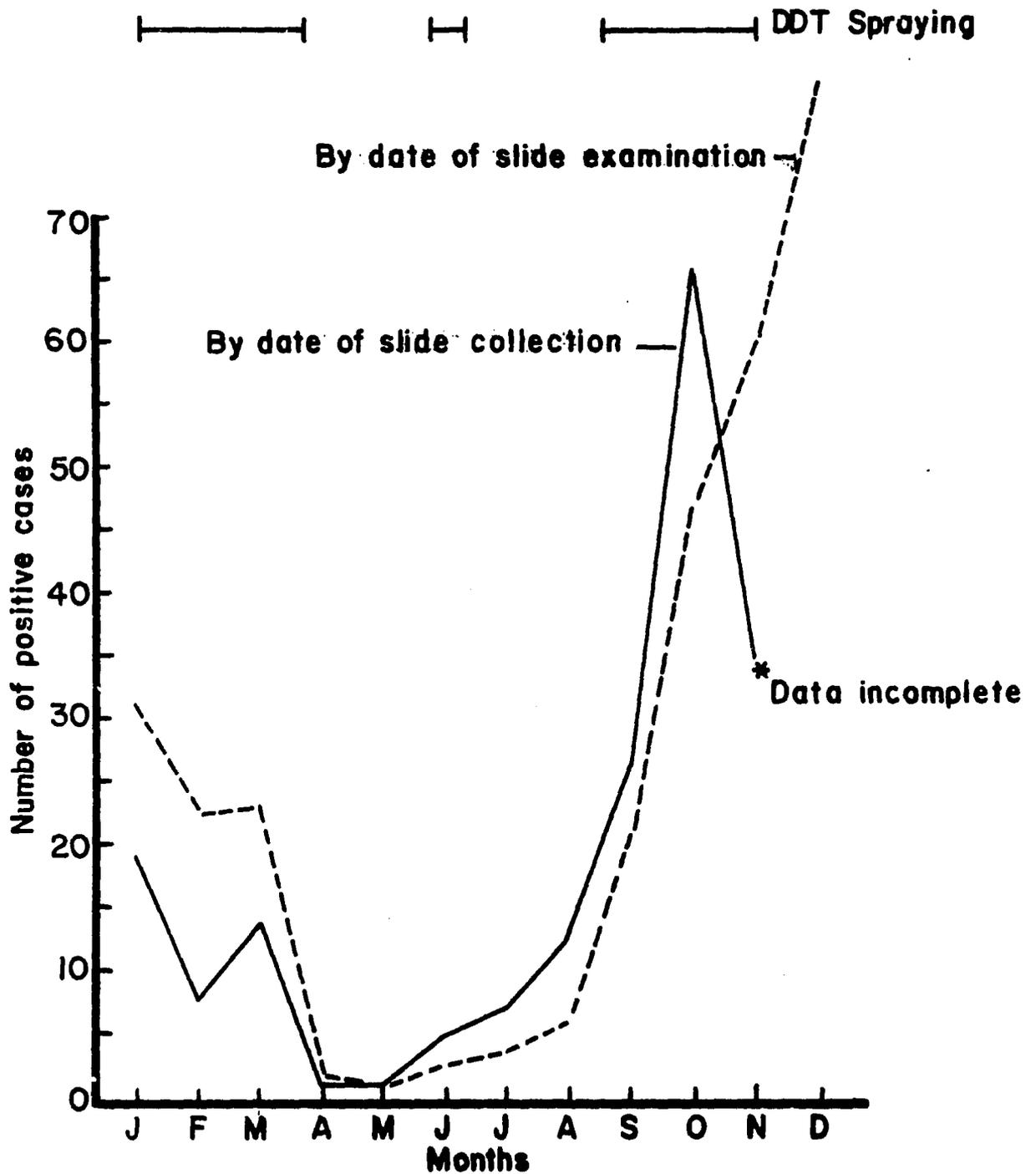


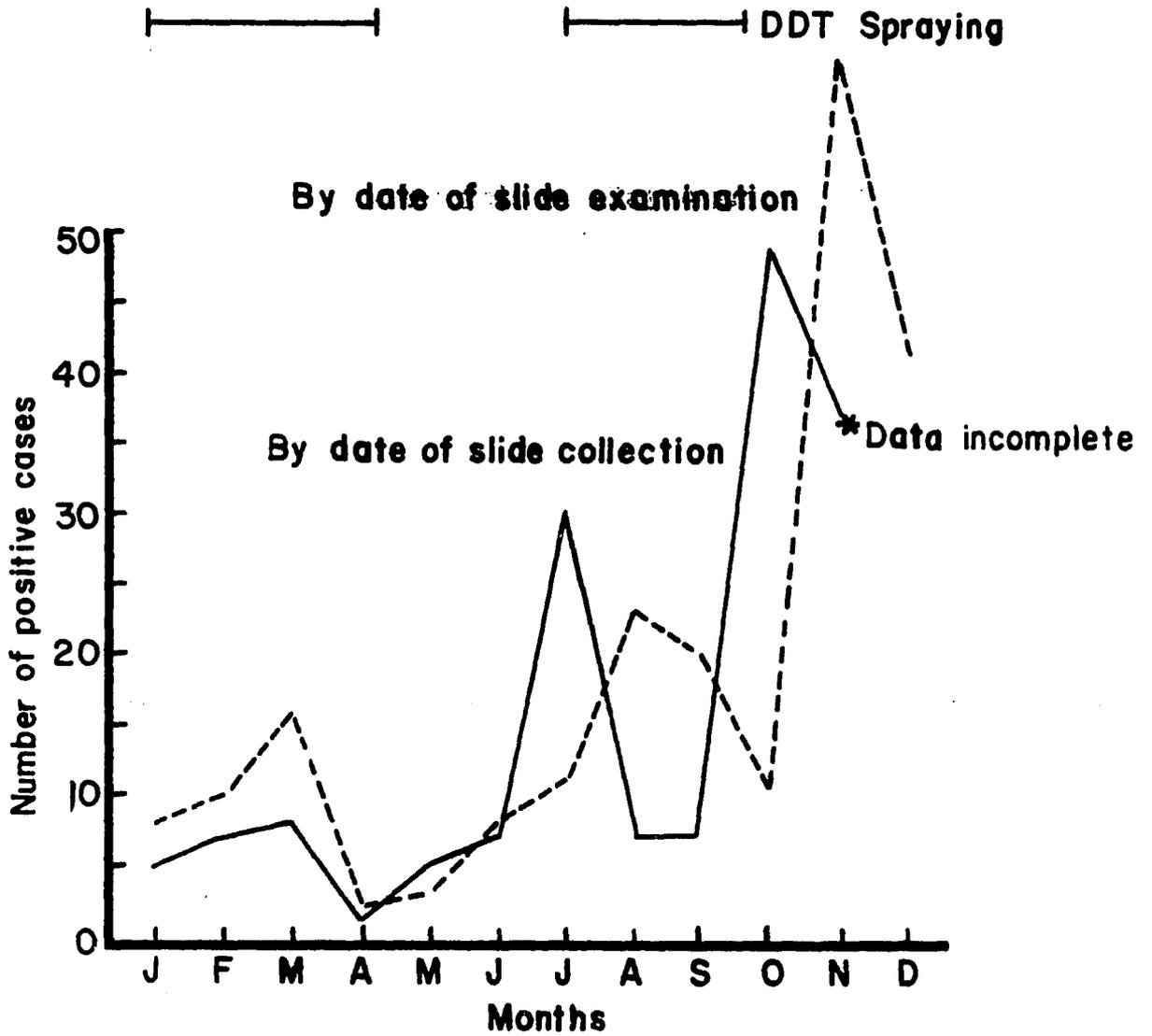
