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73021

AGENCY FOR INTERNATIONAL DEVELOPMENT PPC/CDIE/DI REPORT PROCESSING FORM

ENTER INFORMATION ONLY IF NOT INCLUDED ON COVER OR TITLE PAGE OF DOCUMENT

1. Project/Subproject Number

9365948

2. Contract/Grant Number

DPE-5948-C-00-0030-00

3. Publication Date

11/90

4. Document Title/Translated Title

Community Based Multisectorial Malaria and Dengue Control Program For the Bay Islands, Honduras

5. Author(s)

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2.

3.

6. Contributing Organization(s)

Vector Biology and Control Project
Medical Service Corporation International

7. Pagination

41

8. Report Number

81139

9. Sponsoring A.I.D. Office

S&T/H

10. Abstract (optional - 250 word limit)

Abstract area (empty)

11. Subject Keywords (optional)

1.

4.

2.

5.

3.

6.

12. Supplementary Notes

Supplementary Notes area (empty)

13. Submitting Official

Robert W. Lennox, Sc.D.

14. Telephone Number

703-527-6500

15. Today's Date

9/27/91

16. DOCID

DOCID field (empty)

17. Document Disposition

DOCRD [] INV [] DUPLICATE []



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**Community-Based Multisectorial
Malaria and Dengue Control Program
For the Bay Islands, Honduras**

July 10-28, 1990

by

Jeffrey C. Stivers

VBC Report No. 81139

Author

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Acknowledgement

I would like to thank Mrs. Kay Watson, Peace Corps volunteer, for her time and assistance while I was working in the Bay Islands.

Preparation of this document was sponsored by the Vector Biology and Control Project under Contract No. DPE-5948-C-00-9030-00 to Medical Service Corporation International, Arlington, Virginia, USA, for the Agency For International Development, Office of Health, Bureau for Science and Technology.

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Glossary

1. APRODIB Asociacion Pro Desarrollo Islas de la Bahia
2. DCV Vector Control Division
3. HRD Mission's Human Resources Development Division
4. HSI USAID Health Sector II Project
5. MOH Ministry of Health
6. SANAA Servicio Autonomo Nacional de Agua y Aquiductos
7. VC Voluntary Collaborator

1. Executive Summary

At the request of USAID/Tegucigalpa, the consultant conducted an assessment of the malaria and dengue situations in the Bay Islands and the willingness of personnel from various sectors of the community to participate in establishing and maintaining local control operations. Recommendations were made to improve the existing malaria and dengue surveillance systems and for collecting the data necessary to develop a three-year control program to be operated primarily by the communities of the Bay Islands.

During a subsequent visit, the contractor will be expected to develop comprehensive malaria and dengue control plans, with estimates of local costs for participating groups, for presentation to all the parties interested in implementing control operations on the Islands. At that time, the interested parties will sign an agreement delimiting individual responsibilities for the implementation and operation of a three-year project.

The work was performed between July 10 and July 28, 1990, in various towns in the Bay Islands and in Tegucigalpa. Site visits were made to elected officials, organized community groups, interested individuals (primarily hotel owners), the MOH (Ministry of Health) and the DCV (Vector Control Division), as well as representatives of the Mission. Visits were also made to potential anopheline breeding sites around the Islands to gain an overview of the types of sites to be found on the Islands.

The Situation

The Bay Islands are a chain of three major islands and several small keys roughly parallel to and approximately 50 kilometers from the northern coast of Honduras. The "native" population of the Islands is a mixture of several Indian groups and blacks. English is the predominant language. In recent years, there has been an influx of predominantly Spanish-speaking people from the mainland. The DCV estimates that the population of the Islands is 25,800. The economy is geared toward tourism, centered around scuba diving on the local barrier reef, and commercial fishing for export. As a result of this dependence on tourism and isolation from the mainland, the cost of living on the Islands is higher than on the mainland.

Reported malaria incidence on the Islands has averaged 281 cases during the last three years (1987 - 89), a small percentage of the national average of 25,311 for the same period. Information on dengue incidence is sketchy and for the most part unreliable, but dengue appears to be a constant problem.

Malaria and dengue control operations, under the auspices of the DCV, have been sporadic and incomplete for a variety of reasons. One reason is the relatively low priority of the Islands for limited national malaria and dengue control funds.

Key Findings

The following observations and opinions are based on my discussions with the individuals listed under "Persons Contacted" in Annex 1, casual talks with Island residents and site visits around the Islands. The findings are numbered to correspond to the specific items listed in the scope of work (SOW).

1. The Bay Islands community, as represented by Asociacion Pro Desarrollo Islas de la Bahía (APRODIB), elected officials, individuals from the private sector, the MOH and the DCV, indicated both a willingness and ability to support community-based malaria and dengue control operations with funds, manpower and materials.

No complete inventory of community groups has been prepared by APRODIB. It is probable that additional groups could assist in such a project.

2. Other than the MOH and DCV, the only national government agency that might be interested in cooperating in malaria and dengue control operations is Servicio Autonomo Nacional de Agua y Aqueductos (SANAA), the national water service.
3. Existing Mission and other donor projects on the Islands do not complement a malaria and dengue control operation.
4. A malaria surveillance and treatment system exists on the Islands, but is ineffective for a variety of reasons, and must be improved before the initiation of control operations.

5. The establishment of criteria for mass medication and perifocal spraying of communities is feasible but will depend upon reliable surveillance data.

Until the surveillance system is improved and further epidemiological and entomological data are collected, such a system cannot be developed.

6. Many of the anopheline breeding sites on Roatan have been identified, but breeding has not been quantified.

Quantifiable data on breeding sites is scarce and out-of-date. This information must be updated before control operations can be designed and implemented.

7. The health services on the Islands are aware of, and concerned about, the dengue problem.

There is no organized dengue surveillance system on the Islands capable of providing the rapid response necessary to prevent or curtail a dengue epidemic.

8. Local governments are interested in and are initiating their own clean-up operations, particularly routine garbage collection. However, their efforts are limited and not organized.

9. Government officials contacted all stated that they were willing and probably able to cover the recurring costs of clean-up operations.

Since neither an operational plan nor a budget has ever been developed for such an operation, it is not possible to determine their actual ability to support such a program.

10. *Aedes aegypti* breeds readily on the Islands but quantifiable information is scarce and needs to be updated.

11. Based on the types of potential anopheline breeding sites observed on the Islands, it is probable that source reduction projects would complement small-scale water and sanitation projects under the private sector component of the Health Sector II Project.

Key Recommendations

The following are broad recommendations based on the SOW. Specific recommendations, expanding on those presented here, are presented in the body of the report.

1. Because of the willingness and ability of community groups and local governments to participate in community-based malaria and dengue control operations, the Mission should continue to support such an effort to the extent possible within existing Mission projects.
2. SANAA should be included in the development of source reduction projects on the Islands in order to increase resources and collateral benefits to the community.
3. APRODIB should initiate requests to other donors for assistance pending the development of an operational plan and full budget.
4. The malaria surveillance and treatment system should be strengthened immediately because it provides the basis for establishing priorities for control operations.
5. Criteria for mass medication and perifocal spraying of communities should be developed, but only after more epidemiological and entomological information are available.
6. The DCV should send entomological and engineering teams to the Islands to gather information on the habits of the vector(s), the location and ecological characterization of all breeding sites, and the development of engineering plans and budgets for source reduction operations at each site.
7. The national dengue surveillance system currently being developed by Dr. Steve Waterman should be implemented on the Islands.

The health care professionals on the Islands should be trained by the MOH in the proper clinical diagnosis of dengue to allow rapid notification of control personnel.

8. The elected officials on the Islands should institute and implement a law prohibiting property owners from

having either actual or potential *Aedes aegypti* breeding sites on their property. This law should include provisions for fining violators. Community volunteers should be trained in enforcement of the law.

A bilingual education program should be developed and implemented to raise community awareness about dengue, its transmission and prevention.

The local authorities should implement garbage collection services in all towns on the Islands.

9. The MOH, with Mission assistance, should work with the elected officials on the Islands to develop an operational plan and budget for organized garbage collection.
10. The DCV should send an entomological team to the Islands to determine the breeding, resting and feeding habits, as well as insecticide susceptibility, of *Aedes aegypti*.

Routine surveillance of the vector would be handled by the community volunteers discussed in 8 above.

11. When developing source reduction recommendations, the DCV should work closely with the Mission and SANAA. This will allow for the maximum integration of vector control and water projects.

2. Introduction

Background

During recent months, USAID/Tegucigalpa has received various requests from both the public and private sectors of the Bay Islands for assistance in controlling malaria and dengue. Initially, the Mission was not interested in participating in such a project for the following reasons:

1. all Mission assistance for malaria and dengue control is currently channeled through the DCV and
2. the number of cases in the Islands is very low in comparison to the total number of cases in the country and therefore of a lower priority for attention.

However, the attitude of the Mission has changed because of:

1. repeated displays of interest on the part of the Bay Islands community to contribute to such a project;
2. the importance of the Islands' tourism industry to the country and the damage caused to this industry by malaria and dengue;
3. the very real possibility of an outbreak of dengue hemorrhagic fever on the Islands and
4. the logistical difficulties encountered by the DCV and the MOH in providing adequate services to the Islands.

The last reason indicates the need to develop the capabilities of Island personnel to provide their own malaria and dengue control services.

At the beginning of May, the Mission's Human Resources Division (HRD) received another request for assistance from APRODIB, an organization that coordinates water and sanitation, small industry and other community-based programs in the Islands. As a result of this request, Dr. Stanley S. Terrell, Technical Advisor for the Health Sector II Project, discussed the situation with the Director of the DCV and scheduled a visit to the Islands. Dr. Terrell attended a meeting May 13, 1990 to discuss the problem with Island representa-

tives. Attending the meeting were the Governor of the Islands, the Mayor of Coxen Hole, most of the Islands' health personnel, representatives of APRODIB and the Peace Corps, and various individuals from the private sector.

