PN-ABS-120

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1. Project/Subproject Number: 9365948

2. Contract/Grant Number: DPE-5948-C-00-9030-00

3. Publication Date: 8/91

4. Document Title/Translated Title:

Environmental Assessment of the Use of the Insecticides Permethrin and Temephos (Abate) in the Malaria Control Component of the Health Systems Support Project Amendment (APSISA 519-0308)

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6. Contributing Organization(s)

Vector Biology & Control Project
Medical Service Corporation International

7. Pagination: 28 text + Attach.

8. Report Number: 81248

9. Sponsoring A.I.D. Office: S&T/H

10. Abstract (optional - 250 word limit)

11. Subject Keywords (optional)

1.
2.
3.
4.
5.
6.

12. Supplementary Notes

13. Submitting Official: Robert W. Lennox, Sc.D.

14. Telephone Number: 703-527-6500

15. Today's Date: 9/10/91

DO NOT write below this line

16. DOCID

17. Document Disposition: DOCRD [ ] INV [ ] DUPLICATE [ ]

AID 590-7 (10/88)

Vector Biology
and Control Project

Environmental Assessment of the Use of the Insecticides Permethrin and Temephos (Abate) in the Malaria Control Component of the Health Systems Support Project Amendment (APSISA 519-0308)

El Salvador, June 1991

by

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and

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VBC Report No. 81248

Managed by Medical Service Corporation International • Sponsored by the Agency for International Development
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Acknowledgment

Dr. Hobbs' participation in this assessment 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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1. Executive Summary

The Health Systems Support Project (APSISA 519-0308) provides, among other components, support for the Government of El Salvador (GOES) to reduce the incidence of malaria through a "responsive, efficient and effective nationwide malaria control program." Support elements include technical assistance, training and commodity support for insecticides and equipment. The Mission is proposing an extension to this project.

The integrated GOES program resulted in a steady reduction of malaria morbidity, from 2,000 cases per 100,000 in 1980 to about 600 cases per 100,000 in 1986, when the current A.I.D. support began. The decline continued to a level below 200 cases per 100,000 (9,095 cases) in 1988. The number of cases of *P. falciparum*, the most severe form of malaria, was reduced from 15,782 to 120 during the same period. More recently, the number of cases of malaria detected was 9,605 in 1989 and 9,269 in 1990; the number of these cases caused by *P. falciparum* was 40 in 1989 and 18 in 1990. For the first 21 weeks of 1991, 2,086 cases of malaria were identified, seven of which were due to *P. falciparum*. During that same reporting period in 1990, eight of 2,646 cases were attributed to *P. falciparum*.

From 1980 through 1988, the annual parasitic index (API = number of blood slides positive for malaria parasites/1,000 inhabitants) fell from 20.0 to 1.8. This trend has continued for the past two years, when El Salvador reported APIs of 1.86 and 1.76.

This reduction in malaria cases was achieved through a well-organized control program that includes indoor house spraying in areas of highest transmission, larviciding of proximal anopheline breeding areas, timely peridomiciliary ultra-low-volume (ULV) spraying with pyrethroid insecticides, physical larval control through source reduction activities, and prophylactic and therapeutic distribution of medication. The various approaches in the integrated scheme are guided by appropriate entomological, parasitological and medical surveillance data. Surveillance and control efforts are strongly supported by community participation efforts.

The impact of the two insecticides reviewed, Abate[1] and permethrin, is mitigated by the limited amount of insecticide used and the way they are used as components of a well-integrated control program. Abate is applied only during the dry season to limited breeding sites located within or near groups of houses. Permethrin is used as an adulticide in the few localities that have high densities of vectors, as well as a concentration of microscopically confirmed malaria cases. Permethrin is applied on an emergency basis, and applications do not extend over a long period of time.

Because the use of these insecticides is limited and focal, the environmental impact of their continued use will be negligible. There is no endangered species list in El Salvador, and the only nature reserve, Monte Cristo, is not in the malarious zone, so the malaria control program does not need to use insecticides in or near the reserve.

Few alternatives are available should Abate or permethrin become ineffective. Monomolecular films or *Bti* could replace Abate, and natural pyrethrins or other pyrethroids could replace permethrin, but at a higher cost.

After assessing the environmental impact of the use of Abate and permethrin in the GOES malaria control program, the Evaluation Team urges A.I.D./GOES to:

1. Continue using temephos (Abate) as a larvicide and permethrin as a ULV-applied adulticide in the El Salvador malaria control program;

2. Make the improvement of storage facilities and practices a priority;

3. Support continued susceptibility testing of field-collected vectors to permethrin and Abate;

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[1]Abate is a registered trade name (American Cynamid Co.) of temephos (Spanish temefos), a name also used in Latin America and in other areas of the world.

4. Continue their support for the integrated control program as it is currently being conducted;

5. Continue supporting training and monitoring of personnel in safe use of insecticides;

6. Have labels and instructions for safe use and disposal of insecticide made in Spanish; and

7. Prepare a booklet of instructions on the appropriate disposal procedures for bulk packaging and sachets and monitor the implementation of these instructions in the field.

2. Background

2.1 Purpose

The purpose of this activity was to conduct an Environmental Assessment (EA) for the amendment to the Health Systems Support Project (APSISA 519-0308) in El Salvador. The EA team reviewed the proposed use of temephos (Abate) as a larvicide and the synthetic pyrethroid permethrin as an adulticide in peridomiciliary ULV sprays in the malaria control component of this project.

2.2 Objectives

The objective of this activity was to prepare an Environmental Assessment document to determine whether the use of the insecticides Abate and permethrin in the project conforms to A.I.D. Regulation 22 CFR Part 2, 216.

2.3 Scoping process and Scope of Work (SOW)

According to A.I.D. Environmental Procedures (22 CFR Part 2, 216.3 (4)), a written statement of the Scope of an Environmental Assessment that identifies potentially significant issues is prepared and cleared through the Bureau Environmental Officer and the Mission. The SOW for this activity is presented as Appendix 1.

2.4 Project description (adapted from IEE of Project Paper)

The purpose of the Health Systems Support Project and Amendment is to support and strengthen the capabilities of the Ministry of Public Health and Social Assistance (MOH) to deliver basic health care services, particularly those that extend the access of the Salvadoran population to preventive and primary health care services such as immunization, oral rehydration therapy, and health/nutrition education. The Project has three components: 1) supplies and

equipment acquisition and management, including support to strengthen the capacity of the MOH to select, acquire, distribute and manage such commodities based on needs and priorities; 2) enhancement of basic health services delivery (including child survival and **malaria control activities**), particularly by improving the way basic care and outreach programs function; and 3) improvement of the planning and management capabilities of the MOH, particularly the systems essential to basic health services (e.g., drugs and supply management, transport, and equipment and facility maintenance).

The approach of the Project is to focus on increasing the use of existing facilities by improving service programs and outreach activities. The Project also emphasizes improving the flow of information to ensure the availability of drugs and supplies at all facilities and to facilitate decision-making and rational allocation and use of resources.

Malaria control activities included in the Health Services Support component will help the GOES contain or further reduce the incidence of malaria through a responsive, efficient and effective nationwide malaria control program. This program is based on the assumption that the most effective method of controlling the disease is to concentrate the available resources in areas with the greatest number of cases. This reasoning is a departure from the philosophy of malaria eradication campaigns, which was to allocate resources to all areas of the country equally.

For the purposes of the GOES' malaria control program, the country of El Salvador is divided into five zones. These zones are subdivided into departments, which are composed of a number of areas. Each area is made up of a collection of houses called a *caserio*. A *caserio* is the epidemiological unit of the program.

The "voluntary village collaborators" are the backbone of the program. Trained by the GOES, they are responsible for collecting blood samples, preparing slides from people who come to their house with fevers, and treating these people with an initial dose of chloroquine and primaquine. If the area microscopist finds that a slide is positive for malaria, the individual is notified and begins a five-day treatment regime.

Village collaborators are responsible for extensive record keeping and treatment follow-up. Treated individuals are re-bled after 30 days to determine the efficacy of the treatment. Currently there is one voluntary collaborator for approximately 700-800 people. (The ultimate goal is a ratio of 1:300). These collaborators have functioned efficiently for at least the past 10 years.

Village collaborators are supervised by *auxiliares de epidemiología,* who collect blood slides from several collaborators, and from public and private health facilities, deliver them to the microscopist (one or more per department), and return the findings to the village collaborators. The timing of this cycle is determined and stratified according to the level of malaria endemicity (the average time for hyperendemic areas is eight days, with longer turnaround times for the areas of lower endemicity). The *auxiliares de epidemiología* are given helmets and small motorcycles, and are also responsible for ensuring that the village collaborators are well-supplied.

Each microscopist's performance is monitored by the GOES in San Salvador. All positive slides and 10 percent of the negative slides examined by each microscopist are reexamined at the national headquarters. Microscopists with an error rate in excess of five percent receive supplementary training.

The malaria control program has defined four levels of endemicity for the country: hyperendemic, mesoendemic, hypoendemic and no malaria. This classification was completed in 1979 and was based on the results of a retroactive study of the incidence of malaria, as well as geographical and entomological data. Within each of these zones, areas are prioritized as follows:

1. First priority - areas with an A.P.I. > 15.0;
2. Second priority - areas within A.P.I. > 5.0 and < 14.9;
3. Third priority - areas with an A.P.I. < 4.9.

These priorities are revised at weekly meetings of the field and department chiefs, and upon review of the latest data from the microscopists and entomological surveillance teams. Spray teams and entomological surveillance teams are found at the departmental level.

An information management system has been developed by the project and is located in the Malaria Department of the GOES. This system provides weekly summaries of:

1. the results of all slides examined; the number of slides positive for *P. vivax* or *P. falciparum*, and the number that are negative; not only for the slides collected from the voluntary village collaborators, but also from both public and private clinics, in addition to any active case detection studies;

2. results for each *caserio* for the week, for the previous four weeks, and the totals for the year;

3. summaries by department, region and priority, for all sources of slides; and

4. annual totals to date for the current year and, for comparison's sake, the previous year during the same reporting period.

These findings are distributed to the various officials to provide the information necessary to allocate program resources appropriately.

To minimize the use of insecticides while maximizing their effectiveness, the control program only uses insecticides in hyperendemic areas. Decisions on insecticide application are made at the field level with the input of the Zone Chief.

Project support assists the MOH's Malaria Department in implementing targeted anti-malaria activities in high-priority hyperendemic areas. These efforts, along with vector control and radical drug treatment, are expected to result in continued declines in malaria transmission and progressive reduction of the geographical area requiring intensive control measures, which will in turn reduce the administrative and financial costs of the program.