FIGURE 4

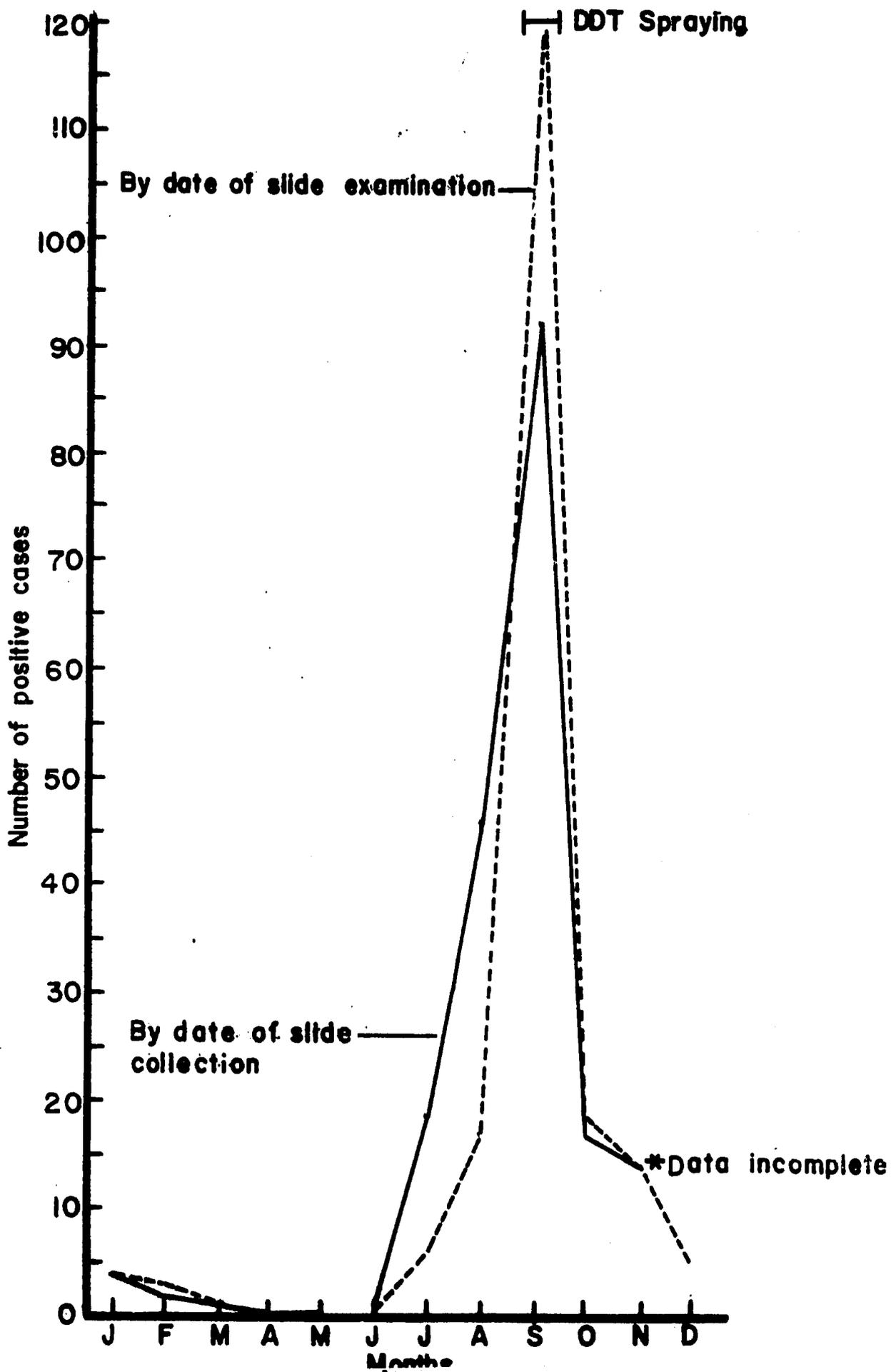
ANNEX No.