At that meeting, the following points were discussed and agreed upon:

- o The need to look for feasible, sustainable solutions to the problem instead of taking short-term or emergency actions.
- o The need to develop an operational plan to cover two to three years of operations, uniting the resources of the MOH, the DCV, other government agencies, the community (both public and private), and external donors.
- o APRODIB will be the coordinating entity for the project.
- o The need to implement new control strategies, primarily source reduction programs, in order to reduce reliance on traditional wall spraying and other insecticide operations.
- o The need to focus on strategies involving appropriate technologies that do not require high recurrent costs.
- o The need to be self-sufficient, rather than dependent upon the national or regional DCV offices for the implementation of control strategies.

Following this meeting in Roatan, Dr. Terrell held meetings with MOH, DCV and APRODIB representatives, during which the needs of the Islands were further refined. Of particular importance was the perceived need to integrate vector control and small-scale water and sanitation operations.

Dr. Terrell held another meeting on Roatan with local health officials, and representatives from APRODIB, the Peace Corps and various community groups June 21.

As a result of the continuing interest in the development of dengue and malaria control operations in the Islands, the Mission asked the Vector Biology and Control Project to provide technical assistance. The following SOW, which defined the VBC consultant's responsibilities, was prepared and agreed upon by all parties. The consultant was to:

1. Review the current inventory of community groups on the Islands prepared by APRODIB and make an assessment of their potential for contributing manpower, money, materials, supplies and logistical support to the project.
2. Review the inventory of government organizations, including SANAA, the Ministries of Tourism and Agriculture, prepared by APRODIB and assess their potential contribution.
3. Review A.I.D. and other donor projects (tourism, irrigation, housing, etc.) and assess how they could complement vector control activities.
4. Establish a plan for strengthening the malaria surveillance and treatment system so that all slides are collected, examined and reported to the responsible health authorities within one week of the date the blood smear was taken.
5. Establish criteria and procedures for mass medication and perifocal spraying of communities based on the surveillance system. These procedures may involve the training of local people, such as hotel employees, as sprayers.
6. Review the information on breeding sites of *Anopheles* with DCV personnel and establish plans for: 1) collecting the missing information within the next two months and 2) maintaining a surveillance of the vector on the Islands.
7. Review the existing dengue surveillance system and make suggestions for its improvement in terms of coverage and rapidity.
8. Review the current clean-up strategy of the municipal authorities and make suggestions for improvement, including the stipulation of a reward/fee system.
9. Assess the municipal authority's capability for covering recurrent costs as part of their line-item budget and obtain a commitment from them in this regard.
10. Review the entomological information available on *Aedes* and establish plans for: 1) collecting the missing information within the next two months and 2) maintaining a surveillance of the vector on the Islands.

11. Identify the potential for complimentary small-scale water and sanitation projects that can be developed as collateral projects under the private sector component of the Health Sector II project.

The timing of the second visit is tentative. The SOW would be completion of a two- to three-year plan for vector control activities in the Bay Islands clearly demarcating the duties and responsibilities of all participants. The plan, to be signed by all participating agencies, will contain estimates of local costs with specific commitments of resources (cash, materials, supplies, logistics and personnel).

To fulfill the requirements of this SOW, the consultant traveled to Honduras on July 10, 1990, where the work was performed through July 28, 1990.

Geography and climate

The Bay Islands are a chain of three major Islands and several smaller keys located in the Caribbean approximately 50 kilometers off the northern coast of Honduras. The Islands are surrounded by a barrier reef, second in size only to the great barrier reef of Australia, which attracts scuba divers from around the world.

The main Island, Roatan, is approximately 45 kilometers long, with a maximum width of about 10 kilometers. It is formed by a central ridge running the length of the Island, with numerous finger ridges extending laterally to a very narrow shore area. These finger ridges, radiating from the central ridge, form small, well-defined watersheds, which discharge into the sea. Some of these watersheds contain water continually, but most of them contain water only during the rainy season.

The Island has a poorly developed road system. The primary road runs nearly the length of the Island on the mainland side. From this main road, there are several lateral roads that extend to the opposite side of the Island, where they run parallel to the coast for short distances. Much of the road is constructed at or near the coast and interrupts normal drainage of the lateral watersheds.

Because of the terrain, most of the villages on the Island are located on the coast. The villages are long and narrow, following the shore, but extending up onto the ridges where vehicles cannot enter because there are no streets. There are also villages constructed on some of the keys and headlands of the Island. Access to these villages is strictly by boat.

The islands of Utila and Guanaja are much smaller than Roatan and are both basically mountain peaks rising from the sea, with limited flat shorelines. The location of villages on these islands is similar to that of Roatan. Roads are nearly non-existent on these islands and travel is mainly by boat or on foot. Travel between the three islands is limited to personal boats and non-scheduled boat service from Roatan to each of the other Islands.

At one time the Islands were well-forested inland from the shore. However, much of the forested area has been cut over for firewood and small farming operations. This deforestation has led to an increase in erosion and in the sediment load being introduced into the ocean around the Islands.

The climate of the Islands is tropical, with temperatures high enough year-round to allow mosquito breeding. Rainfall is seasonal (Figure 1). The peak of the rainy season is in October, with rainfall diminishing to nearly zero in June. This seasonality in rainfall should limit mosquito breeding in temporary sites to a definite period and make vector control operations easier.

Culture

The native, or original, population of the Islands is predominantly a mixture of black and Indian ethnic groups. There is also a segment of the population that is English and northern European. Recently there has been an influx of Latins from the mainland of Honduras. This group has established villages mainly by squatting on less desirable land.

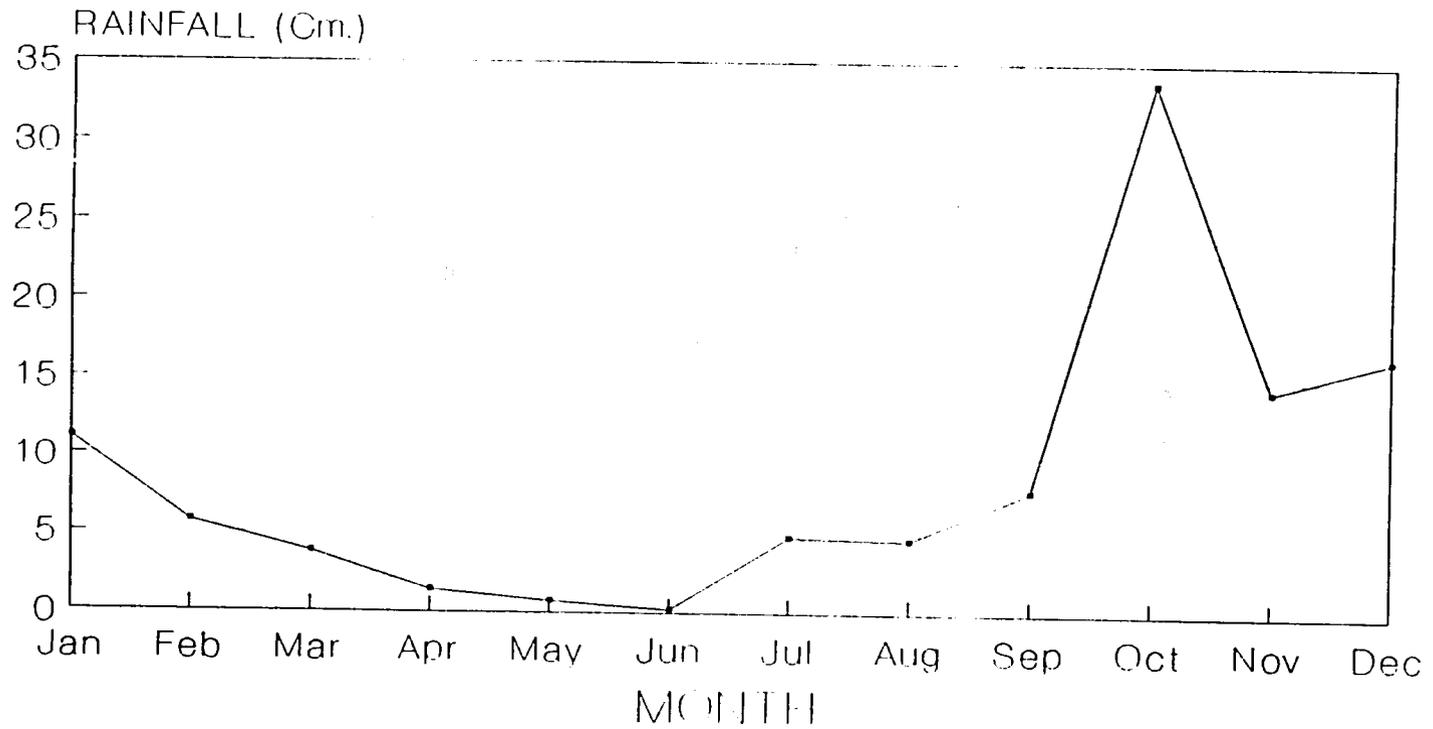
Culturally, the native Islander is more Caribbean than Hispanic. The major language on the Islands is English and there is considerable commerce with the other English-speaking islands of the Caribbean. Because of the geographical and cultural separation of the Islands from the mainland, they have never been fully integrated into Honduran society and have, in large part, received few services from the central government.

The economy of the Islands is based on tourism and commercial fishing. The barrier reef surrounding the Islands provides excellent snorkeling and scuba diving and attracts divers from around the world. Commercial fishing fleets operate from the Islands and local processing plants prepare the catch for export to the United States and other countries.