Malaria control activities supported by Project funds fall into two categories:

1. Technical assistance for program monitoring, including upgrading methodologies currently in use and developing alternatives to these methodologies, and training personnel to operate and maintain U.S.-supplied equipment and commodities; and

2. Commodity support for insecticides, spraying equipment, vehicles, and various other laboratory and entomological equipment and supplies.

The implementing agency of the malaria component of the proposed extension will be the Malaria Department the MOH. During project implementation, the Malaria Department will continue to monitor malaria parasite susceptibility to drug treatment, as well as the efficacy of the insecticides being used to control larval and adult stages of the malaria mosquito vector.

2.5 IEE findings

The Initial Environmental Evaluation (IEE) for the Health Systems Support Project resulted in a **Negative Determination** for the malaria control components. Propoxur was reviewed and approved as the insecticide of choice for residual house spraying. It was noted in the IEE that bendiocarb (to be purchased with MOH funding) was to be field-tested in 1986 as a possible back-up insecticide. These tests were completed and the use of bendiocarb was proposed as the insecticide of choice for residual house sprays. The IEE recommended that "if new chemical, biological or physical vector control methodologies are introduced into the program after the approval of the Project, the environmental impact will be reviewed, and, if necessary, environmental studies or assessment will be carried out" (Aug. 4, 1986). As a result, an EA for the use of Bendiocarb as a residual house spray was conducted by Drs. Arata and Breeland in 1989, who recommended using the insecticide. The program has used bendiocarb successfully since 1990.

2.6 Need for the EA

The EA is mandated by Reg. 216 for a "substantive amendment or extension of an ongoing project." Preparation of an EA is thus required (though both Abate and permethrin have been used successfully in malaria control in El Salvador for at least the last 15 years, as well as in neighboring countries, without incident of human illness or environmental damage).

3. Alternatives -- Including the Proposed Action

3.1 Alternative: continued use of Abate and permethrin (no action)

The authors were very impressed with many aspects of the malaria control program. One of its major goals is to reduce the use of insecticides by targeting their use in areas where they will have the greatest benefit. This aim is being accomplished by using the information obtained from the medical, parasitological and vector surveillance systems to appropriately target insecticide applications. During the past 15 to 20 years, this procedure has reached a high level of efficiency. By using this approach, the program has been able to reduce the number of houses treated annually from more than 200,000 to the current 30,000, while simultaneously reducing the incidence of malaria, as previously described.

The authors believe that the current program is using a very limited quantity of insecticides (approximately 600 gallons/year of 5% permethrin and 600 gallons/year of 50% emulsion of Abate) very effectively. However, there should be continued emphasis on additional reductions, particularly of ULV applications of permethrin. The efficacy of these applications on the reduction of malaria transmission is difficult to evaluate and is of value only in very restricted areas. Continued limited and highly targeted use of both Abate and permethrin is recommended. Their use should be routinely monitored for efficacy not only in killing mosquitoes but also in reducing the transmission of malaria.

3.2 Alternative: The use of alternative insecticides to Abate and Permethrin

Alternatives to Abate include the use of monomolecular films and biocontrol measures such as *Bacillus thuringiensis israeliensis* (Bti), larvivorous fish, copepods, or other predators. These control measures may be included in the program in the future. Their

incorporation into the current program, however, would result in either increased cost, reduced safety, or reduced effectiveness. Because of the long history of the program's successful use of Abate, its low toxicity, and its minimal impact on nontarget organisms, the authors find no compelling reason to suggest any changes.

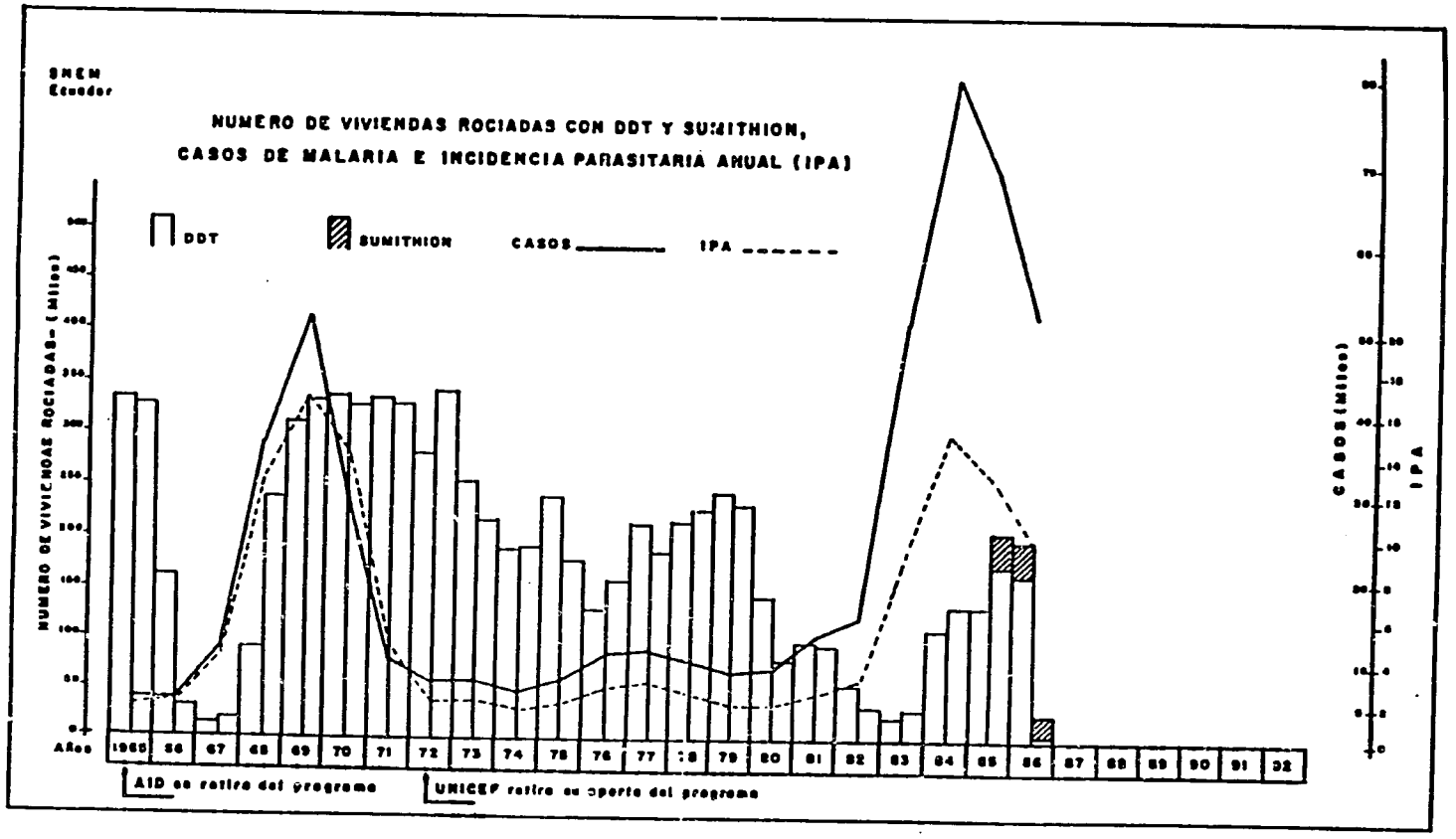
Of the compounds registered by the U.S. Environmental Protection Agency (USEPA) for ULV application to control adult mosquitoes, permethrin, a synthetic pyrethroid, is the logical choice for El Salvador's program. The use of organophosphate compounds, such as malathion, is not recommended, since there is resistance to these compounds in the vector populations of El Salvador. Alternatives to permethrin for ULV spraying would be other formulations of pyrethroids (Scourge, Punt) or natural pyrethrins. Though of similar mammalian toxicity, they are generally more expensive.

3.3 Alternative: Exclusion of larviciding with Abate and adulticiding with ULV applications of permethrin

Eliminating the use of the insecticides Abate and permethrin in the GOES malaria control program would have a negative impact on its success. The potential repercussions of eliminating the use of insecticides may be seen in Figure 1, which illustrates what happened in Ecuador. When, for various reasons, the amount of insecticides available for use in Ecuador's control program was decreased, the result was a corresponding increase in the incidence of malaria.

The GOES program has dramatically reduced the incidence of malaria while simultaneously reducing its use of insecticides. It is the opinion of the authors that, by targeting the use of insecticides through medical, parasitological and entomological surveillance and by constantly reevaluating the priority areas, this control program is making excellent use of a very limited amount of insecticide. To entirely eliminate the use of these control measures would severely reduce the effectiveness of the program in future years, and result in the loss of many of the gains that the program has made in the past 20 years.

Figure 1. Malaria and Insecticide Use in Ecuador



4. Affected Environment

Applications of limited quantities of the insecticides Abate and permethrin are restricted to high-priority, hyperendemic areas (see Appendix 6). The majority of these localities are in the lowlands, along the Pacific coast and in the western departments of Ahuachapan, Santa Ana, Sonsonate and La Libertad and the eastern departments of San Miguel and La Union. The latter region is rural and highly agricultural, including both subsistence and large commercial farms. Because of the high overall population density of the coastal region, the tropical lowland vegetation is highly modified to the agricultural pursuits of the inhabitants.

The potential for major environmental damage due to the use of insecticides is very limited. There are numerous streams throughout the treated areas, but only limited quantities of each insecticide are stored, transported or used in any given local. Abate and permethrin biodegrade rapidly, and the applicators are well-trained in the safe use of these compounds.

5. Environmental Consequences: Issues, Analysis and Mitigation Measures

This section addresses the list of questions about the use of insecticides under A.I.D. Regulation 216.3 (b)(1) specifically adapted to the use of the larvicide, Abate, and the adulticide, permethrin, by the Malaria Department (MOH/GOES). Both insecticides are used only in previously identified, high-priority hyperendemic areas. The most recent data obtained from medical, entomological and parasitic surveillance in these priority areas, which are generally conducted weekly, are reviewed routinely. Abate is applied to previously identified limited anopheline larval sites. Permethrin is applied peridomestically by ULV sprayer when entomological surveillance indicates that unusually high adult anopheline populations in high-priority areas coincide with an increase in the incidence of malaria.

5.1 The USEPA registration status of the requested pesticides

An emulsifiable formulation of Abate (4E) is used as a larvicide in hyperendemic areas. The USEPA registration number for the product is 6720-Fl-1. The registration number for the active ingredient is 241-220. The USEPA registration for 1% sand granule (1-SG) formulation for Abate is 241-174, which is also used on occasion.