INDICATOR DISTRICT IV, MIRAGOANE-1971 (Pop. 42,140)



INDICATOR DISTRICT 6, JACMEL-1971 (Pop. 36,005)





PAGE 1

SLIDES AND CASES COLLECTED BY VOLUNTARY COLLABORATORS

Haiti 1967-1971

YEAR	Total Collaborators	Active Collaborators	SLIDES	CASES	% POS
1967	4664	2590 (55%)	24,250	102	0.4%
1968	5738	2914 (51%)	25,212	64	0.2%
1969	6564	2641 (40%)	173,252	195	0.1%
1970	6627	2396 (36%)	149,852	555	0.4%
1971	6596	2847 (43%)	152,456	525	0.3%

TABLE II

Number of respondents for taking slides sample from Zone II (Non

REASON GIVEN

Pos.

31	0
309	0
52	0
16	0
1	0
224	0
	<hr/>
	0

Indicator Districts Petit-Goave, Jacmel)

REASON GIVEN

Pos.

60	0
1	0
0	0
0	0
0	0
20	0
Other	0
1	0
<u>TOTAL</u>	<hr/>
138	0

TABLE III
CASES OF MALARIA-HAITI
 1967 - 1971

67	1,220,347		931 - Zone I
	1,343,242		3,303 - Zone II
	<u>883,549</u>		<u>734</u> - Zone III
	Pop. 3,447,138	Cases	4,968
68	1,186,646		1,057
	1,361,812		1,289
	<u>1,016,475</u>		<u>225</u>
	Pop. 3,564,933	Cases	2,571
69	1,161,747		928
	1,327,831		3,006
	<u>984,417</u>		<u>1,071</u>
	Pop. 3,473,995	Cases	5,005
70	1,208,217		2,418
	1,381,376		3,644
	<u>1,023,791</u>		<u>4,599</u>
	Pop. 3,613,384	Cases	10,661
71	1,286,800		1,967
	1,483,964		4,483
	<u>1,042,973</u>		<u>4,897</u>
	Pop. 3,813,737		11,347