Figure 1

11

AVERAGE MONTHLY RAINFALL ROATAN AIRPORT, 1987-1989



Vector Control Activities

The DCV is responsible for disease surveillance and control operations on the Islands. The DCV regional office responsible for the Islands is located on the mainland in La Ceiba. All operational supplies and personnel for the Islands are assigned to the regional office and then shipped to the Islands as needed.

This dependence of the Islands on the regional office causes serious problems in maintaining adequate vector control operations on the Islands. Because of the high cost of living on the Islands, the DCV cannot afford to send operational teams there with the frequency or permanence required for proper vector control. Also, since the regional office is staffed only with Spanish speakers, there are language and other cultural barriers between the native Islanders and DCV personnel when control operations are undertaken on the Islands.

In the past, the DCV has used only traditional malaria and dengue control techniques on the Islands. For malaria these have been primarily 1) disease surveillance through a system of volunteer collaborators who collect blood smears, 2) drug treatment of infected individuals and 3) spraying of houses with residual insecticide. For dengue control the thrust has been on 1) destruction of artificial containers and 2) application of Abate insecticide to containers that cannot be destroyed.

All of these measures must be performed either continually or with a set periodicity to be effective. They also depend heavily on DCV personnel for their implementation. For a variety of cultural, financial and logistical reasons, these traditional control measures have not been successful in the Islands.

Currently the DCV has one permanent employee assigned to the Islands, an evaluator named Mr. Mario Pacheco, who lives on the islands. Mr. Pacheco's primary duties are to maintain the system of malaria volunteer collaborators, treat all infected individuals, investigate all malaria cases, and educate the community about malaria and dengue.

Reported annual malaria incidence for the Islands has been increasing steadily during the last three years, as shown in Figure 2. Malaria incidence is also rising on the mainland, placing an increasing demand on DCV resources to control the problem on the mainland. As a result of this increased demand for resources, the

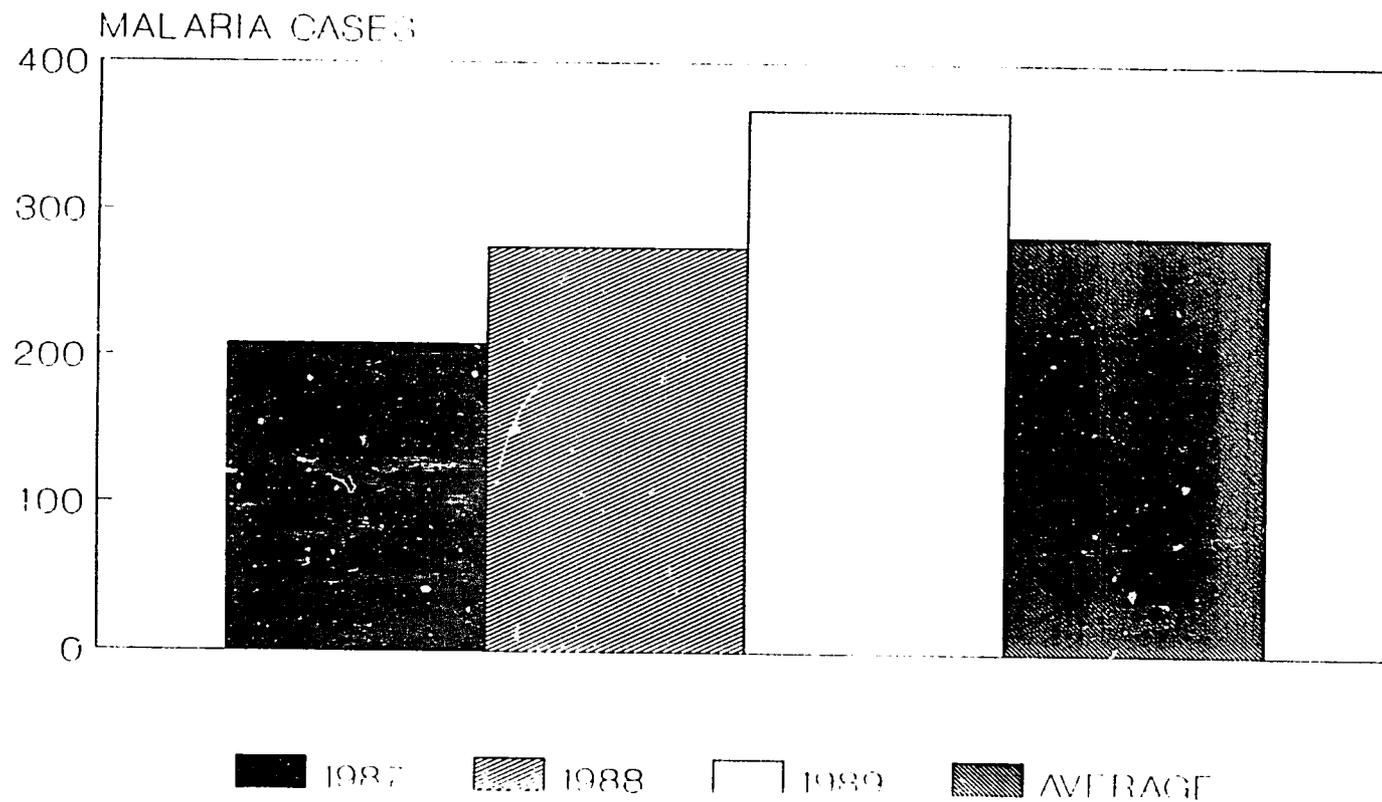
Islands have received an even lower level of support from the DCV than previously.

The average annual distribution of reported malaria cases is presented in Figure 3. There are several peaks in incidence, but they do not correspond well with the rainfall data presented in Figure 1.

The DCV is actively involved in malaria surveillance, but there is no active system to track dengue incidence on the Islands.

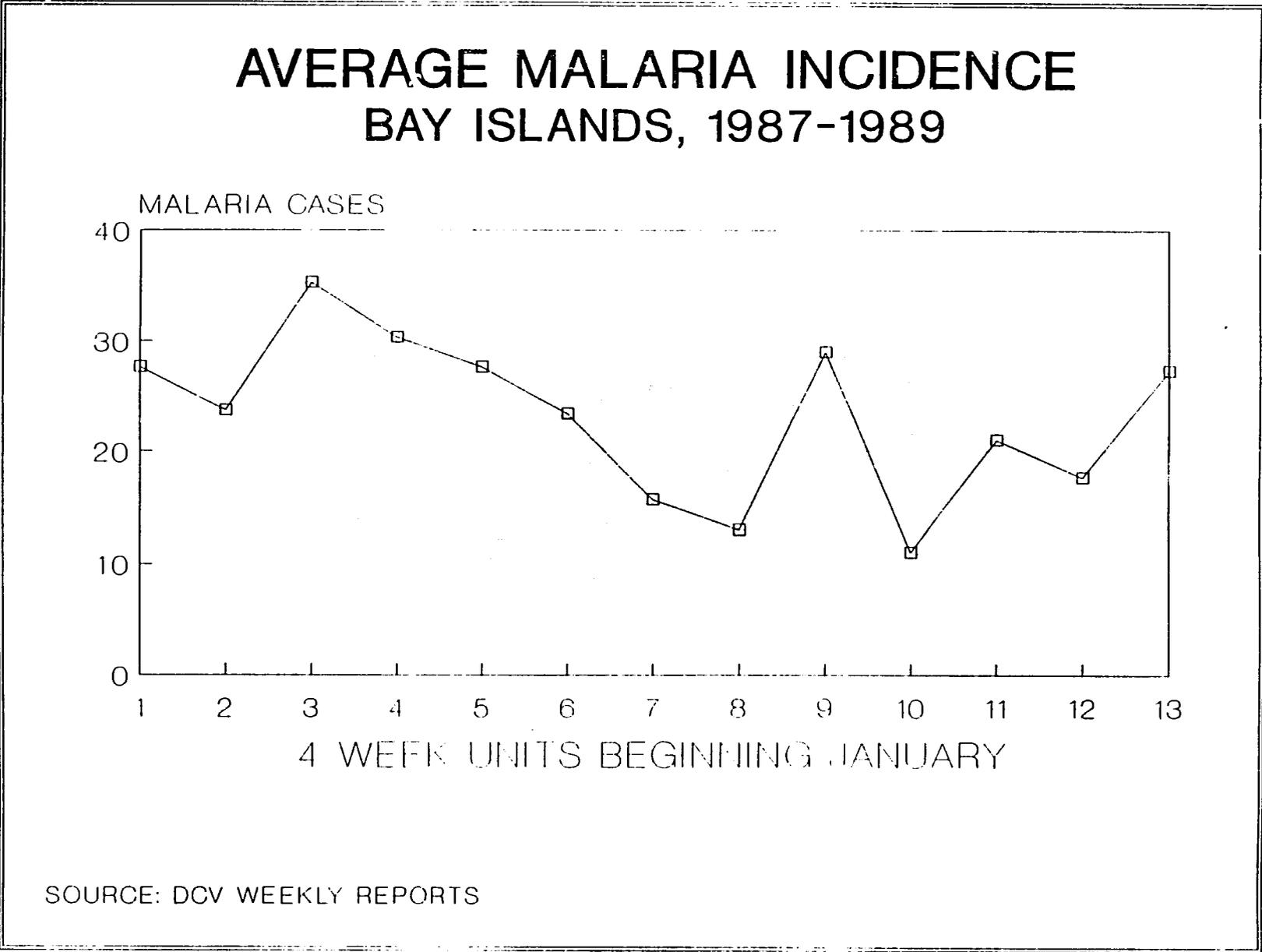
Figure 2

ANNUAL MALARIA INCIDENCE BAY ISLANDS, 1987-1989



SOURCE: DCV WEEKLY REPORTS

Figure 3



3. Findings and Recommendations

The following findings are numbered to correspond to the SOW. Following each finding, and designated with letters, are the corresponding recommendations. The alpha-numeric designation used for each recommendation is also used in Table 1, which presents an approximate timeframe and responsibility for completion of each recommendation. The major group responsible for each recommendation is also designated in the discussion of that recommendation.