The USEPA registration number for a 5% formulation of permethrin is 011551. It is registered as a mosquito adulticide when applied by the ULV technique. For the GOES malaria control program, permethrin is used as a peridomiciliary ULV spray in hyperendemic areas where entomological surveillance finds abnormally high adult anopheline populations.

5.2 The basis for selection of the requested pesticides

Abate was chosen as the larvicide for the program because of its long history of safe, effective use in mosquito control in both developed and developing countries. It has a low mammalian toxicity and a minimal effect on nontarget organisms. Appropriate biosassays have shown that the local vector, *Anopheles albimanus*, is susceptible to Abate. In addition, Abate is effective against anopheline larvae at low concentrations (< 2 ppm), which makes it an economical insecticide to apply.

Permethrin is the adulticide of choice for the program due to its long history of safe use for ULV sprays in El Salvador, neighboring countries, and in many U.S. mosquito abatement districts. The program had to choose a pyrethroid insecticide as an adulticide because it had been demonstrated more than 15 years ago that the local anopheline vector had developed resistance to organophosphorus compounds such as malathion.

The use of permethrin has also helped maintain the capability of GOES malaria personnel to apply the insecticide with ULV equipment. Though these capabilities are only needed occasionally for malaria control, they would be invaluable in case of a dengue epidemic. The most appropriate action to take in the event of such an epidemic is quick destruction of adult mosquitos by ULV insecticide applications, but *Aedes* control personnel have not been trained to do ULV applications. Explosive epidemics have occurred in San Salvador and may recur. The malaria program is now equipped to provide vector control capabilities for the dengue control program.

5.3 The extent to which the proposed pesticide use is part of an integrated pest management program

Malaria control activities under the APSISA project in El Salvador are in their final year (1991). The proposed amendment is a continuation of this project. As previously described (2.4), antimalaria strategies include the use of integrated measures aimed at reducing malaria morbidity in malarious regions. High-priority, hyperendemic (API > 15) areas are especially targeted. The malaria

control component of this project has reduced the incidence of malaria by integrating the following strategies:

1. Epidemiological surveillance;

2. Entomological surveillance;

3. Source reduction by large- and small-scale permanent drainage and habitat alterations;

4. Distribution of drugs by a network of volunteer village collaborators to people infected with malaria;

5. Residual house spraying with Ficam (bencdiocarb);

6. Larviciding of limited breeding sites with Abate; and

7. Adulticiding by peridomiciliary ULV applications of permethrin in areas of high adult vector density.

As previously described, all of these measures are well-integrated and interdependent. The components of this integrated system are illustrated in Appendix 5.

5.4 The proposed method or methods of application, including availability of appropriate application and safety equipment

Abate will be applied directly to the proven breeding places of vector mosquitoes either by the hand broadcasting of 1% Abate on sand granules, or in the form of a 5% emulsion sprayed on the surface of water using handheld Hudson x-pert sprayers. Spray personnel are thoroughly familiar with this equipment, since it has been used for many years in the house spray program.

Permethrin will be applied at a dose of no more than 6 oz./acre by a truck-mounted aerosol generator. The program has a sufficient number of these machines, namely LECO and LONDONAIR.

Larvicide applicators, as well as ULV machine operators, are well-trained in the safety precautions necessary for working with these pesticides (see Section 5.11).

5.5 Any acute or long-term toxicological hazards, either human or environmental, associated with the proposed use and measures available to minimize such hazards

Abate has been used by the GOES/MOH Department of Malaria for more than 15 years without any indication of adverse human health affects. Toxicity of Abate (LD50) for humans is approximately 10,000 mg/kg (oral); by contrast, the oral LD50 of table salt is 5,000 mg/kg and that of aspirin is 2,000 mg/kg. In addition, applications are restricted to limited anopheline larval sites in high priority hyperendemic areas. Thus the current use of this insecticide presents minimal human or environmental danger.

The hazards of using permethrin are also minimal, either to humans or non-target organisms, mainly because of the extremely low dosages of this insecticide applied to control adult vectors of malaria. Permethrin is applied with ULV equipment at a rate of no more than 6 oz./acre. This low application rate, and the low mammalian toxicity of the insecticide, make permethrin an extremely safe insecticide to use in malaria control operations. No poisoning accidents have been reported by spray personnel or homeowners during more than 15 years of use in El Salvador.

Measures are available to ensure that these applications rates are adhered to. Machines are calibrated before the spray season starts, and the spray applicators receive a one- to two-week training course at the central malaria headquarters before the spraying season begins. This course includes proper applications techniques and safe handling practices for the insecticide.

5.6 The effectiveness of the requested insecticides for the proposed use

Abate has been used successfully by the GOES malaria control program for many years and is recommended by the World Health

Organization (WHO) for mosquito larval control. Susceptibility trials have been conducted recently; however, they were done with *Aedes aegypti* larvae. These assays should be repeated using *Anopheles albimanus* larvae collected from areas where the insecticide is or will be used. It should be noted that officials are cognizant of the problem of resistance and that larval sites have been sampled routinely before and after the application of Abate. The malaria control program has not detected any decrease in the effectiveness of this pesticide.

Permethrin has proven effective against the vectors of malaria in El Salvador in field trials, pilot projects and operating malaria programs. Early trials conducted at Tapachula by the Mexican Government in 1980 and monitored by bioassays of caged *Anopheles albimanus* showed a high mortality (90 percent or more) in caged mosquitoes. Epidemiological trials carried out in El Salvador in 1985 clearly demonstrated that when permethrin was applied around houses in areas of high endemicity, it could lower mosquito density and reduce malaria rates, as measured by both the active and passive case detections system. Permethrin was found to be particularly useful in localities that had already been sprayed with propoxur but needed additional suppressive action against mosquito populations to reduce malaria. Needless to say, localities with these characteristics are limited in number, so large-scale use of permethrin in malaria control in El Salvador is not planned.

5.7 Compatibility of the proposed pesticides with target and non-target ecosystems

As it is currently used in limited anopheline larval sites in high-priority hyperendemic areas during the dry season, Abate is non-phytotoxic and of minimal toxicity to nontarget organisms (Appendix 9, WHO). Anopheline larvae have not demonstrated resistance to this compound, so its use is compatible with target and nontarget ecosystems.

Permethrin is compatible with the target and nontarget ecosystems because of its low toxicity, plus the low application rates used. Permethrin is a knock-down insecticide for mosquitoes, it is not persistent in the environment, and it is biodegradable. Because of

the ULV delivery of the spray, it is unlikely that nontarget organisms will come in contact with the insecticide for long periods of time.

5.8 The conditions under which the insecticides are used, including climate, flora, fauna, geography, hydrology and soils

As described above, the use of Abate by the GOES malaria control program is very limited and highly targeted. The areas treated do not represent a single type of environment, though the majority of the treated regions are in rural areas of the coastal plains. This region is largely agricultural and the native flora is highly modified due to the relatively high population density.

Permethrin will be used only in the few localities where application of an adulticide is appropriate. ULV application of permethrin method will be used only in combination with other integrated control methodologies, such as house spraying, source reduction, larviciding where appropriate, and chemotherapy. Localities to be sprayed with ULV permethrin will generally lie within the tropical zone of the coastal plains. This area is one of mixed agriculture, with cotton, corn, beans and sugar cane crops. Spraying will be done at sundown, and only when weather conditions permit the suspension of aerosol droplets of the insecticide for long periods of time.

In general, the use of pesticides for public health is extremely minimal compared to their widespread use for agricultural purposes.

5.9 The availability and effectiveness of other pesticides or nonchemical control measures

Nonchemical control measures such as small and large-scale source reduction projects are included in the malaria program. Alternative larvicides are available, but they would represent increased cost and/or decreased effectiveness. Alternate pesticides are available for ULV applications, but permethrin and its pyre-

throid chemical relatives remain the least toxic, most effective and most economical.

5.10 The requesting country's ability to regulate or control the distribution, storage, use and disposal of the requested pesticides

The GOES Malaria Department has many years of experience in receiving, distributing, storing and using toxic pesticides, including DDT, dieldrin, malathion, propoxur and bendiocarb. House spraying for malaria control has been carried out in some form, with some interruptions, since the late 1950s. During these years the Malaria Department has demonstrated an awareness of the health and environmental hazards of pesticides. In general, safe handling practices have been good, and spray personnel have been well-trained in safety precautions. During the five-year life of the current project, there have been no reports of adverse health effects due to the use of insecticides. These results compare quite favorably with the more than 200 cases of insecticide poisoning reported by the MOH/GOES from other sectors during the first 21 weeks of 1991.

The authors visited the warehouse facilities at the central level and one outlying storage point. The central warehouse was secure, clean and well-organized. It had a solid floor and was constructed in a way that protects the insecticide from rain and exposure to direct sunlight. We also visited the warehouse in Sonsonate. It was secure, with concrete floors and a good roof. The room was also used as a general storage area. The housekeeping was not good and could be easily improved. The room also contained a bed, which was obviously being used. This practice should be discontinued and all regional storage facilities should be visited and the necessary improvements made. Plans for new regional storage facilities were discussed and blueprints were shown to the authors. When completed, the buildings detailed in these plans will greatly enhance the storage capabilities of the GOES malaria program.

5.11 Provisions made for training users and applicators

The malaria program provides training in all aspects of the application of pesticides through its national and regional departments and health system network. Applicator training is generally provided by well-trained supervisors through an apprentice learning system in the field. This system of on-the-job-training, which includes frequent monitoring by supervisors, is quite adequate for the continued safe use of Abate and permethrin. The program administration is exceptionally cognizant of outside training resources offered by various groups, including PAHO, USAID and VBC.

Special attention is given to the handling of the insecticide concentrates (both water-dispersible powders and emulsion concentrates) by the malaria department. Long-handled mixers are used in the preparation of suspension or emulsion of the insecticides to protect operators from splashing and to allow them to stand while they stir to further reduce the risk of intoxication.

Insecticide concentrates left over from the operation (unused packets or unused mixed concentrates) and empty containers are returned from the field, which allows for inventory control. They are either stored or disposed of safely so that they cannot contaminate water sources or create any other environmental hazard. The washing waste water is not allowed to enter wells, streams, lagoons, swimming pools or any other water source that could be used by people or animals for drinking or washing.

It should be noted that each spraymen receives up to 10 days' training each year in spray techniques and operational matters before the major spray cycle begins. Approximately 15 percent of training time is spent on health safeguards for protecting both personnel and villages. At the start of the spraying cycle, each sprayman is issued three sets of protective uniforms, including a long-sleeved shirt, a metal helmet, rubber gloves that extend about halfway up to the elbow, an aspirator, an eye shield, and some belladonna drops in case of a sudden emergency. Spray operators are supervised and required to change uniforms regularly and are given an allowance for washing their uniforms. In addition, they are instructed to bathe thoroughly at the end of each working day.