SNEM - HAITI

ESCALA 1 : 200,000

INCIDENCIA PARASITARIA ANUAL EN 1970

LEYENDA



MAPA Nº 31



SNEM - HAITI

4.3

INCIDENCIA PARASITARIA EN AGOS

LEYENDA



TABLE IV

**RURAL SECTORS OF HAITI WITH
PARASITIC INDEX GREATER THAN 25**

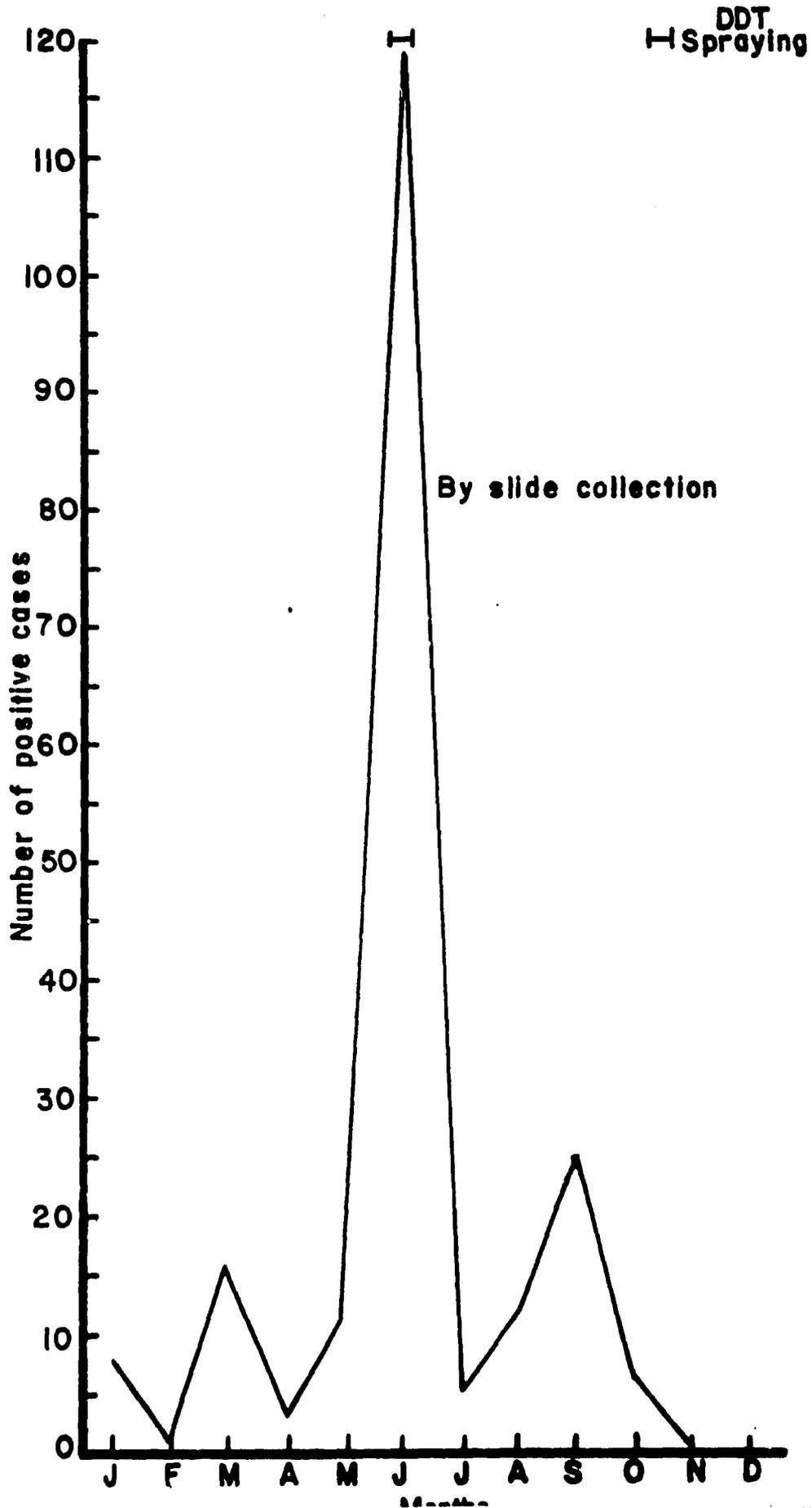
1971

	<u>RURAL SECTORS</u>	<u>CASES</u>	<u>POPULATION</u>	<u>PARASITIC INDEX</u>
1.	La Coma	486	16,534	27/1000
2.	Damé	72	2,370	30
3.	Citerne Rémy	218	1,199	102
4.	Dos d'Ane	52	1,944	27
5.	Rav. Normande	195	4,920	40
6.	1 ^o Plain	665	13,288	50
7.	2 ^o Plain	484	9,708	50
8.	Trou Chouchou	348	6,305	55
9.	Gérard	235	6,176	46
10.	Flamand	178	5,318	34
11.	La Colline	640	12,758	168
12.	Guirand	156	5,188	69
13.	Chalon	1,035	8,569	120
14.	Belle Riviera	190	7,326	26
15.	Pemerle	258	8,541	31
16.	Sillègues	258	5,565	46
17.	Champy	57	1,568	36
18.	Cholette	70	2,352	29
19.	Tiby	208	6,560	32
	TOTAL	6,053	126,189	40/1000