1. APRODIB had not prepared a formal list of community groups on the Islands. However, with the assistance of Mrs. Kay Watson and John Moser of the Peace Corp and APRODIB staff, a list of individuals representing various groups was developed during this visit. These individuals (see Appendix 1) were contacted and their willingness and ability to participate in vector control activities were discussed.

Without exception, all of the individuals contacted expressed both a willingness and an ability to participate in the project. Offers of participation included funds, manpower, transportation of both personnel and equipment, food and lodging, equipment and other logistical support. However, everyone wanted to see a final operational plan and budget prior to making any specific commitment of funds or other resources.

Based on my discussions with the individuals on Roatan, I believe that there is a willingness and ability to participate in the project. Their ability of individuals and community groups to participate, however, will have certain finite limits. These limits will place constraints on both the size and types of control operations that can be instituted on the Islands.

From discussions with different individuals, I learned that I had not been able to contact all of the groups and individuals who might be interested in assisting the project.

- A. APRODIB should make an effort to develop a more complete list of individuals and groups interested in the project and discuss the project with those individuals not contacted by the contractor.

- B. APRODIB should maintain contact with all interested parties and inform them of the project's progress regularly.
 - C. APRODIB should develop a list of the resources, other than funds and manpower, that individuals and groups are willing to contribute to the project. This list would include heavy equipment (backhoe, bulldozer, front-end loader, dump truck), ocean transportation of materials from the mainland and the United States, local land and water transportation, free or reduced-rate food and lodging for DCV personnel, public radio access, and individuals with special skills that could enhance the project.
2. Based on discussions with APRODIB staff and others, it appears that the only government organization currently operating on the Islands that could assist in the project is SANAA, the national water unit.

The national tourism ministry is likely to have a vested interest in reducing malaria and dengue incidence in order to promote tourism.

- A. The MOH and the Mission should contact both SANAA and Tourism to assess their interest in and ability to support the project.
3. Based on discussions with representatives of APRODIB and the Mission, it appears that there are no current donor projects on the Islands that could complement vector control operations. This does not mean that complementary projects could not be developed.

Because of the geography of the Islands, much of the vector control effort should be directed toward environmental modification to reduce mosquito breeding. Much of this environmental modification should take the form of small impoundments in the Islands' watersheds, which could be developed in such a way as to provide household and/or irrigation water.

- A. The Mission should investigate the possibility of using P.L. 480 funds to develop the environmental modifications in a manner that will provide proper vector control and at the same time provide other services to the community.

- B. Mission Human Resources Development Division (HRD) should discuss the project with other Mission divisions to determine the feasibility of involving other Mission projects in the vector control project.
 - C. APRODIB should begin approaching other donor agencies it has worked with and explore the possibilities for assistance.
4. A complete, reliable malaria surveillance system is essential to any malaria control operation. Such a system must provide the information needed to determine where and when control operations are needed. It should also provide information that allows the establishment of priorities for the most effective use of limited resources.

A surveillance system is in place on the Islands. It is operated by Mr. Pacheco the DCV evaluator. A chain of 43 voluntary collaborators (VCs) exists on the Islands to collect blood smears for malaria diagnosis. Data from this system were used to develop Figures 2 and 3. However, for a variety of reasons, this system is not functioning well and the data it generates are not reliable.

A chain of collaborators has been established on the Islands, but they do not have sufficient supplies to perform their job. Many of the collaborators cannot be reached by road and the DCV evaluator does not have ready access to boat transportation around or between the Islands. Therefore, the collaborators do not receive supplies regularly and samples are not picked up on a timely basis. This delays the timely treatment of malaria cases and undermines public confidence in, and acceptance of, the system.

Because there is not a DCV or MOH microscopist stationed on the Islands, all blood smears must be shipped to the regional office in La Ceiba for diagnosis. People who are infected with malaria cannot be identified and treated until the results are returned to the Islands. As a result, it can take as much as four months between the time an individual has a blood smear drawn and the initiation of treatment. This is totally unacceptable for malaria control. Not only are infected individuals left in the population to suffer from the disease and serve as a source of infection for others, but public confidence in the system is eroded, causing individuals to stop using the system.

Based on discussion with many individuals on the Islands, I concluded that the malaria incidence data developed by the DCV seriously underestimates the actual incidence of the disease. Many people have lost confidence in the system and no longer report to the collaborator for a blood smear when they think they have malaria. They simply buy drugs and treat themselves, often incorrectly.

Since accurate reporting of malaria is essential to the operation of an effective control program, the existing system must be improved and modified somewhat.

- A. The DCV and MOH should ensure an adequate, timely supply of the materials collaborators need to collect blood smears.
- B. Until a laboratory can be set up in the MOH clinic, expendable supplies used in the diagnosis of blood smears should be provided to Dr. Jackie Wood Bush. Dr. Wood has volunteered the services of her private clinic for the diagnosis of a limited number of slides, providing that the DCV supply the materials necessary.
- C. The DCV or the MOH should assign a microscopist to the MOH clinic on Roatan to perform the diagnosis of malaria slides.
- D. The Mission should assist the DCV and the MOH in the purchase of laboratory equipment to establish a malaria laboratory in the MOH clinic on Roatan.
- E. A system of petty cash should be established at the MOH clinic on Roatan to allow the evaluator to hire a boat, as needed, to travel to otherwise inaccessible villages to investigate and treat malaria cases. The rotating fund established under USAID Health Sector II Project (HSII) could be used for this purpose. The funds would be under the control of physician in charge of the MOH clinic on Roatan and disbursed to the evaluator as needed.
- F. The evaluator should investigate each case of malaria when treatment is initiated. The objective of the investigation is to determine, if possible, whether the patient was infected on the Islands or at some other

location. This information will be useful for the selection and prioritization of control measures.

- G. The local bus drivers should be used to transport blood smears from the collaborators to the clinic in Coxen Hole. Initial contacts with the bus drivers should be made by the DCV evaluator. If problems are encountered, the Governor of the Islands has said that he will use the power of his office and the police to ensure that the drivers cooperate.
 - H. Once the above improvements are implemented, a large-scale community education program should be developed in both Spanish and English and implemented throughout the Islands. The program should be developed jointly by the DCV, which has staff members trained in community education, and interested community groups. The community should be responsible for implementation. APRODIB should be the coordinating agency in this operation.
 - I. On the Islands of Utila and Guanaja, due to the low number of blood smears collected and the logistical difficulties involved in transportation of the smear to and from the laboratory, the collaborators should be trained and authorized to administer curative treatment to those patients who present clinical symptoms of malaria.
5. The establishment of criteria for mass medication and perifocal spraying of communities requires an adequate surveillance system and an adequate source of entomological information on the vector. The Islands have neither. Because of the lack of information, criteria cannot be established at this time.
- A. Once the surveillance system has been in service long enough to develop reliable data and the necessary entomological information has been obtained, this information should be used to develop criteria for mass medication and perifocal spraying.
6. Adequate entomological information on the vector(s) of malaria on the Islands is not available. The DCV has always assumed that the vector on the Islands was *Anopheles albimanus*, as in the rest of Honduras. However,

~~A~~ 200

Figure 1. Average Monthly Rainfall, 1987 – 89

many of the potential breeding sites inspected by the contractor appear to be the type of site that would support the breeding of *Anopheles darlingi*. Since *A. darlingi* has been found along the north coast of Honduras in recent years, it is possible that it is also found on the Islands.

While many of the actual and potential breeding sites for *Anopheles* on the Islands have been identified, they have not been characterized ecologically, breeding has not been quantified for each site, nor have plans for environmental modification been developed. Until this is done, it is not possible to develop specific control recommendations or budgets, both of which are necessary before any agreement can be reached on the commitment of resources by participants in the project.

The establishment of a surveillance system for the vector requires knowledge of the habits of the vector(s) and the specific control options selected for each village. Until this information is developed, no surveillance system can be established.

- A. The DCV should send an entomological team to the Islands to develop the necessary entomological information. This information should include: 1) the species of *Anopheles* found on the Islands; 2) the biting and resting habits of each species; 3) quantification of breeding by site; 4) ecological characterization of each breeding site and 5) susceptibility of both larvae and adults to insecticides.
 - B. The DCV should send an engineering team to the Islands to 1) locate and map all potential breeding sites and 2) develop engineering plans and budgets for environmental modification of each site. The engineering plans and budgets should be developed so that all possible (i.e. permanent and temporary construction techniques, drainage, impoundment, channelization) environmental options for each site are covered. Where feasible, plans should concentrate on modifications that allow the water from the site to serve other purposes, such as community water supply or irrigation.
7. No organized dengue surveillance system exists on the Islands. Official reports of dengue cases go directly to either the regional or central DCV offices and Island personnel

are not notified of the results. Dengue control measures cannot properly respond to dengue outbreaks until a fast, efficient surveillance system is in operation.

During my visit I met with Dr. Steven Waterman, another VBC consultant. Dr. Waterman was charged with developing an emergency response plan for the control of dengue outbreaks. Part of his work will be to develop a national dengue surveillance system.

- A. The national dengue surveillance system being developed by Dr. Waterman should be implemented in the Islands. The health care professionals on the Islands should be trained by the MOH in the proper clinical diagnosis of dengue to allow rapid notification of control personnel.
 - B. Island vector control personnel should be notified of dengue cases on the Islands in a timely manner so that the appropriate action can be taken.
8. In discussions with the Governor of the Islands and various mayors, it became quite evident that they were interested in clean-up operations both from a dengue control and an environmental sanitation standpoint.