Each sprayman is also issued a personal instruction booklet describing the proper techniques and precautions a spray operator should follow. Series of instructions are issued to the malaria program spraymen, team, leaders, chiefs of zones, and villages in the application of insecticides.

The "Manual de Operaciones de Rociado," issued by the GOES Department of Malaria and used as a guide by the program, contains instructions on health safeguards for field personnel to follow in applying insecticides and in training. There are specific instructions for each insecticide.

5.12 The provision made for monitoring the use and effectiveness of the insecticides

The integrated control program in which Abate and permethrin are used is based on a combination of data on the epidemiology of the disease and vector susceptibility to the pesticide. The program has training facilities and testing programs that go hand-in-hand with this program. The national laboratory in San Salvador is an outstanding example of appropriate staffing, facilities and operational efficiency. This laboratory should be supplemented by field facilities in the areas where Abate and permethrin are sprayed and insecticide susceptibility and bioassay studies are conducted in support of the project. Such a system would allow frequent contact between supervisors and applicators in the field, providing a means of detecting changes in efficacy early and making any necessary modifications in application procedures.

It should be noted that susceptibility assays have been conducted recently for permethrin (May 1991). The authors suggest that future trials should use wild-caught anophelines. Abate trials with *Anopheles albimanus* have not been conducted recently and should be initiated, also using the appropriate mosquitoes.

An effective voluntary collaborator network that reports malaria case information and the regional epidemiological centers associated with the national health care system provide the means to measure the impact of vector control activities on malaria incidence.

5.13 Will the pesticides affect endangered or threshold species?

The only way the pesticides under consideration (Abate and permethrin) could affect endangered or threshold species is in the event of a large-scale spill. Accidents of this nature are unlikely (see Section 4.0). These materials are purchased in five-gallon metal containers. Since only limited quantities are used in each area, few containers are transported together, thereby reducing the opportunities for a large spill. Spillage of one or even several of these small containers would not do great environmental harm, especially if the spill was quickly treated in the way malaria personnel have been trained to deal with pesticide spills. In normal operational use for malaria control, these pesticides pose no threat to endangered species.

6. Recommendations

Following its analysis of documentation, interviews, and field visits, the Evaluation Team made the following recommendations.

1. A.I.D. should concur with the continued use of temephos (Abate) as a larvicide and permethrin as a ULV-applied adulticide in the El Salvador malaria control program.

2. USAID and the MOH/GOES should make improvements of insecticide storage facilities and practices a priority and evaluate them routinely.

3. The Department of Malaria (MOH/GOES) should conduct appropriate susceptibility/resistance trials for Abate and permethrin using both wild-caught and colony mosquitoes. Mosquitoes should be collected in areas where the insecticide is or will be applied.

4. USAID and the MOH/GOES should continue to support the efforts of the Malaria Department to develop a fully integrated control program through improved surveillance and stratification that will continue to reduce the number of communities needing protection through insecticide applications.

5. The MOH should continue to train its personnel in safe use of insecticides and to provide required safety equipment and clothing.

6. A.I.D. procurement procedures for the purchase of both insecticides should specify clearly that labels on the bulk packaging be in Spanish and that the vendor provide an adequate number of safety and first-aid instruction pamphlets in the same language.

7. The MOH/GOES should prepare a booklet of instructions on the appropriate disposal procedures for bulk packaging and sachets, and should monitor the implementation of these instructions in the field.

7. Approval of EA by LAC Environmental Officer

The environmental officer for the Bureau for Latin America and the Caribbean, James Hester, approved this environmental assessment report July 1991, (reference cable state #254773).

8. List of People and Places Visited

A. People Visited

Dr. Angel Guerra Sandoval	Director, Malaria Department, GOES/MOH
Dr. Dr. Rodrigo Castanada	Epidemiologist, Malaria Department
Sr. Jacobo O. Solórzano	Chief, Entomology Section, Malaria Department
Sr. Francisco Estrada	Chief, Malaria Health Region (Western), Department of Santa Ana
Sr. Jesus Guevarra	Chief, Field Operations Malaria Department
Sr. Alberto Escabar	Entomologist, Malaria Department
Sr. Juan Linarus	Zone Chief, Malaria Department
Sr. Manuel Aragon	Administrator, Malaria Department
Dr. Mauricio Sauerbrey	USAID Long-Term Advisor to the Malaria Department, MSCI
Dr. Raphael Cedillos	Chief of Party, MSCI
Mr. Richard Thornton	Director, HPN Division USAID/San Salvador
Ms. Sandy Del Prado	Project Manager, USAID/San Salvador

B. Places Visited

Malaria Department/MOH San Salvador	Hematology Laboratory Entomology Laboratory Central Warehouse (El Matazano)
Environmental Vector Control Project	Rio San Antonio, Estero Ticuiziapa, Department of La Libertad
Western Health Region	Malaria Department, Sonsonate and Environs
Western Health Region Spraying Operations	Caserio Apancoyo Department of Sonsonate
Western Health Region	Health Unit of Department Sonsonate (Malaria Microscopist)
Voluntary Collaborator	Cangrejera Department of Libertad

Appendix 1

Scope of Work

Proposed Scope of Work (SOW)
for an
Environmental Assessment

Request by USAID/El Salvador

A. Purpose

The purpose of the proposed environmental assessment (EA) is to consider the environmental and human safety implications of utilizing the insecticides, Temephos (Abate) and Permethrin in a USAID - supported malaria control program in El Salvador. This program is a component of the Health Systems Support Project 519-0308.

B. Project Background

The Health Systems Support Project (APSISA 519-0308) provides, among other components, support for the Government of El Salvador (GOES) to reduce the incidence of malaria through a "responsive , efficient and effective nationwide malaria control program." Support elements include technical assistance, training and commodity support for insecticides and equipment.

The integrated GOES program resulted in a steady reduction of malaria morbidity from 2,000 cases per 100,000 in 1980 to about 600 cases in 1986, when the current A.I.D. support was implemented. The decline continued to a level below 200 cases per 100,000 (9,215 cases) in 1988. From 1980 through 1988, the annual parasitic index (API = number positive slides/1,000 examined) fell from 20.0 to 1.8. The number of cases of P. falciparum, the most severe form of malaria, was reduced from 15,782 to 120 during the same period. In 1989 and 1990 the number of cases of malaria reported annually has been between 9,000 to 10,000: the number of these cases which were found to be caused by P. falciparum was 40 and 18 for 1989 and 1990 respectively.

This reduction was achieved through the development of a well-organized control program that include indoor house spraying in areas of highest transmission, larviciding of proximal anopheline breeding areas, timely peridomiciliary ULV spraying with pyrethroid insecticides, physical larval control through source reduction activities and prophylactic and therapeutic distribution of medication. The various approaches in the integrated scheme are guided by appropriate entomological, parasitological, and medical surveillance data. Both surveillance and control efforts are strongly supported by community participation efforts.

C. Scope and Significance of the Issues

The proposed amendment to the project includes continuation of the use of Permethrin

and Abate in the malaria control activities under the APSISA Project El Salvador. These activities are currently in the fourth year (1989) of a five year strategy. The anti-malaria strategy includes the use of integrated measures aimed at reducing malaria morbidity among the inhabitants of approximately 35,000 houses in several communities in malariogenic areas of El Salvador.

The targeted areas were selected on the basis of local high rates of endemic malaria (A.P.I.>15.0). These insecticides are only one aspect of the integrated approach. Abate is used for the larviciding of proximal breeding areas to reduce production of anophelines prior to the use of Bendiocarb (Ficam) as intradomiciliary spray. This residual insecticide is used in three spaying cycles of 120 days each; Permethrin is used as a special peridomiciliary space spray (applied by ULV) when ongoing surveillance indicates a surge in malaria cases. Also integrated in the malaria control program are: the construction and maintenance of source reduction structures to promote drainage of breeding areas; distribution of prophylactic and therapeutic medication along with entomological and parasitological surveillance through the voluntary collaborator and appropriate medical systems; and community participation and training programs designed to increase personnel capacity in the program. Thus, pesticides play a limited role in the project with focal application, no broad-scale area-wide applications.

The purpose of the proposed EA is to consider the environmental and human safety implication of utilizing abate, and Permethrin (an EA for Bendiocarb the third insecticide used by this program was performed in 1989) CFR-22 regulation contain several sections which apply to this EA and therefore will be addressed. Section 216.3 (A) states that "For projects including the procurement or us of pesticides, the procedures set forth in 216.3 (B) will be followed". These procedures are:

1. The USEPA registration status of the requested pesticide.
   The basis for selection of the requested pesticide.

2. The extent to which the proposed pesticide use is part of an integrated pest management program.

3. The proposed method or methods of application, including availability of appropriate application of safety equipment.

4. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use and measures available to minimize such hazards.

5. The effectiveness of the requested pesticide for the proposed use.

6. Compatibility of the proposed pesticide with target and non target ecosystems.

7. The conditions under with which the pesticide is to be used, including climate,

- flora, fauna, geography, hydrology, and soils.

8. The availability and effectiveness of other pesticides or nonchemical control methods.

9. The requesting country's ability to regulate or control the distribution, storage, use and disposal of the requested pesticide in strict adherence to the label.

10. The provision made for training of users and applications.

11. The provisions made for monitoring the use and effectiveness of the pesticide (i.e. susceptibility trials).

12. Will the use of the pesticide impact on an endangered or threshold species?

The EA will focus on these factors and will:

1) Clarify users of insecticides usage - determine the current quantities used, procedures for application, storage, distributions and disposal.

2) Determine the efficacy of the project's proposed pesticide use minimization activities.

3) Examine possible substitute insecticide use.

D. Timing and Planning

The E.A. will be written as a result of a two person team review to the ongoing project and the proposed amendment in El Salvador. The team will visit El Salvador May 12-19. They will discuss pertinent issues with: the appropriate representatives of USAID/El Salvador, Dr Angel Guerra Sundoval, Director of Department of Malaria, and Sr. Jacobo O. Solorzano, Chief of the Entomology Section of the Department of Malaria. In addition, the team will visit field sites, to ascertain the adequacy of storage facilities and the adequacy of the safety measures used in preparation and application of the insecticides. The field sites will be determined after consultation with the mission. Before leaving El Salvador, they will submit a draft to USAID/El Salvador and will brief Mission personnel on EA recommendations. Upon returning to the US the team will complete the EA for submission to USAID/El Salvador for submission to AID/LAC.

The proposed team is composed of Dr. Stephen Landry, a Medical Entomologist, currently a AAAS Fellow with the Malaria Vaccine Development Program and

E. Conduct of Analysis and Team Composition

The Content and form of the assessment will be prepared according to the requirements of A.I.D. environmental regulations, as outlined under 22 CFR 216.