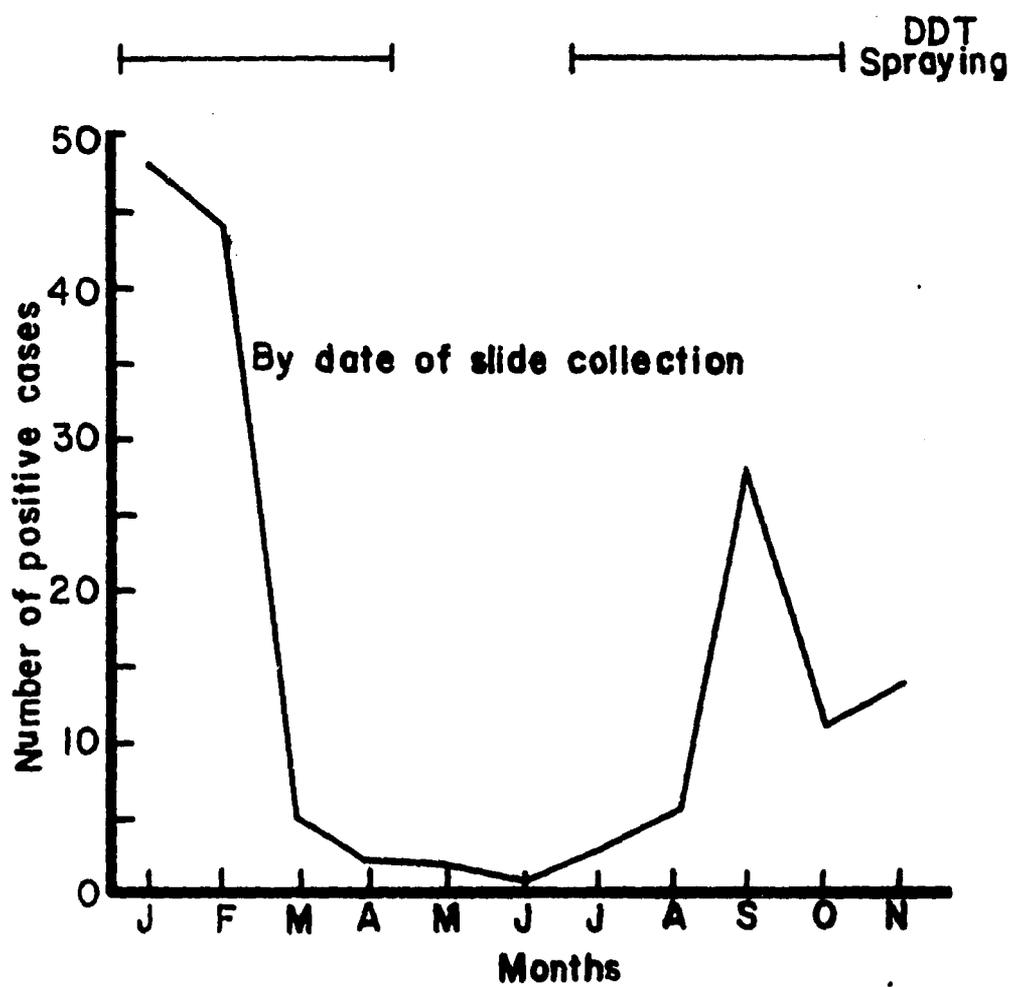
TABLE V

DISTRIBUTION OF CASES IN SEGMENTS OF TOTAL POPULATION

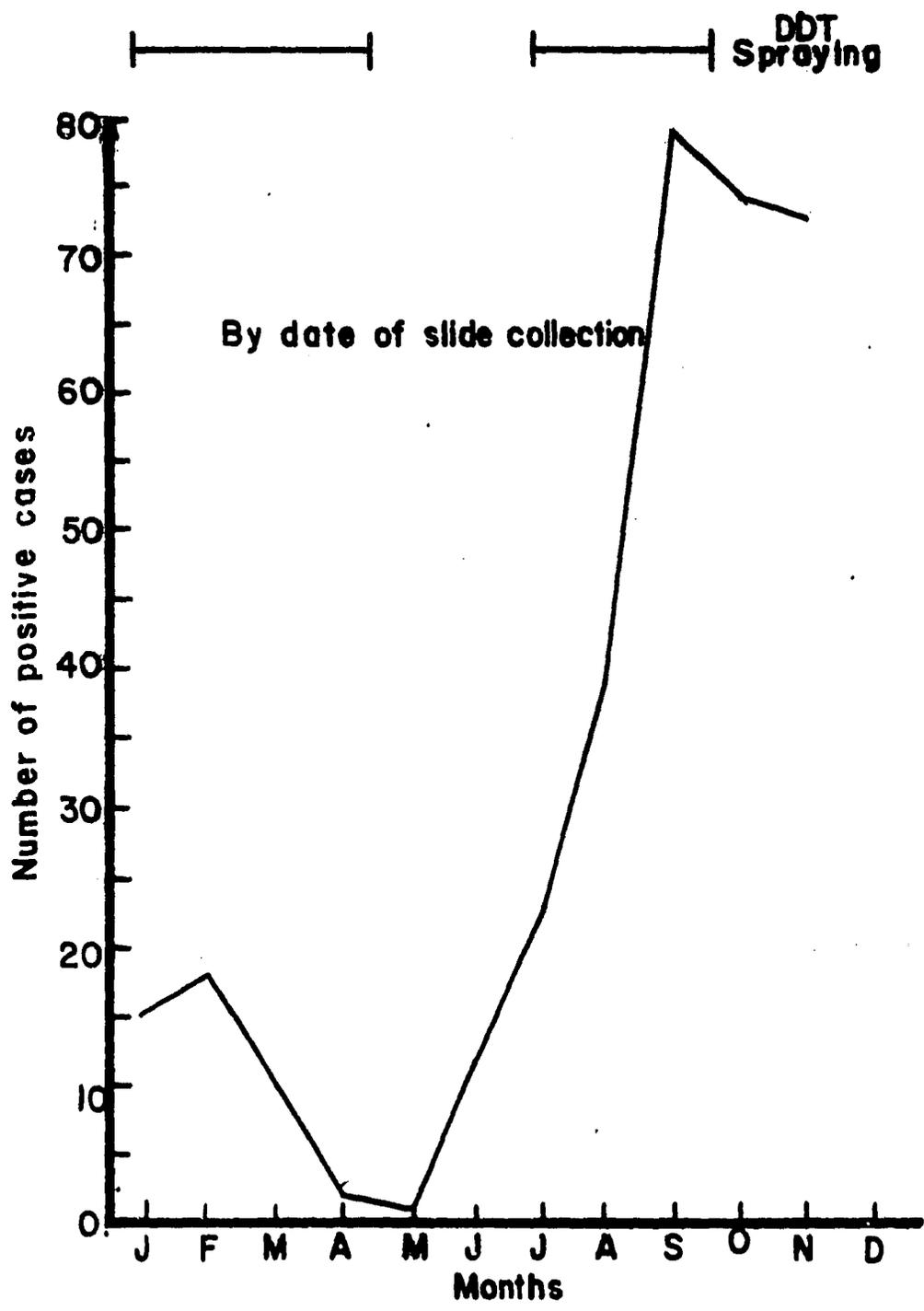
% OF TOTAL POPULATION	CUMULATIVE % OF TOTAL CASES
3.45	53.5
6.6	71.3
11.7	85.4
36.5	99.7