The Island of Guanaja, through APRODIB, has purchased a 40-foot work boat, which will be used to collect and transport trash on that Island. The Mayor of Roatan has appropriated a dump truck belonging to the national highway department and is using it to pick up trash. Several of the villages on the Islands have passed laws, with fines for violation, prohibiting littering.

While everyone contacted by the contractor was interested in clean-up operations, none of the governments had developed a comprehensive plan and budget for such operations. Clean-up operations are therefore not adequate to provide the level of coverage necessary for dengue control.

- A. The municipal governments should institute routine, full-coverage trash pickup. For more details on this topic, see 9 below.
- B. The municipal governments should institute laws making it illegal for property owners to have

potential or actual breeding sites for *Aedes aegypti* on their property. Fines should be established for violation of the law.

- C. Community volunteers should be selected and trained to inspect properties for *Aedes aegypti* breeding. These inspections should be performed at least once a month and more frequently if possible. Volunteers would be trained by the DCV and work under the authority of the municipal governments. They could be either unpaid or receive a percentage of the fines levied as a result of their inspections. The residual of any fines would go to the municipal governments to help finance the trash collection operation.
 - D. A bilingual community education program should be developed and implemented to improve community awareness of dengue and the importance of compliance with the dengue control laws discussed above. The program should be developed jointly by the DCV and personnel from the Islands under the coordination of APRODIB. Implementation of the program should be the responsibility of local community groups.
9. Since the local governments have never developed plans or budgets for clean-up operations, it was not possible to assess their ability to cover the recurrent costs of such an operation. However, discussions with several governmental officials led me to believe that recurrent costs of such an operation would receive a high priority in government budgets.

None of the governments contacted had sufficient equipment to provide adequate trash pickup in their area of responsibility. This was of concern to the officials since, who felt that they could cover recurrent costs, but did not have a large enough budget to purchase the needed equipment.

- A. The MOH, with Mission assistance, should provide technical assistance to the local governments of the Islands to develop comprehensive trash pickup and disposal plans and budgets.

- B. Once plans and budgets are developed, the ability of the local governments to cover recurrent costs should be determined by the Mission.
 - C. If the local governments are deemed capable of covering the recurring costs of clean-up operations, the local governments should seek a source of funding for the required equipment. This effort should be coordinated through APRODIB and include the MOH and the Mission as possible funding sources.
10. *Aedes aegypti* on the Islands is associated with the major villages. Breeding occurs primarily in discarded artificial containers and devices such as cisterns, overhead tanks and barrels used for storage of household water. Much of this breeding could be eliminated by eliminating discarded containers through the operations discussed in 8 and 9 above. The residual breeding occurring in household water storage devices can be eliminated by covering or otherwise sealing the container. Instructions on how to perform this operation would be addressed as part of the community education program discussed in 8 above.
- Surveillance of vector breeding would be performed by the community inspectors, as discussed above in 8.
- A. Concurrent with the entomological work to be performed for malaria, discussed in 6 above, the DCV should perform studies to determine 1) the resting and biting habits of *Aedes aegypti* and 2) larval and adult susceptibility to insecticides.
11. Based on my observations of potential *Anopheles* breeding sites, it appears that malaria control operations and small-scale water and sanitation projects can go hand-in-hand.

Many of the villages in the Islands are located on the narrow coastlines. The construction of houses, roads and pathways on what is essentially a flood plain has led to a blockage of normal water flow patterns. This blockage of water flow produces large areas of stagnant water, often mixed with sewage, in and around the houses. Not only does this standing water serve as breeding sites for vector mosquitoes, but it can also be a source of other diseases. Sanitation projects to provide adequate drainage in and around the villages would therefore serve to alleviate several problems.

Until such time as the entomological and engineering surveys discussed in 6 above are completed, however, specific complementary water and sanitation projects cannot be discussed.

- A. Once the surveys discussed in 6 are completed, Mission personnel responsible for water and sanitation projects should review the information with the DCV and the MOH to determine which, if any, breeding sites could be worked under the auspices of water and sanitation.

In addition to the SOW-specific findings and recommendations presented above, several comments and general recommendations should also be made. These comments and recommendations are numbered in the same manner as the SOW-specific findings and recommendations, beginning with number 12.

12. Curtailment of the local transmission of malaria on the Islands appears feasible, given the nature of potential breeding sites and the level of community interest. The majority of breeding sites appear to be amenable to environmental modification which, while being initially expensive to implement, are permanent and inexpensive over the long term. However, too much information is still lacking to allow for the preparation of specific operational plans for the control of either problem, particularly engineering plans for specific breeding sites.

During discussions with individuals on the Islands, it became apparent that there is considerable concern for the environment, particularly regarding the conservation of fresh water and prevention of damage to the reef. Specifically, concern was expressed over the sedimentation of the reef due to erosion and uncontrolled runoff from the Islands, the lack of adequate piped water for domestic use, and the lowering of the water table due to heavy pumping.

If properly designed breeding site modifications are implemented, these operations will serve to alleviate these problems. As mentioned previously, many of the potential *Anopheles* breeding sites are found in the small watershed valleys formed by the lateral ridges. If a series of properly constructed small impoundments can be installed in these valleys along existing stream beds, breeding can be reduced or eliminated, sedimentation of the reef can be reduced,

more surface water will be available for domestic use and groundwater recharge can be increased.

- A. The DCV should make every effort to develop engineering plans that include the use of impoundments.
 - B. The Mission should consider the use of P.L. 480 funds to finance the construction of permanent structures, as discussed above.
13. While the implementation of the dengue control measures discussed in 8 and 9 should eliminate most of the locally transmitted dengue, adulticiding should still be considered as part of the dengue control program. Due to the lack of roads, vehicle-mounted fogging equipment is not appropriate. The use of hand-held equipment would be appropriate, however, in response to both isolated cases of dengue and small outbreaks in villages.
- A. The use of hand-held thermal foggers should be an integral part of the dengue control program. Fogging should be performed over three consecutive days, in a radius of 100 meters around the home of anyone diagnosed as having dengue.
14. As currently anticipated by the SOW, a consultant is to return to Honduras two to three months after the first visit to develop a two- to three-year operational plan and to estimate local costs for control measures. Due to the large amount of information that needs to be gathered and processed before control options can be selected, this timeframe is not valid.
- A. Once all of the basic information discussed above has been gathered, the contractor should travel to Honduras for two to three months. During that visit, the contractor would work with the DCV in developing control options and corresponding budgets for each potential breeding site. Villages should be prioritized for the allocation of limited resources and full operational plans developed for each village. These plans would be presented to all parties interested in supporting vector control operations and the responsibilities of each party defined by an agreement.

4. Timeframe and Responsibilities for Recommendations

Table 1

REC. NO.	OPERATION	RESPONS.	INITIATE	DURATION
1A	Develop list of interested individuals	APRODIB	Immediate	2 months
1B	Maintain contact with interested parties	APRODIB	Immediate	Continuous
1C	Develop list of resources	APRODIB	Immediate	2 months
2A	Contact SANAA and Tourism	MOH Mission	Immediate	2 months
3A	Investigate use of P.L. 480 funds	Mission	Immediate	Until development of final plan

3B	Involve other Mission divisions in project	HRD	Immediate	Until development of final plan
3C	Investigate other donor agencies	APRODIB	Immediate	Continuous
4A	Provide supplies for surveillance system	DCV MOH	Immediate	Continuous
4B	Provide lab supplies to Dr. Wood Bush	DCV MOH	Immediate	Until lab is set up in MOH clinic
4C	Assign microscopist to MOH clinic	DCV MOH	Immediate	Continuous
4D	Provide lab equipment for MOH clinic	DCV MOH Mission	Immediate	Continuous
4E	Set up petty cash system for evaluator	MOH Mission DCV	Immediate	Continuous
4F	Investigate malaria cases	Evaluator DCV	Immediate	Continuous
4G	Involve bus drivers in transport of blood smears	Evaluator Governor Transit police	Immediate	Continuous
4H	Develop community education program	DCV Community	When 4A-4G are in place	3 months
	Implement community education program	Community APRODIB	After above	3 months
4I	Train collaborators on Utila and Guanaja	DCV	Immediate	Continuous

5A	Develop criteria for mass medication	Contractor	When data available	1 month
6A	Entomological team salaries, per diem, equipment and travel to and from Islands	DCV MOH	mid-Oct.	3 months
	Transportation, food and lodging entomological team on Islands	APRODIB Community	mid-Oct.	3 months
6B	Engineering team salaries, per diem, equipment and travel to and from Islands	DCV MOH	mid-Oct.	3 months
	Transportation, food and lodging for engineering team on Islands	APRODIB Community	mid-Oct.	3 months
	Develop engineering plans and budgets	DCV Mission	Feb.	2 months
7A	Implement dengue surveillance system	MOH DCV Mission	When developed	Continuous
7B	Notification of dengue cases to control personnel	MOH Private health services	When control system established	Continuous
8A	Provide garbage collection	Local governments MOH Mission Other donors	After 9A-9C	Continuous
8B	Pass dengue control law	Local governments	Immediate	Continuous

8C	Select and support volunteer inspectors	Community Local government	After law passed	Continuous
	Train inspectors	DCV Community	After above	1 week
8D	Develop community education program	DCV Community	Immediate	2 months
	Implement community education program	Community APRODIB	After above	2 months
9A	TA for garbage collection	MOH Mission	Immediate	1 month
9B	Evaluate local government budgets	Mission Local governments	After above	1 week
9C	Seek funding for garbage collection	MOH Mission Local governments APRODIB	After above	Continuous
10A	Entomological team for <i>Aedes</i> information	See 6A	See 6A	See 6A
11A	Small-scale water and sanitation	MOH Mission DCV	After 6A-6B	1 month
12A	Environmental modification designs	DCV	With 6B	With 6B
12B	Use P.L. 480 funds	Mission MOH	After plans are developed	Continuous
13A	Personnel for fogging	Community	When surveillance is established	Continuous