Team member will develop an action plan. Mission responsibilities include:

a) arrangement of the necessary meetings and a Spanish translator,

b) arrange for the services of Dr. Mauricio Sauerbrey to accompany the review team,

c) provide transportation and logistic support during the assessment,

d) provide a secretarial support for the preparation of the EA

e) cover all cost incurred by as indicated in cable San Salvador 05020 (Dr. Landry's expenses will be covered by AAAS)

Resumes for both team members are attached.

Appendix 2

Evaluacion de la efectividad del Abate al 1% contra *Ae. aegypti*

EVALUACION DE LA EFECTIVIDAD DEL ABATE AL 1% CONTRA A. AEGYPTI ALBIMANUS.-

Jorge Alberto Escobar
Jacobo Oscar Solórzano
Entomología - Malaria-

INTRODUCCION:

El Abate un órgano fosforado, larvicida presentado en emulsión y en forma granulada. El Abate emulsificable para tratamiento en criaderos naturales productores de larvas de mosquitos, y el Abate, granulado aplicado en colecciones artificiales, criaderos generalmente en el área urbana.

METODOLOGIA:

La evaluación del Abate, se ha realizado con larvas procedentes del Insectario del Departamento de Malaria, situado en el Departamento de la Libertad.
La evaluación del Abate, se hizo en bandejas plásticas, aplicando: uno, dos y tres gramos en 12 litros de agua de chorro.
El Abate emulsificable, se aplicó a razón de 2 cc del producto en un litro de agua y luego aplicándolo por medio de una bomba del tipo Hudson con boquilla 8002.
La lectura de la mortalidad se hizo directamente en el depósito tratado, habiéndose considerado como muertas las larvas que siendo estimuladas tocando diferentes partes del cuerpo no reaccionaron o si lo hicieron, no pudieron abandonar el piso de la bandeja. La lectura se hizo a las 24 horas despues del tratamiento.

RESULTADO:

Abate granulado con larvas de A. Aegypti, produjo las mortalidades de: 1 gramo, 94%, 2 gramos, 97.7% y 3 gramos, 96.6%, (ver cuadro Nº. 1) contra A. Albimanus, las mortalidades fueron las siguientes:
1 gramo, 69%, 2 gramos, 52% y 3 gramos, 74%, (ver cuadro Nº. 2)

.../

La mortalidad en las A. Albimanus, es menor en relación a las obtenidas con A. Aegypti, siendo probablemente una de las causas que las larvas de Anofelinos, se convierten en pupas más rapidamente.-
En cuanto al Abate emulsificable, solamente se probó contra A. Albimanus y la mortalidad fue la siguiente: 2 cc de Abate por litro, 99.8 de mortalidad, 1 cc de Abate por litro, 94.6 de mortalidad, (ver cuadro NO. 3)
La mortalidad en los controles fue para: granulado en A. Aegypti, 0% mortalidad, para A. Albimanus, del 20 al 40% de mostalidad y en cuanto al Abate emulsificable, la mortalidad fue del 0%.

CONCLUSIONES:

El Abate en forma granulada, es efectivo contra larvas de Anofelinos y Aedinos, el emulsificable produjo excelentes resultados contra Anofelinos, faltando comprobar su eficacia contra los Aedes.
Se notó diferencia en la mortalidad de Aedes contra Anófeles, porque el ciclo de Aedes es más lento y por tanto permite mayor contacto con el producto en su estado larvario.

/bama.-
8/May/91.-

CUADRO Nº 1

DEPTO. MALARIA
ENTOMOLOGIA

PRUEBAS DEL ABATE GRANULADO CON LARVAS DE AEDES *aegypti*

CANTIDAD UTILIZADA DE ABATE GRANULADO	LARVAS					LARVAS CONTROL
	Nº EXPUESTAS	VIVAS	MORTALIDAD		DESARROLLADAS A PUPAS	% MORTALIDAD
			Nº	%		
1 GRAMO	90	0	85	94.4	5	0.0
2 GRAMOS	90	0	88	97.7	2	0.0
3 GRAMOS	90	0	87	96.6	3	0.0

MAY/91

CUADRO Nº 2

DEPTO. MALARIA
ENTOMOLOGIA

PRUEBAS DEL ABATE GRANULADO CON LARVAS DE ANOFELES *albimanus*

CANTIDAD UTILIZADA DE ABATE GRANULADO	LARVAS					LARVAS CONTROL
	Nº EXPUESTAS	VIVAS	MORTALIDAD		DESARROLLADAS A PUPAS	% MORTALIDAD
			Nº	%		
1 GRAMO	100	16	69	69.0	15	20.0 A 40.0
2 GRAMOS	100	22	52	52.0	26	20.0 A 40.0
3 GRAMOS	100	10	74	74.0	16	20.0 A 40.0

TECNICAMENTE LA IMPORTANCIA DE ESTA PRUEBA ES LIMITADA. DEBIDO A QUE LA MORTALIDAD EN LOS CONTROLES RESULTO MUY ELEVADA

MAY/91

CUADRO Nº 3

DEPTO. MALARIA
ENTOMOLOGIA

PRUEBAS DEL ABATE EMULSIFICABLE CON LARVAS DE ANOFELES *albimanus*

CANTIDAD UTILIZADA DE ABATE EN EMULSION	LARVAS					LARVAS CONTROL
	Nº EXPUESTAS	VIVAS	MORTALIDAD		DESARROLLADAS A PUPAS	% MORTALIDAD
			Nº	%		
1 cc	2200	0	2082	94.6	18	0.0
2 cc	2200	0	2197	99.8	3	0.0
—	—	—	—	—	—	—

MAY/91

Table 3. [illegible] of ABATE [illegible] Mosquito Species Resistant to Organochlorine Compounds

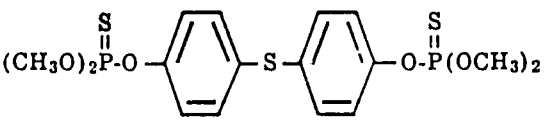
Compound	Anopheles quadrimaculatus LC ppm	Aedes aegypti LC ppm	Culex quinquefa[illegible] LC ppm
[illegible]	0.004	0.004	[illegible]
Malathion	[illegible]	0.02	[illegible]
[illegible]pyritos	0.004	0.004	[illegible]
[illegible]enthion	0.02	0.02	[illegible]
Malathion	0.5	0.5	[illegible]

Data from U.S. Department of Health, Education and Welfare. 1973. Public Health Pesticides: 1973. Pest Control 41:47-50.

GENERAL PROPERTIES:

Chemical Name.....0,0,0′,0′-tetramethyl 0,0′-thiodi-*p*-phenylene phosphorothioate

Structural Formula.....



Empirical Formula..... $C_{16}H_{20}O_6P_2S_3$

Molecular Weight.....466.4

Physical Constants.....

Analytical Grade.....white, crystalline solid. Melting point—30.0-30.5°C

Technical Grade.....light brown, moderately viscous liquid may crystallize below 15°C
Refractive index nD 25°C. — 1.586-1.588
Specific Gravity — 1.3 at 25°C.
Viscosity — 5°C. = 3000 centipoises
25°C. = 300 centipoises
40°C. = 180 centipoises
80°C. = 30 centipoises

Solubility in water.....about 25 ppb at 25°C.

Solubility in solvents.....soluble in acetonitrile, carbon tetrachloride, chloroform, ether, ethylene dichloride, lower alkyl ketones, and aromatic hydrocarbons; insoluble in hexane and methyl cyclohexane.

Stability.....Appears to be stable indefinitely at room temperature; moderately stable to hydrolysis in contact with aqueous alkali, no observed hydrolysis at pH=8 at room temperature for several weeks or at pH=11 at 40°C for several hours; hydrolysis at high pH for prolonged periods of time may be expected.

Appendix 3

Medion de la efectividad de la Permetrina (Pipetroide) al 5% sobre mosquitos, *Ae. aegypti* and *An. albimanus*

MEDICION DE LA EFECTIVIDAD DE LA PERMETRINA (PIRETROIDE) AL 5%, SOBRE MOSQUITOS, A. AEGYPTI Y A. ALBIMANUS.

Jorge Alberto Escobar
Jacobo Oscar Solórzano
Entomología - Malaria-

INTRODUCCION:

La Permetrina (Piretroide) al 5%, es un producto que se utiliza en formulaciones para ULV, bajo volumen y Termonebolización aplicado en varias áreas. Los rociamientos con la Permetrina al 5% se efectúan cuando las densidades de mosquitos sobrepasan los parámetros indicadores. Las aplicaciones comprenden el tratamiento intra y peridomiciliar, ejecutado durante las horas de mayor - actividad de los mosquitos.
Para la evaluación de la efectividad se realizaron aplicaciones especiales, en áreas previamente seleccionadas.

METODOLOGIA:

La evaluación de la efectividad de la Permetrina (Piretroide) al 5%, se realizó con mosquitos Aedes Aegypti y A. Albimanus, en diferentes áreas y distintas fechas. Los mosquitos utilizados provinieron de la colonia establecida en el Departamento de la Libertad. La exposición se realizó por medio de pequeñas jaulas; construídas de alambre y revestidas con sugitube, teniendo un pequeño ojal (agujero) para introducir y extraer los mosquitos. Para todos los ensayos se delimitó un número de 5 jaulas para representar una casa. Tambien se hizo ensayos para ver la efectividad de la Permetrina (Piretroide) al 5% en relación a la capacidad de profundidad del método ULV. Para la prueba de penetración se tomó el mínimo de 10 mts. y 100 mts, el máximo, de distancia en relación al aparato aspersor y las jaulas.

.../

En todo caso la exposición tuvo una duración de una hora (60') dejando los mosquitos 24 horas en espera en las mismas jaulas, en un sitio especial; donde hubiese luz moderada, adecuada humedad relativa y ausencia de hormigas. Las aplicaciones del producto se hicieron, cuando ya las jaulas estaban instaladas. A cada jaula se le introdujeron con el tubo capturador la cantidad de 15 mosquitos. Toda prueba tuvo su control respectivo.

RESULTADOS:

Para el A. Aegypti la mortalidad final producida por la Permetrina, fue muy variable que asciló entre el 0.0 al 88.6% (ver cuadro Nº. 1), con - ULV, se realizarón seis (6) ensayos con A. Aegypti y tres (3) con A. Albimanus. El número total de mosquitos utilizados para cada especie fue variable. En cuanto a la mortalidad dentro de las casas, esta varió del 5.3% al 88.0%.