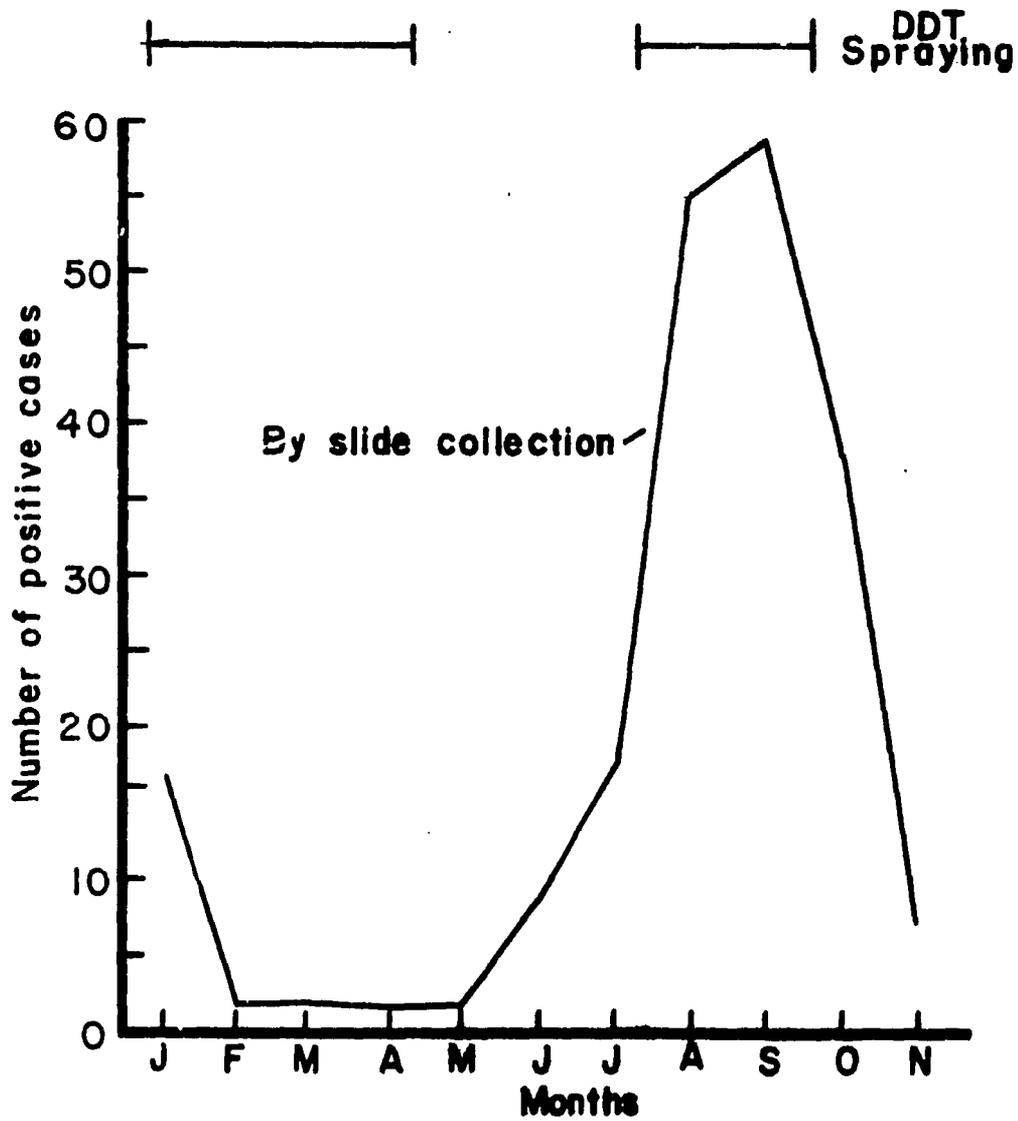
LA GONAVE - 1971 (Pop. 46,387)