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	Equipment for fogging	Mission MOH DCV	When system installed	6 months
	Train foggers	DCV	As needed	2 weeks
14A	Develop plan and agreement	Contractor DCV All parties	When data available	2-3 months

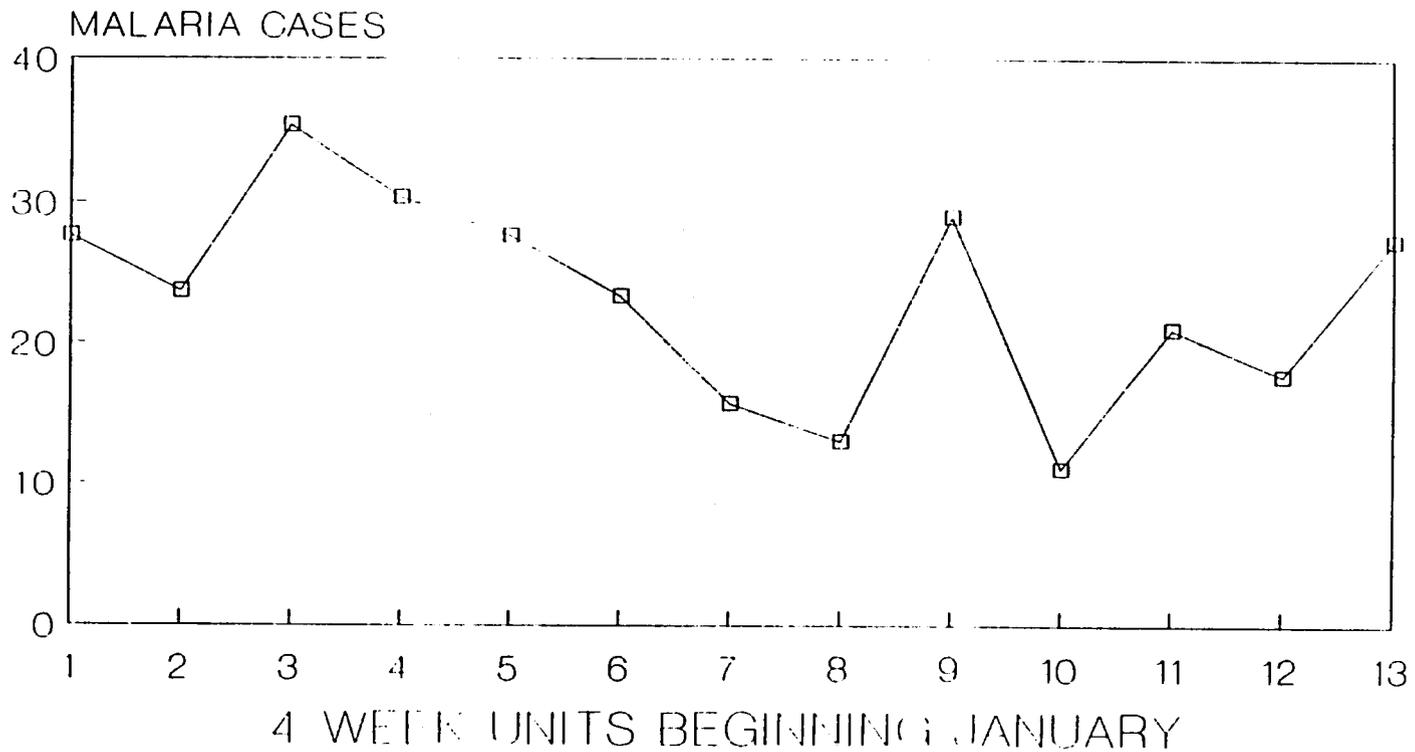
Annex 1. Persons Contacted

Solomon, Glenn	Governor of the Bay Islands
Hyde, Allan	Mayor of western end of Roatan Island and owner of a packing plant on the Island
Grant, Sam	Administrative Assistant to Mayor Hyde
Galindo, Julio	Congressman for the Bay Islands and owner of Anthony's Key Resort
Wood Bush, Dr. Jackie	MOH physician in charge of MOH clinics on Roatan Island
Facheco, Mario	DCV evaluator responsible for the Bay Islands
Moser, John	Peace Corps Volunteer assigned to the MOH clinic in Coxen Hole, Roatan Island
Severns, Wayne	Peace Corps Volunteer in public works assigned to Governor Solomon's office
Watson, Kay	Peace Corps Volunteer in small business assistance and collaborator with APRODIB
Watson, Len	Peace Corps Volunteer in small business assistance and collaborator with APRODIB
Wagner, Mandy	Manager Anthony's Key Resort
Webster, Bob	Manager Fantasy Island Resort
Perdomo, Nelson	Executive Director of APRODIB
Norman, Mel	Mayor of eastern end of Roatan Island
Howell, Woodbry	Mayor of Utila Island
Evans, Evelyn	Owner of Coco View Resort
Anderson, Eric	Owner of French Harbor Yacht Club and official in the Bay Islands Conservation Association

Silvestre, Rita	Owner of Buccaneer Inn and President of the French Harbor Women's Club
Silvestre, Romeo	Owner of Romeo's Resort
Pineda, Eva	Owner of Lost Paradise Hotel
Terrell, Dr. Stanley	Health Sector II Project Officer, USAID/Tegucigalpa
Haladay, Robert	Health Officer, HRD, USAID/Tegucigalpa
Gomez, Jose Ruben	Director, DCV, Tegucigalpa
Rivera, Dr. Luis	Chief of Entomology, DCV, Tegucigalpa
De Leon, Dr. Carlos	Chief of Epidemiology, DCV, Tegucigalpa
Vargas, Joaquin	Chief Region 6, DCV, La Ceiba
Fernandez, Dr.	Dengue Control Unit, DCV, Tegucigalpa
Crespo, Dr.	Sub-Director General of the MOH for the northern coast and the Bay Islands
Waterman, Dr. Steven	VBC consultant on dengue control and surveillance
Caudill, Herb	Sanitary engineer, HRD, USAID/Tegucigalpa