La aplicación bajo volumen (BV) y Termonebolización, produjeron mejores resultados (ver cuadro número 2).

CONCLUSIONES:

La Permetrina (Piretroide) 5%, en formulación ULV, la mortalidad que se obtiene es muy baja, (ver cuadro Nº. 1) probablemente porque es la aplicación que tiene la mayor cantidad de barreras, impidiendo que se realice al contacto directo entre la Permetrina y el mosquito. Cuando se obtiene buena mortalidad ésta es a costa de las jaulas que tuvieron mejor y mayor contacto con el producto.

La Permetrina (Piretroide) 5%, produjo excelentes resultados, cuando las formulaciones fueron: bajo volumen y Termonebolización. (ver cuadro Nº. 2)

/bama.-
8/May/91.-

CUADRO Nº 1

DEPTO. MALARIA
ENTOMOLOGIA

TRATAMIENTOS CON INSECTICIDA PERMETRINA A ULV

FECHA	MOSQUITOS			CONTROL % MORTALIDAD	LUGAR DE LOS ENSAYOS
	EXPUESTOS	MUERTOS	% MORTALIDAD		
12/SEP/86	AN 30	7	23.3	0.0	HDA. SANTA LUCIA MP/ OLOCUILTA C/SANTA LUCIA DP/ LA PAZ
24/SEP/87	AE 75	0	0.0	0.0	COLONIA MONSERRAT MP / SAN SALVADOR M/SAN SALVADOR DP/ " "
" " "	AN 150	3	2.0	0.0	" " " " "
" " "	AN 180	19	10.5	0.0	CEMENTERIO LA BERMEJA M/SAN SALVADOR " " "
1/OCT/"	AE 75	0	0.0	0.0	COLONIA 10 DE SEP. M/SAN SALVADOR " " "
" " "	AN 180	6	3.3	0.0	" " " " "
" " "	AE 45	3	6.6	4.4	" " " " "
" " "	AN 135	33	24.4	4.4	" " " " "
15/DIC/"	AE 150	133	88.6	0.0	COLONIA MONSERRAT M/SAN SALVADOR " " "
16 " "	AE 148	23	15.5	0.0	" " " " "
17/MAR/88	AN 150	38	25.3	0.0	SAN BLAS MP/ LA LIBERTAD C/MAJAHUAL DP/ " "
" " "	AN 125	110	88.0	0.0	" " " " "
" " "	AN 75	4	5.3	0.0	" " " " "
" " "	AE 50	4	8.0	0.0	" " " " "
17/SEP/91	AN 150	48	32.0	0.0	COLONIA LAS PALMAS MP/ SAN SALVADOR M/SAN SALVADOR DP/ " "
" " "	AN 75	59	78.6	0.0	" " " " "

AN _ ANOFELES
AE _ AEDES

MAY/91

CUADRO N° 2

DEPTO. MALARIA
ENTOMOLOGIA

TRATAMIENTOS CON INSECTICIDA PERMETRINA A BAJO VOLUMEN Y TERMICO

FECHA	TIPO DE APLICACION		MOSQUITOS			CONTROL	LUGAR DE LOS ENSAYOS	
	BAJO VOLUMEN	TERMICA	EXPUESTOS	MUERTOS	% MORTALIDAD	% MORTALIDAD		
13/JUL/87	X		AN 75	75	100.	0.0	B° LA CHURLA M/SAN DIONISIO	MP/SAN DIONISIO DP/USULUTAN
7/DIC/"	X		AE 40	39	97.5	0.0	COL. MONSERRAT M/SAN SALVADOR	MP/SAN SALVADOR DP/ " "
9 " "	X		AN 20	20	100.	0.0	COL. SANTA CLARA M/CUSCATANCINGO	MP/CUSCATANCINGO DP/SAN SALVADOR
" " "	X		AN 20	20	100.	0.0	" "	" " "
17/OCT/88		X	AN 75	75	100.	0.0	EL CENTRO C/ISLA MENDEZ	MP/JIQUISCO DP/USULUTAN
18 " "	X		AN 75	75	100.	0.0	" "	" "
4/SEP/89	X		AN 75	75	100.	0.0	CAMALOTE C/SALINAS	MP/USULUTAN DP/ "
5 " "	X		AN 75	75	100.	0.0	" "	" "
13 " "		X	AN 75	73	97.3	0.0	PUERTO PARADA C/SALINAS	" " " "
14 " "		X	AN 75	29	38.6	0.0	" "	" "
25/ENE/90		X	AN 50	50	100.	0.0	EL LINDERO C/SAN FRANCISCO	MP/SAN ILDEFONSO DP/SAN VICENTE

AN _ ANOFELES
AE _ AEDES

MAY/91

FORMULACIONES

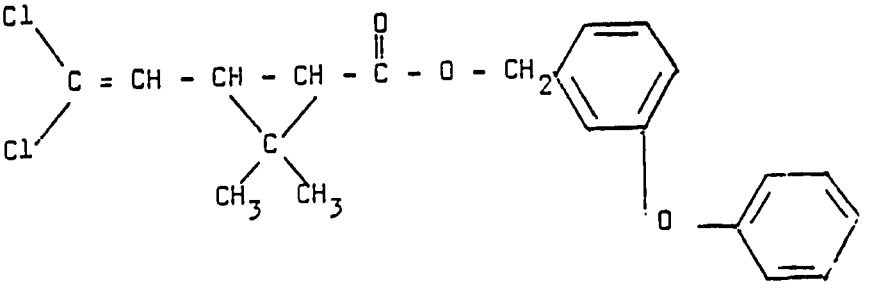
Las formulaciones siguientes están disponibles:-

- concentrado emulsionable al 25%
- polvo humectable al 25%
- concentrado emulsionable al 10%
- formulación UBV al 10%
- formulación UBV al 5%
- formulación para nebulización al 5%

Estabilidad durante el almacenamiento: Estas formulaciones se almacenan de modo satisfactorio en los envases de venta nunca abiertos durante un período mínimo de dos años en condiciones normales de almacenamiento, es decir protegidas de las heladas y la luz directa del sol.

Propiedades corrosivas: Las formulaciones no son corrosivas para el aluminio ni el acero dulce laqueado.

PROPIEDADES QUIMICAS Y FISICAS

Nombre químico	:	Carboxilato de 3-fenoxibencil (+) *cis*, *trans* 3-(2,2-diclorovinil)-2,2-dimetil-ciclopropano.
Nombre común	:	Permetrina
Número de código	:	PP557
Fórmula molecular	:	$C_{21}H_{20}O_3Cl_2$
Peso molecular	:	391,28
Fórmula estructural	:	
Mezcla de isómeros	:	40% cis : 60% trans
Solubilidad	:	Miscible con la mayor parte de los disolventes orgánicos.

Appendix 4

Labels for Permethrin and Temephos

MINISTERIO DE SALUD PUBLICA Y ASISTENCIA SOCIAL - ATT: PROVEEDURIA
CALLE ARCE NO. 827
SAN SALVADOR, EL SALVADOR, C.A.
RIO/C 519-0308-5-70138
P.O. OPS-P-OX203-1

P-Y-R-E-T-H-R-O-I-D (PERMETHRIN)

5% CONCENTRATE

FOR EXPORT ONLY FOR EXPORT ONLY

ACTIVE INGREDIENT:
Permethrin - (3-phenoxyphenyl)-methyl (±) cis-trans 3-(2,2-dichloroethenyl) -2,2-dimethyl-cyclopropanecarboxylate 5.0
INERT INGREDIENTS: 95.0
TOTAL 100.0

EPA EST. No. 6720-FL-1

KEEP OUT OF REACH OF CHILDREN

CAUTION

STATEMENT OF PRACTICAL TREATMENT

If in eye: Flush eyes with water for 15 minutes. Call a physicia
If swallowed: Do Not induce vomiting. Call a physician.
If on skin: Remove contaminated clothing. Wash with plenty of soa and water. Get medical attention if irritation persists.
Note to Physician: Vomiting should be supervised by a physician the professional staff because of the possibility of pulmonary damages by aspiration of solvent.
Precautionary Statements: Hazards to Humans and Domestic Animals
Caution: Harmful if swallowed or absorbed through skin. Causes moderate eye irritation. Avoid contact with eyes, skin or clothing. Wash throughly after handling. Remove and wash clothing before reuse.
ENVIRONMENTAL HAZARDS: This product is highly toxic to bees expo ed to direct treatment or residues on crops or weeds. Do not app this product or allow it to drift to crops or weeds on which bee are actively foraging.

PHYSICAL OR CHEMICAL HAZARDS: Do not use or store near heat or open flame.

MANUFACTURED BY
SOUTHERN MILL CREEK PRODUCTS COMPANY, INC
5414 N. 56TH STREET TAMPA, FL 33610

NET CONTENT 5 GALLON

MARMAN

TEMEFOS 1%

GRANULADO A BASE DE ARENA PARA APLICACIÓN DIRECTA
CONFORME A LA ESPECIFICACIÓN WHO/IS/5.0786-2

INGREDIENTE ACTIVO:
O,O,O',O'-TETRAMETIL-O,O' (TIODI-4,1-FENILENO)
TIOFOSFATO (TEMEFOS) ..... 10 GM/KG

PRECAUCION

EL TEMEFÓS ES UN COMPUESTO ORGANOFOSFORADO QUE INHIBE LA COLINESTERASA.

GUÁRDESE FUERA DE LA ALCANCE DE LOS NIÑOS Y LEJOS DE LOS COMESTIBLES DE LOS PIENSOS Y FORRAJES Y DE LOS RESIPIENTES DESTINADOS A CONTENERLOS.

EN CASO DE INTOXICACION LLÁMESE A UN MEDICO.