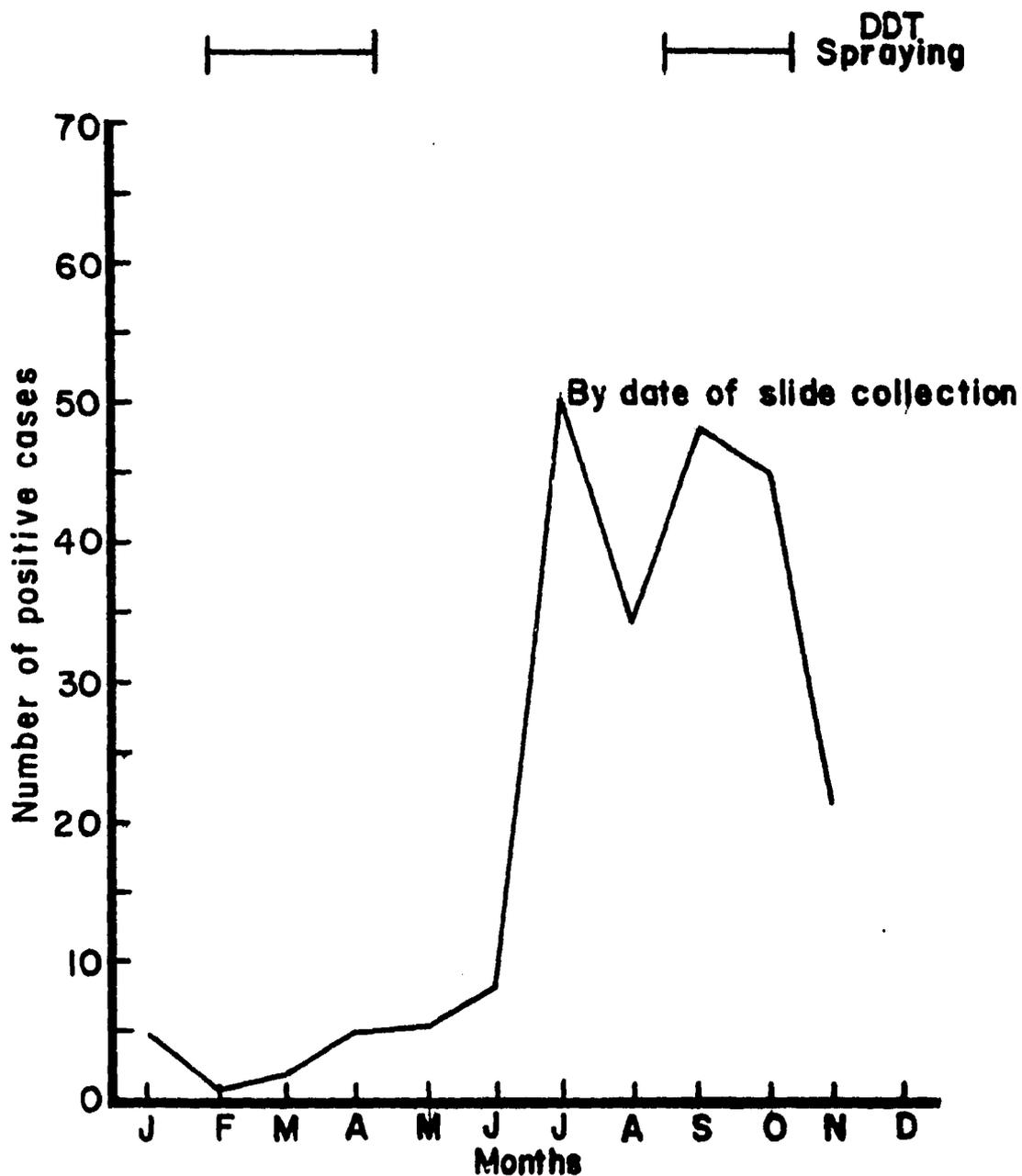
PETITE RIVIERE DE NIPPES-1971 (Pop,15,500)



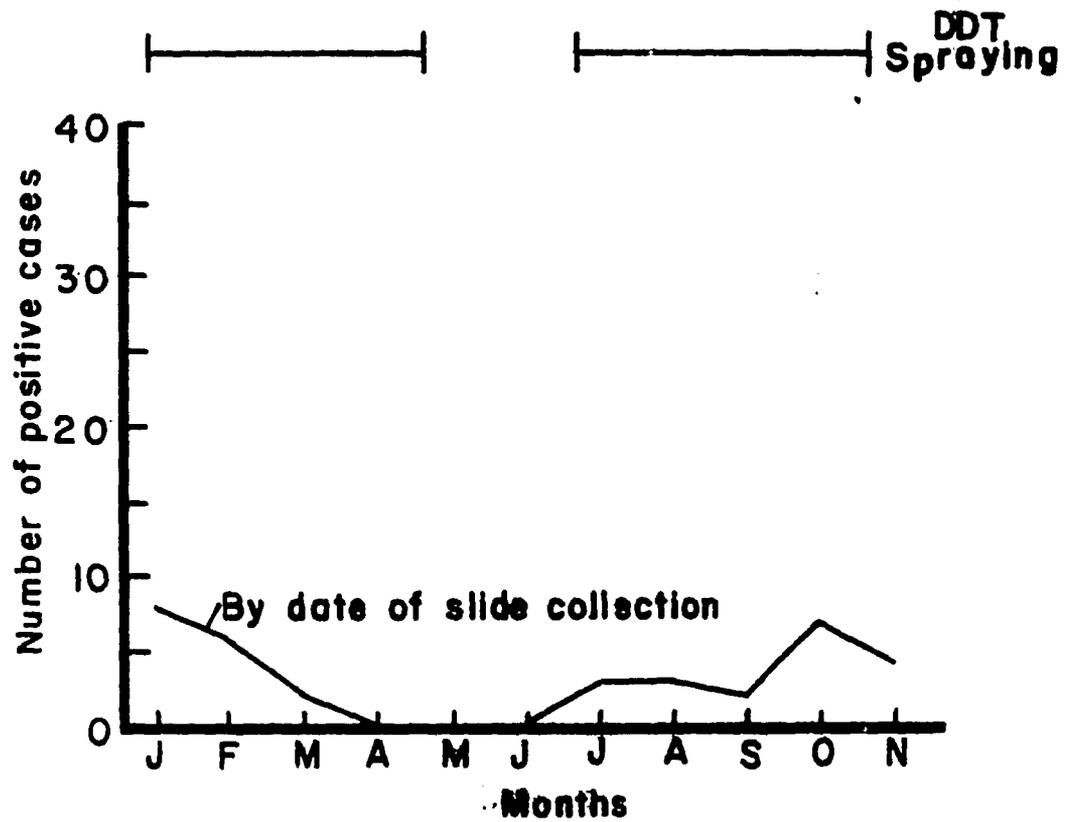
CAYES - JACMEL - 1971 (Pop. 12,000)