Figure 3

AVERAGE MALARIA INCIDENCE BAY ISLANDS, 1987-1989

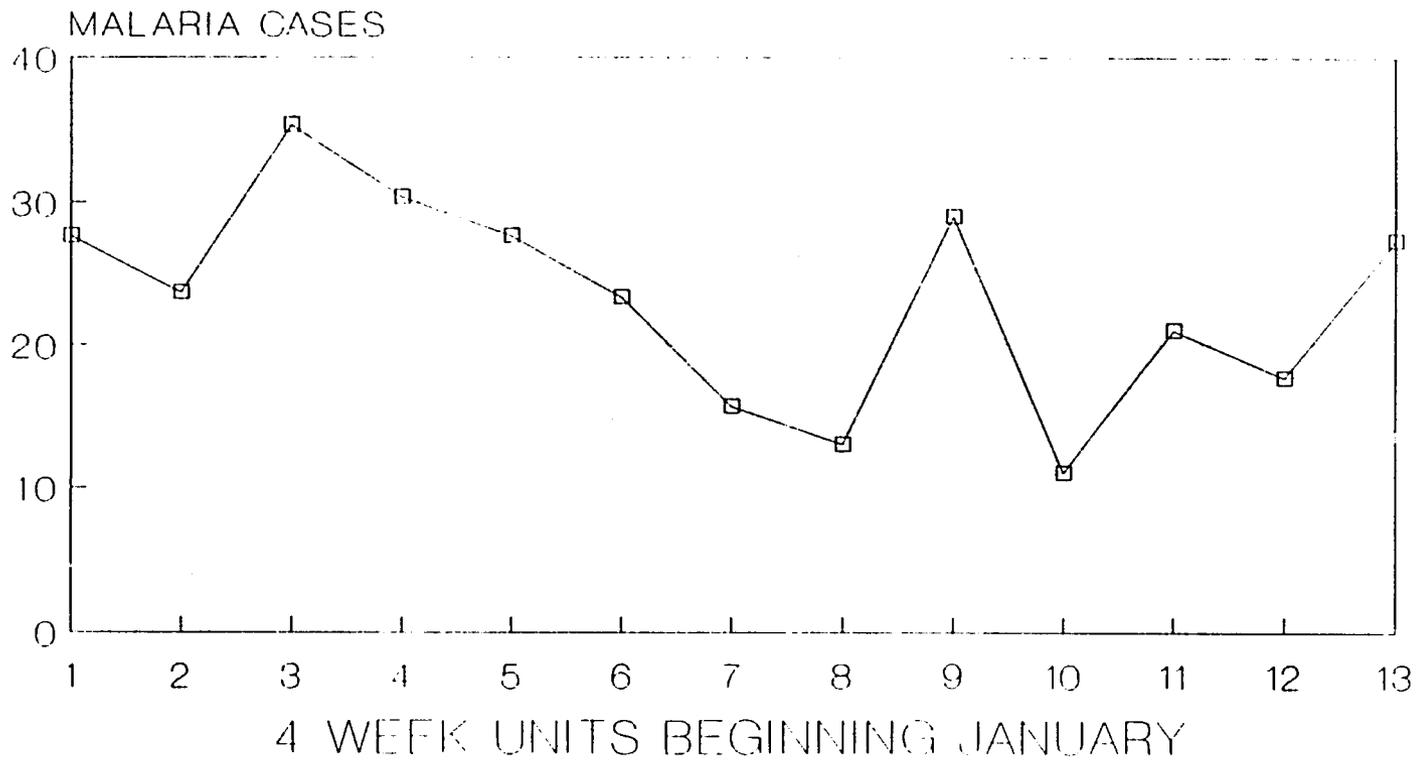


SOURCE: DCV WEEKLY REPORTS

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Figure 3

AVERAGE MALARIA INCIDENCE BAY ISLANDS, 1987-1989



SOURCE: DCV WEEKLY REPORTS

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Figure 2

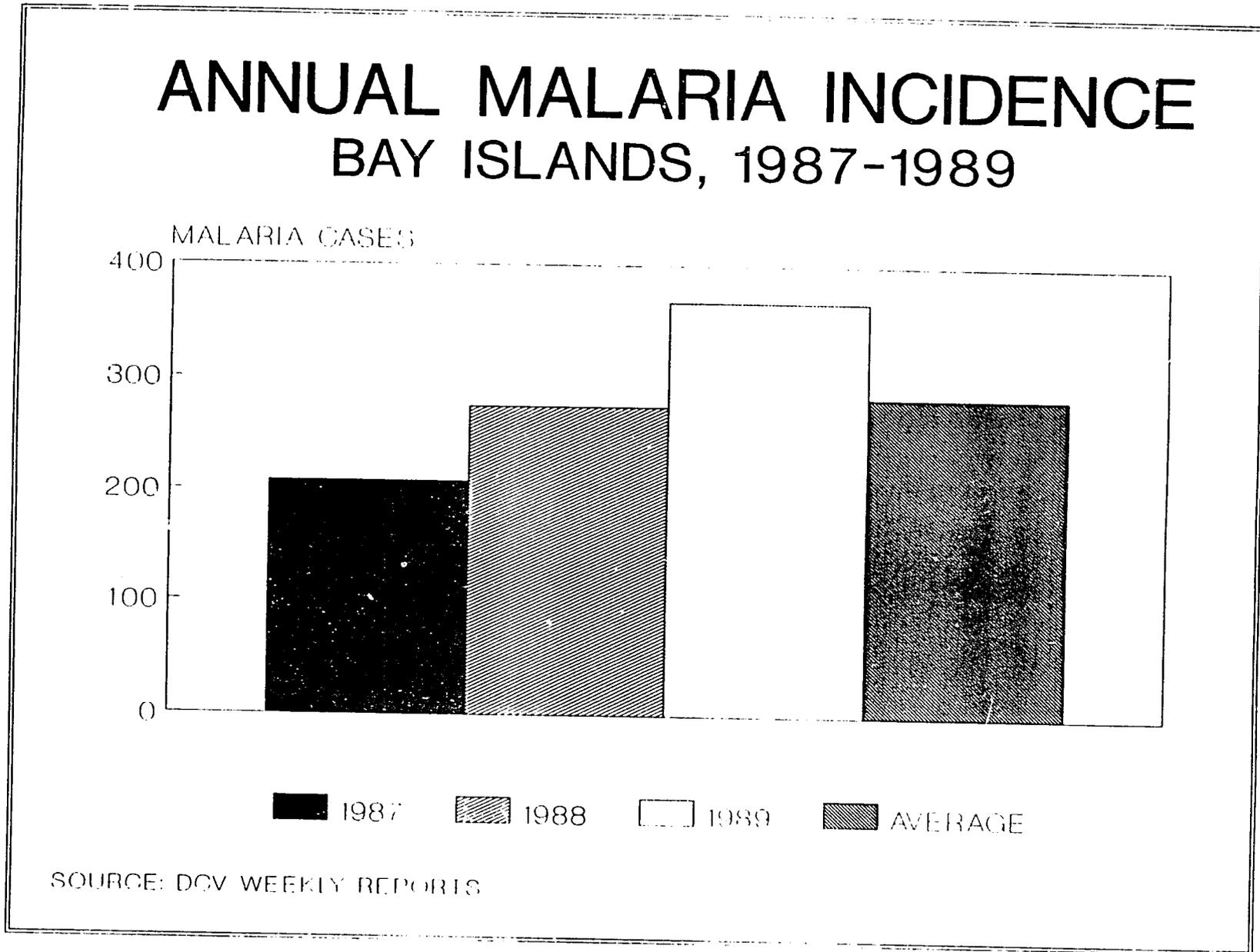
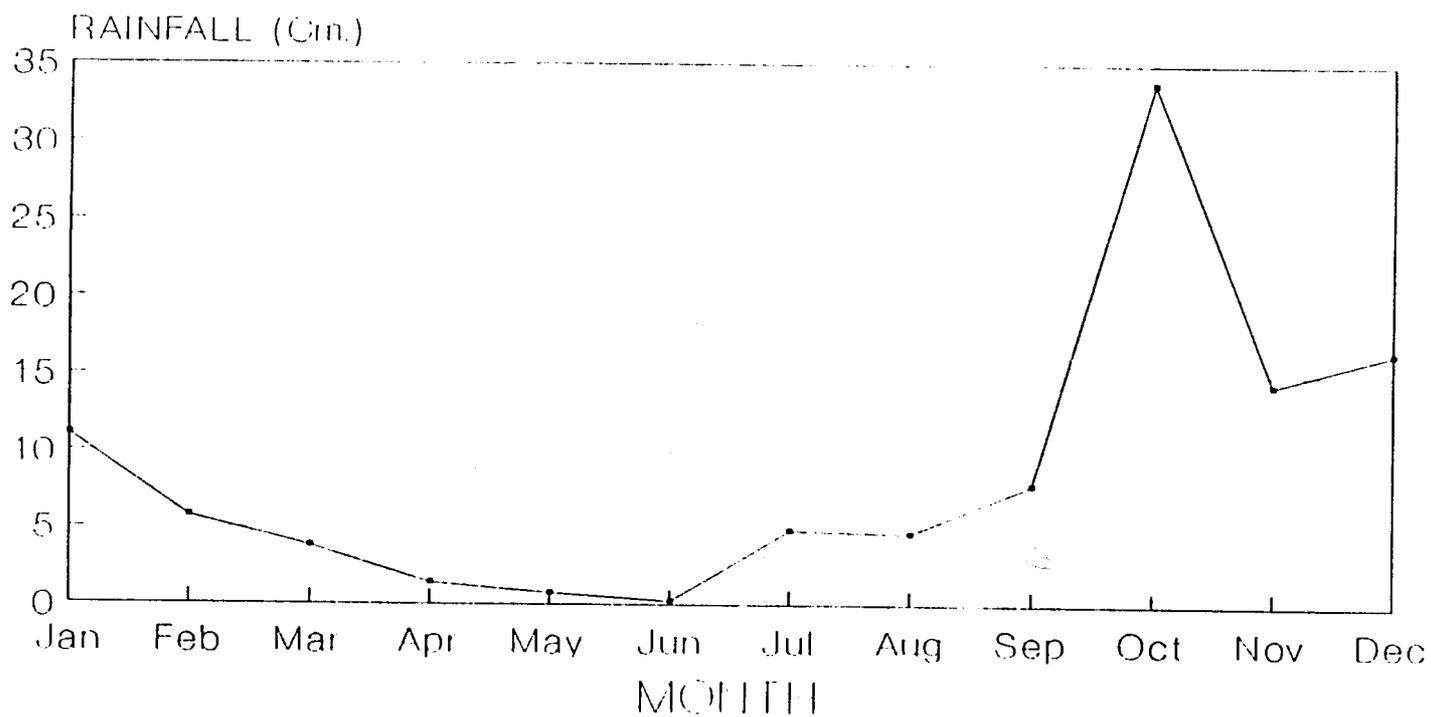