PESO NETO: 25 KG
NUMERO DE LOTE

MANUFACTURADO POR:
MARMAN (USA) INC.
5401 W. KENNEDY BLVD. 388, TAMPA, FLORIDA USA
TELEFONO (813) [illegible]-5503 TELEX 522603 MARMAN USA

Appendix 5

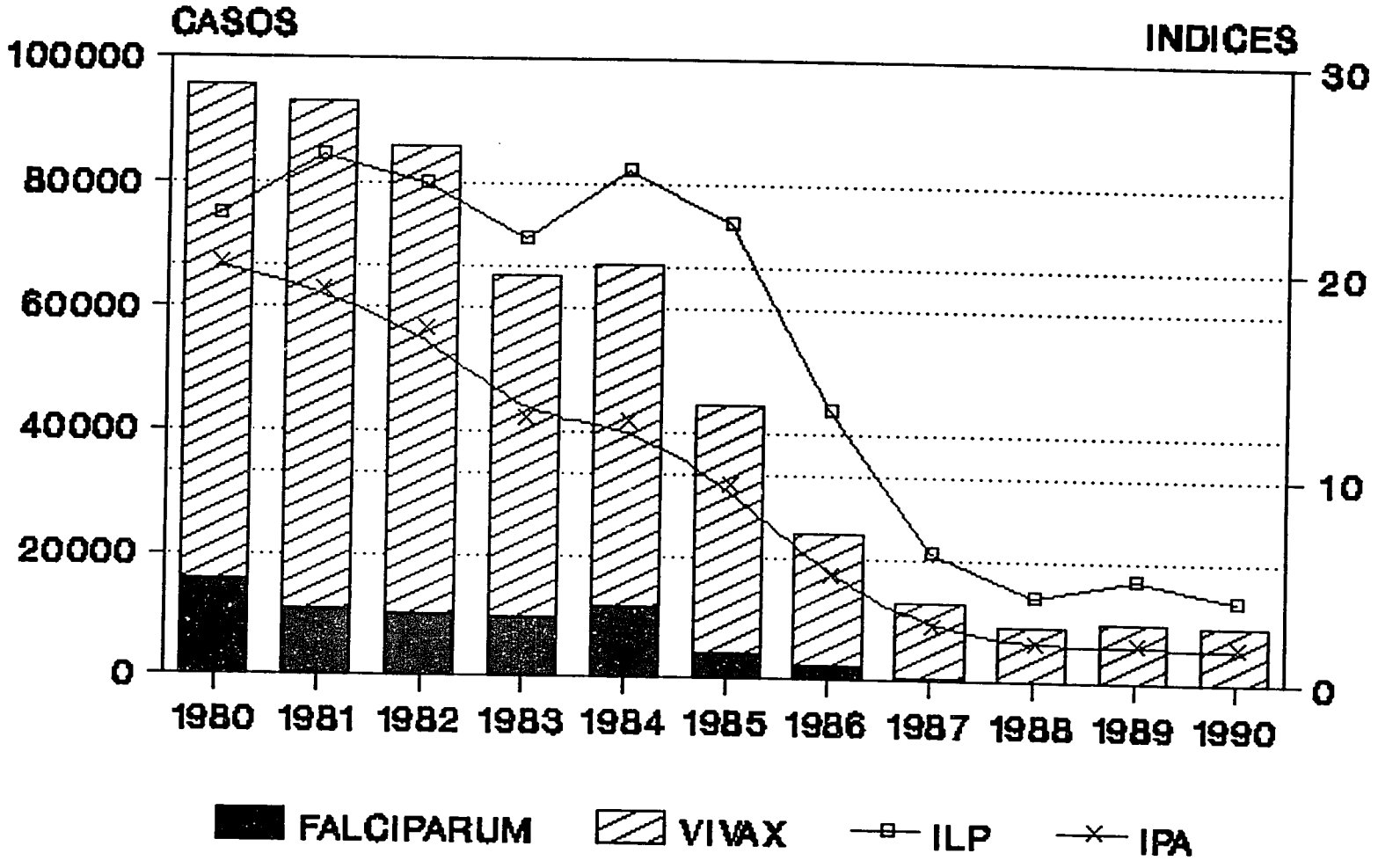
Cronograma de Actividades 1989 Departamento de Malaria

DEPARTAMENTO DE MALARIA

CRONOGRAMA DE ACTIVIDADES 1989

MEDIDAS DE CONTROL	MESES											
	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPTIEMBRE	OCTUBRE	NOVIEMBRE	DICIEMBRE
ROCIADO INTRADOMICILIAR RESIDUAL (PROPOXUR)												
APLICACION DE LARVICIDA (ABATE)												
ROCIADO ESPACIAL A ULTRA BAJO VOLUMEN (PIRETROIDE)												
CONSTRUCCION Y MANTENIMIENTO DE OBRAS FISICAS Y DRENAJE DE ESTEROS, RIOS ETC.												
DISTRIBUCION DE MEDICAMENTOS A TRAVEZ DE COLABORADORES VOLUNTARIOS, SERVIC. GRALES DE SALU TRATAM. MASIVO Y TRATAM. RADICAL												
TOMA DE MUESTRAS HEMATICAS												
DIAGNOSTICO MICROSCOPICO DE MUESTRAS HEMATICAS												
MEDICION DE PARAMETROS ENTOMOLOGICOS												
ENCUESTAS PARASITOLOGICAS			1a ENCUESTA			2a ENCUESTA				3a ENCUESTA		
PROMOCION Y PARTICIPACION DE LA COMUNIDAD												
CAPACITACION DE PERSONAL												
TRIMESTRES	PRIMERO			SEGUNDO			TERCERO			CUARTO		

EVOLUCION MALARICA - EL SALVADOR
1980 - 1990



FUENTE: Departamento de Malaria

Appendix 6

Areas Epidemiologicas en el Pais

ILICA DE EL SALVADOR

MINISTERIO DE SALUD PUBLICA Y ASISTENCIA SOCIAL

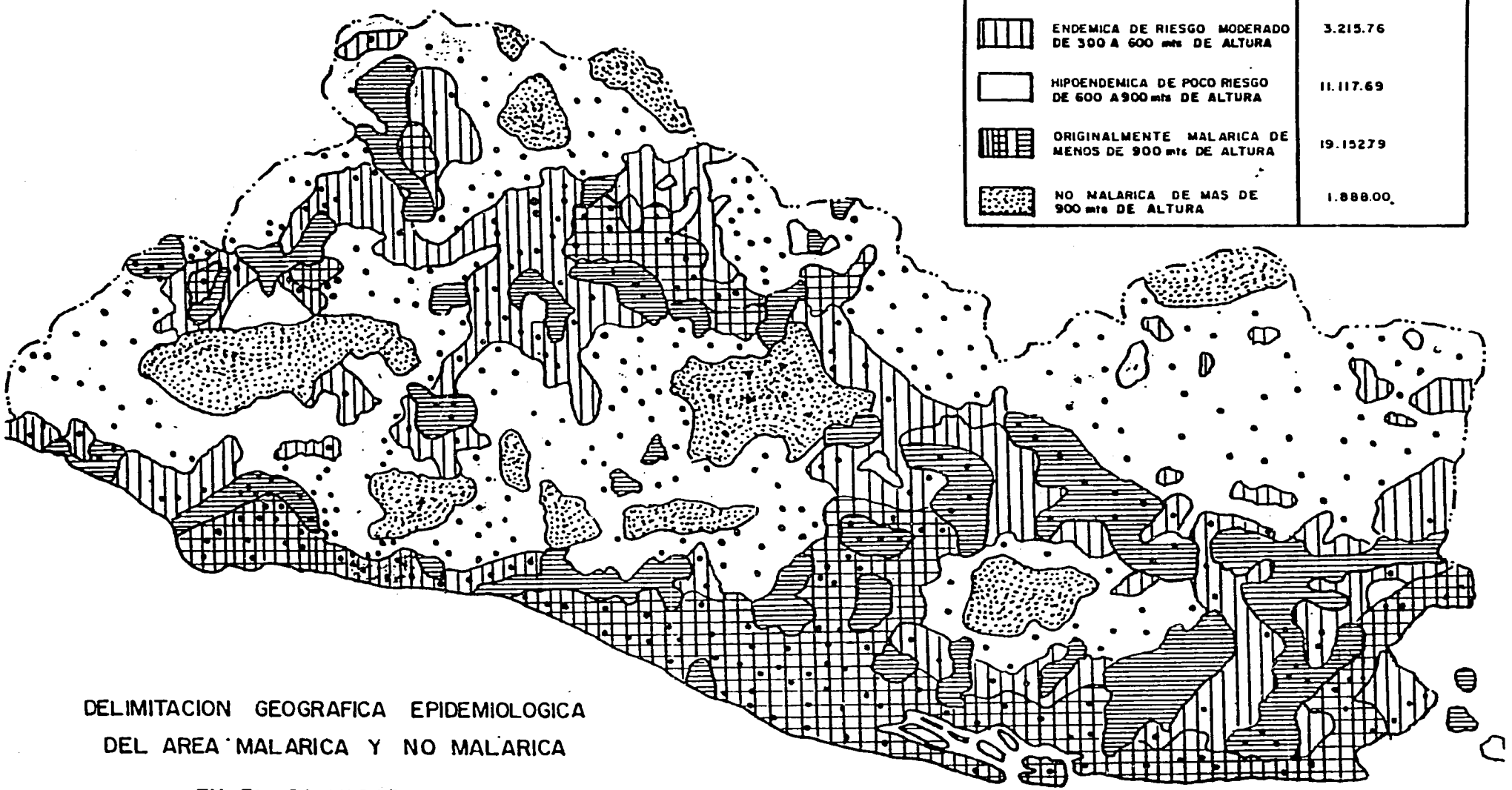
DEPARTAMENTO DE MALARIA

1988

TOTAL AREA DEL PAIS 21.040.79 km²

AREAS EPIDEMIOLOGICAS Y ● DISTRIBUCION DE LOS COLABORADORES VOLUNTARIOS EN EL PAIS

AREA EPIDEMIOLOGICA	AREA Km²
HIPERENDEMICA DE 1ª PRIORIDAD DE 0 A 100 mts DE ALTURA	2.590.97
HIPERENDEMICA DE 2ª PRIORIDAD DE 100 A 300mts DE ALTURA	2.228.37
ENDEMICA DE RIESGO MODERADO DE 300 A 600 mts DE ALTURA	3.215.76
HIPOENDEMICA DE POCO RIESGO DE 600 A 900 mts DE ALTURA	11.117.69
ORIGINALMENTE MALARICA DE MENOS DE 900 mts DE ALTURA	19.152.79
NO MALARICA DE MAS DE 900 mts DE ALTURA	1.888.00