GERARD, GRAND GOAVE-1971 (Pop. 6,200)



LES IROIS, ANSE D'HAINAULT, DAME MARIE-1971 (Pop. 51,500)



BIOASSAY TEST (WHO METHODOLOGY)

ANNEX No. 28

DDT: 2 gms./m²

"Different Houses"

-

10 A. albimanus per cone

ZONE: II

Community: Petit-Goâve

- RURAL SECTION: 1st. Plaine

- LOCALITY: SOURCE PINAUD

TEST DATE	No. of days after spray.	HEIGHT AT WHICH CONES ARE PLACED ON WALLS															REMARKS
		1 FOOT			3 FEET			6 FEET			1 FOOT PROT.			Control			
		Exp.	Dead	%Dead	Exp.	Dead	%Dead	Exp.	Dead	%Dead	Exp.	Dead	%Dead	Exp.	Dead	%Dead	
5- 9-68	13	38	38	100.	30	30	100.	30	30	100.	-	-	-	15	1	7.	T. Res. (S)
11-10-68	49	30	30	100.	30	30	100.	30	29	97.	10	10	100.	20	1	5.	
13-11-68	82	30	27	90.	30	29	97.	30	30	100.	10	9	90.	20	4	20.	
12-12-68	111	30	29	97.	30	30	100.	30	26	87.	10	10	100.	20	1	5.	
13- 2-69	31	30	30	100.	30	30	100.	30	30	100.	10	10	100.	20	1	5.	
23- 5-69	132	30	13	43.	30	15	50.	30	15	50.	10	6	60.	20	0	0.	
19- 6-69	159	30	6	20.	30	12	40.	30	8	27.	10	2	20.	20	0	0.	
23- 7-69	193	30	6	20.	30	4	13.	30	3	10.	10	1	10	20	0	0.	
20- 8-69	221	30	1	3.	29	3	10.	30	2	10.	10	1	10	20	0	0.	
3-10-69	265	30	4	16.	29	4	14.	30	10	33.	10	4	40	10	0	0	

BIOASSAY TEST (WHO METHODOLOGY)

Annex No. 29

DOT: 2 gas/m²

ZONE: I

"Different Houses"

COMMUNITY: Fort Liberté

RURAL SECTOR: 1st. Damas

10 A. albimanus per cone

LOCALE: Fort Liberté

TEST DATE	N° OF BATS AFTER SPRAYING	HEIGHT AT WHICH CONES ARE PLACED ON WALLS												CONTROL			REMARKS
		1 FOOT			3 FEET			6 FEET			1 FOOT PROTECTED			EXP.	DEAD	% DEAD	
		EXP.	DEAD	% DEAD	EXP.	DEAD	% DEAD	EXP.	DEAD	% DEAD	EXP.	DEAD	% DEAD				
26-16-68	28	30	36	87.0	30	32	97.0	29	26	90.0	10	10	100.0	20	0	0.0	T. Res. (S)
28-11-68	15	15	53.0	79	27	93.0	70	29	97.0	10	10	100.0	20	1	5.0		
28-11-68	115	16	53.0	30	15	50.0	36	24	66.0	10	6	60.0	20	0	0.0		
28-11-68	154	12	37.0	35	23	77.0	38	22	73.0	10	7	70.0	20	0	0.0		
28-11-68	104	8	27.0	23	7	30.0	19	26	82.0	10	1	10.0	20	1	5.0		
28-11-68	317	5	13.0	50	13	43.0	30	23	63.0	15	1	10.0	20	0	0.0		
28-11-68	300	2	16.0	30	3	9.0	38	5	17.0	15	1	50.0	20	0	0.0		
28-11-68	44	21	46.0	30	20	75.0	29	14	90.0	-	-	-	10	0	0.0		
28-11-68	58	18	50.0	30	20	67.0	-	-	-	-	-	-	-	-	-	0.0	
28-11-68	58	18	50.0	30	20	67.0	-	-	-	-	-	-	-	-	-	0.0	

(2) The mosquitoes were collected in each house (indicated by asterisk) in the morning, 8 A.M. and 10 A.M.