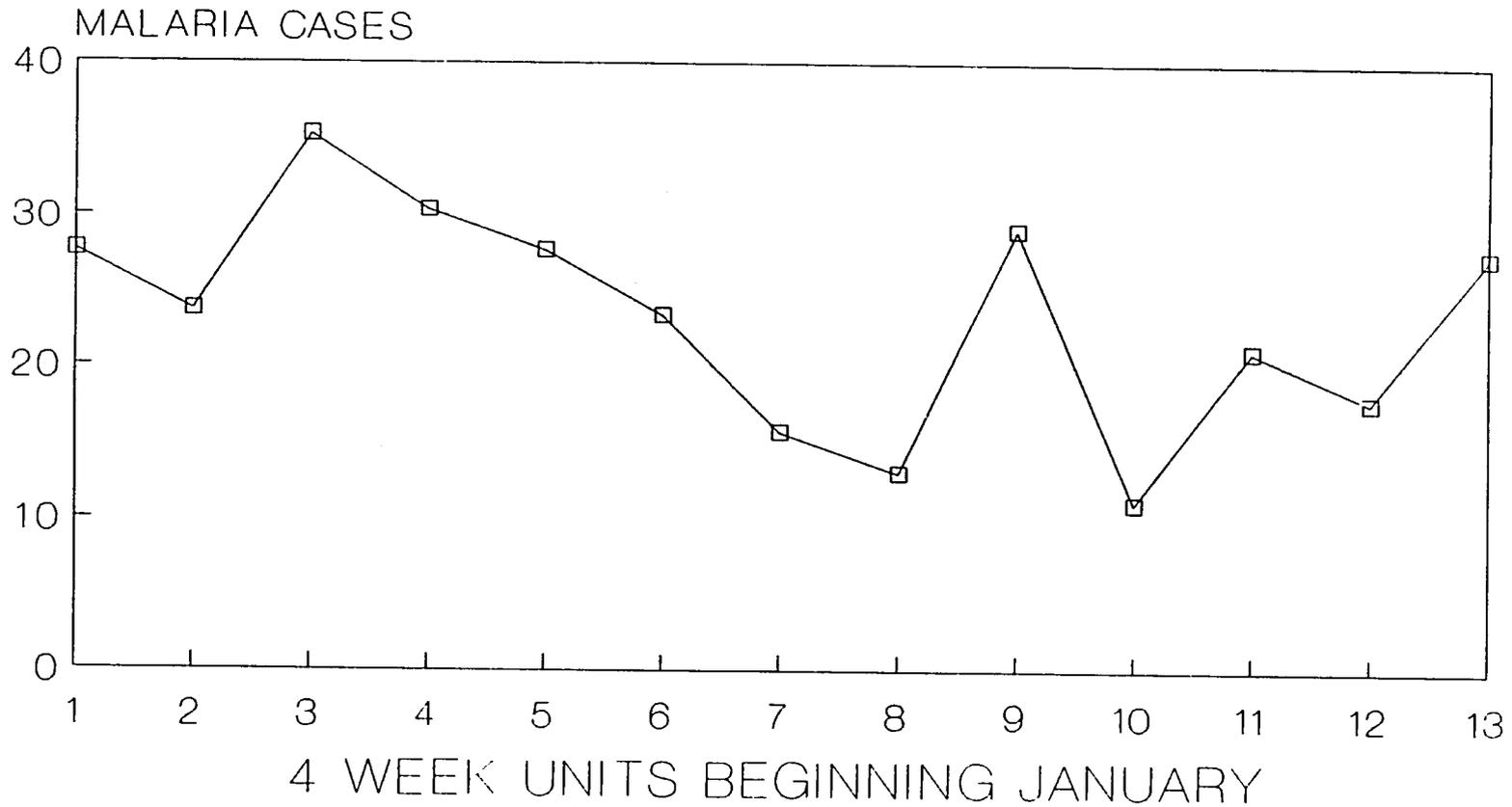
Figure 1

AVERAGE MONTHLY RAINFALL ROATAN AIRPORT, 1987-1989



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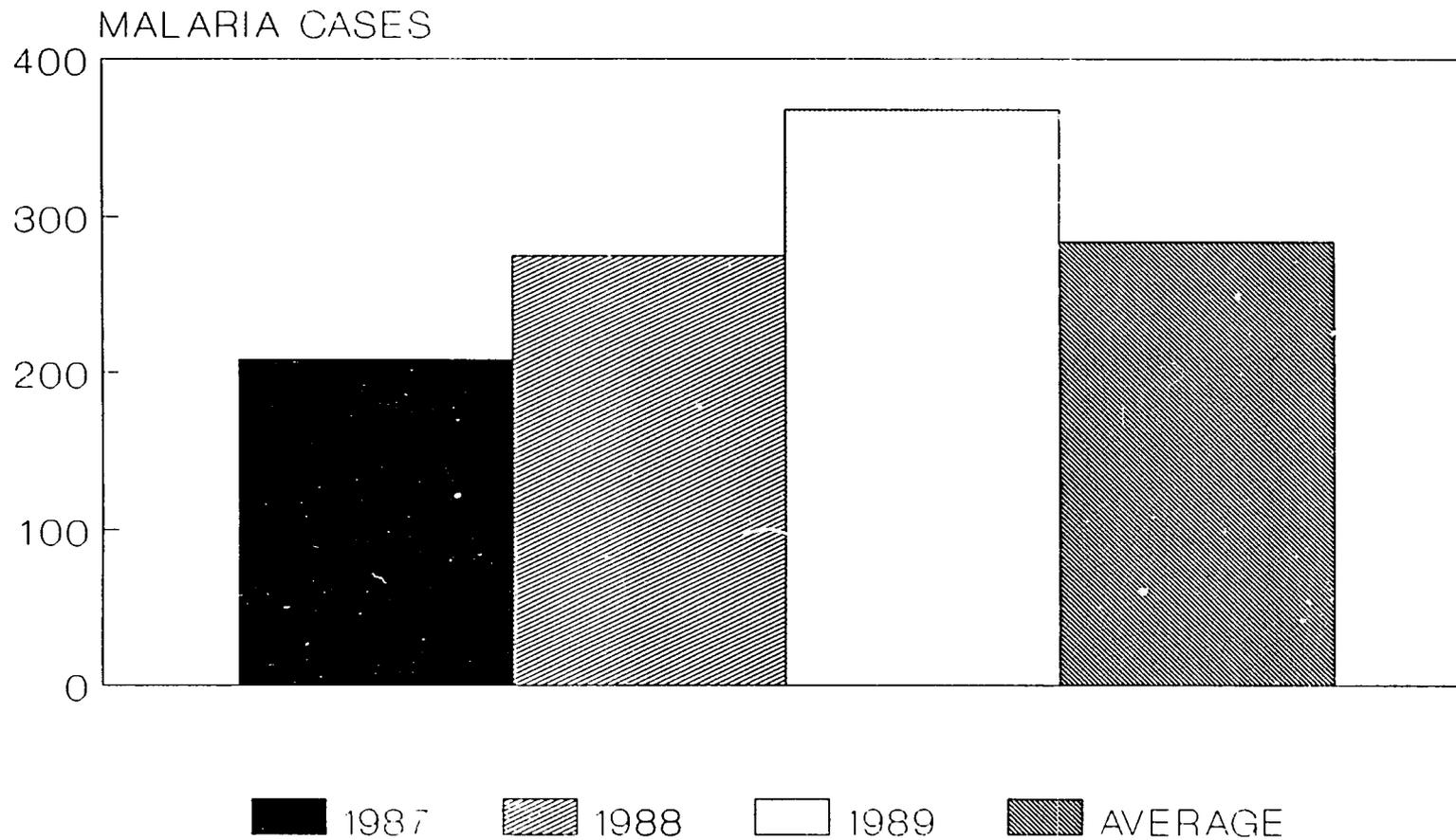
AVERAGE MALARIA INCIDENCE BAY ISLANDS, 1987-1989



SOURCE: DCV WEEKLY REPORTS

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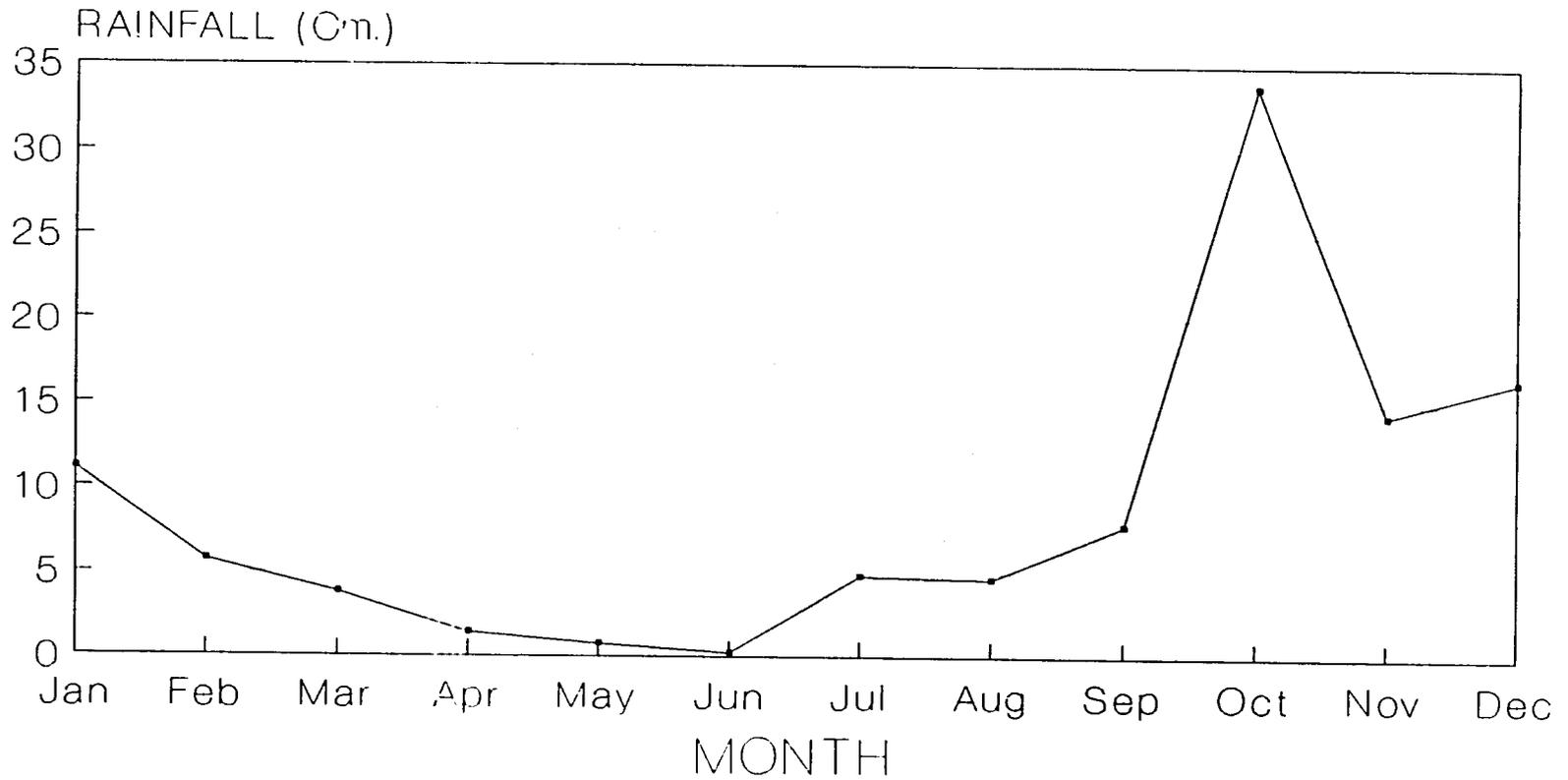
ANNUAL MALARIA INCIDENCE BAY ISLANDS, 1987-1989



SOURCE: DCV WEEKLY REPORTS

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AVERAGE MONTHLY RAINFALL ROATAN AIRPORT, 1987-1989



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