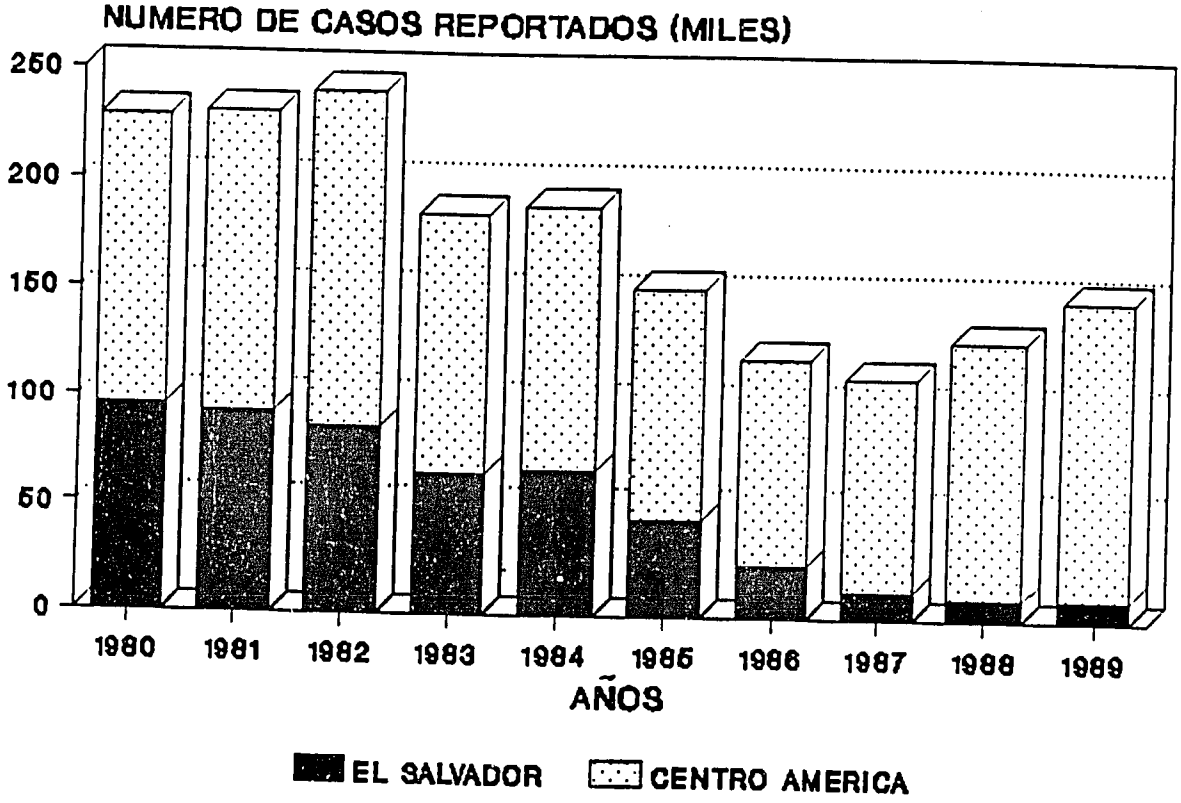


DELIMITACION GEOGRAFICA EPIDEMIOLOGICA DEL AREA MALARICA Y NO MALARICA EN EL SALVADOR C.A.

Appendix 7

Graficas de Estadisticas sobre Malaria en el Pais (5)

EVOLUCION DE LA MALARIA: CENTRO AMERICA
1980 - 1989



INCIDENCIA DE MALARIA EN CENTRO AMERICA

1989

PAIS	I P A *	P. falciparum %
BELICE	18.5	2.1
NICARAGUA	12.3	3.7
HONDURAS	9.2	0.8
GUATEMALA	4.7	2.7
EL SALVADOR	1.8	0.4
COSTA RICA	0.24	4.4
PANAMA	0.18	20.0

* Por cada 1000 habitantes.

Saue3a
MS/spf

MINISTERIO DE SALUD PUBLICA Y ASISTENCIA SOCIAL

DEPARTAMENTO DE MALARIA

EVOLUCION MALARICA: AÑOS 1957-1990

AÑO	POBLACION	LAMINAS	TOTAL CASOS	VIVAX	FALCIP.	IPA	TASA X 100,000 HBS
1957	2,257,000	29,171	6,661	3,655	3,006	3.	295
1958	2,320,000	56,095	10,925	5,854	5,071	4.7	471
1959	2,386,000	71,295	17,521	13,470	4,051	7.3	434
1960	2,453,000	76,287	10,066	7,106	2,960	4.1	410
1961	2,526,000	127,293	12,563	9,599	2,964	5.	497
1962	2,622,164	194,069	15,433	12,872	2,561	5.9	588
1963	2,720,696	238,791	17,846	15,962	1,884	6.6	656
1964	2,676,696	350,843	25,857	23,195	2,662	9.7	966
1965	2,842,432	508,933	34,217	32,028	2,189	12.	1,204
1966	2,936,233	533,047	68,562	57,859	10,703	23.4	2,335
1967	3,110,271	535,494	82,961	75,734	7,227	26.7	2,667
1968	3,214,490	805,311	35,831	34,806	1,025	11.1	1,115
1969	3,322,241	858,916	25,299	23,305	1,994	7.6	761
1970	3,512,283	572,373	45,436	41,150	4,286	12.9	1,293
1971	3,687,012	414,331	46,858	43,623	3,235	12.7	1,271
1972	3,771,765	394,935	38,335	35,276	3,059	10.2	1,016
1973	3,800,333	393,110	35,095	27,809	7,286	9.2	923
1974	3,931,702	478,553	66,691	53,558	13,133	17.	1,696
1975	4,090,000	538,909	83,100	66,791	16,309	20.3	2,032
1976	4,217,729	533,610	83,290	69,470	13,820	19.8	1,975
1977	4,496,165	471,109	32,243	29,300	2,943	7.2	717
1978	4,523,172	507,237	56,533	47,899	8,634	12.5	1,250
1979	4,653,246	434,475	75,657	62,266	13,391	16.3	1,626
1980	4,796,974	425,264	95,835	80,053	15,782	20.	1,998
1981	4,945,953	367,447	93,187	82,300	10,887	18.8	1,884
1982	5,100,991	351,426	86,202	75,939	10,263	16.9	1,690
1983	5,229,096	306,648	65,377	55,681	9,696	12.5	1,250
1984	5,402,893	270,156	66,874	55,292	11,582	12.4	1,238
1985	4,716,176	201,177	44,473	40,100	4,373	9.4	943
1986	4,805,865	182,622	23,953	21,558	2,395	5.	498
1987	4,933,835	200,654	12,834	12,236	598	2.6	260
1988	5,031,484	213,518	9,095	8,975	120	1.8	180
1989	5,137,707	190.955	9,605	9,565	40	1.86	186
1990	5,251,672	230,246	9269 -	9,251	18	1.76	176
1991 (21 weeks)							

MINISTERIO DE SALUD PUBLICA Y ASISTENCIA SOCIAL

DEPARTAMENTO DE MALARIA

CLASIFICACION DE AREAS SEGUN EL POTENCIAL MALARICO COMPRENDIENDO SUPERFICIE, POBLACION, MUESTREO Y PORCENTAJE DEL NUMERO DE CASOS E INDICADORES MALORIOMETRICOS - 1989.

AREA	KMs2	% DEL PAIS	POBLACION	% DEL TOTAL DEL PAIS	NUMERO DE CASOS POR AREA	MUESTRAS COLECTADAS POR AREA.	% DE CASOS POR AREA	IAES	ILP	IPA
MALARICA	1.888	9	513.771	10	0	0	0			
POENDEMICA (BAJO RIESGO), DE 1-29 SOS X ANO. SE INCLUYEN ALGUNAS EAS URBANAS *	11.118	53	3.236.755	63	296	11.979	3.0	0.37	2.4	0.14
DEMICA (MODERADO RIESGO), DE 59 CASOS X ANO.	3.216	15	462.394	9	887	29.320	9.6	6.34	3.0	1.9
ERENDEMICA (ALTO RIESGO) MAS DE CASOS X ANO	4.819	23	924.787	18	8.412	149.696	87.5	16.1	5.6	10.0
SA MALARICA	19.513	91	4.623.936	90	9.605	190.995	100.0	0.0	0.0	0.01
TOTAL PAIS	21.041	100	5.137.707	100	9.605	190.995	100.00	3.7	5.0	1.86

as areas urbanas consideradas son: San Salvador, Santa Ana, Ahuchapan, Sonsonate, Santa Tecla, Zacatecoluca, Usulutan, San Miguel y La Union

ente de Informacion: Departamento de Malaria - Ministerio de Salud Publica.

Appendix 8

Permethrin: Specifications, Methods of Determining Chemical and Physical Properties

Appendix 10

Summary of the Quantities of Insecticides Purchased for/by the Malaria Control Program in El Salvador (1985-1991)

OFICIO No 91-9531-27

Junio, 06

FECHA

MINISTERIO DE SALUD PUBLICA
Y ASISTENCIA SOCIAL
Calle Arce No 827
San Salvador, El Salvador, C. A
Telex 20704 - MSPAS - SAL
Teléfono 22-40 27

SCA-02-No.

Señores,
A.I.D.
Presente.

AÑO	ABTE GRANULADO	ABATE EMULSION	PERMETRINA 5%
1985	30,000 Kgs.	3,000 Gls.	-.-
1986	-.-	-.-	3,000 Gls.
1987	-.-	-.-	500 Gls.
1988	6,000 Kgs.	-.-	1,900 Gls.
1989	-.-	-.-	-.-
1990	-.-	-.-	-.-
1991	10,000 Kgs.	750 Gls.	2,000 Gls.
TOTALES	46,000 Kgs.	3,750 Gls.	7,400 Gls.

CANTIDADES DE LARVICIDAS Y ADULTICIDAS USADOS EN EL DEPARTAMENTO DE MALARIA, DE 1985 A LA FECHA, EN EL CONTROL DE LA MALARIA.

Muy Cordialmente,

DIRECCION GENERAL DE SALUD - EL SALVADOR, C.A. - DIVISION DE MALARIA

Dr. Angel Guerra Sandoval,
Director de Malaria.

AL CONTESTAR ESTE DOCUMENTO CITESE LA FECHA Y EL NUMERO DE OFICIO
DEPARTAMENTO DE CORRESPONDENCIA Y ARCHIVO (FORMULARIO - SCA 07)

Appendix 11

Sample Outputs of the GOES Malaria Department's Information Management System

Dpto. de Malaria, MSPAS. El Salvador
Sistema de Informacion de Malaria
Reporte Epidemiologico de Casos del Pais, Semana : 21

29/05/91
10:01:41

Agrupacion	....Colaborador Voluntario...				.....Busqueda Activa.....				.....Servicio Medico.....				.....Encuestas Especiales...			
	Lam.Exa.	Vivax	Falci.	Asoc.	Lam.Exa.	Vivax	Falci.	Asoc.	Lam.Exa.	Vivax	Falci.	Asoc.	Lam.Exa.	Vivax	Falci.	Asoc.
DPTOS.																
SANTA ANA	95	5	0	0	0	0	0	0	8	3	0	0	0	0	0	0
AHUACHAPAN	137	12	0	0	117	1	0	0	42	1	0	0	0	0	0	0
SONSONATE	136	15	0	0	6	1	0	0	9	1	0	0	0	0	0	0
LA LIBERTAD	245	24	0	0	311	1	0	0	2	0	0	0	0	0	0	0
CHALATENANGO	136	6	0	0	76	0	0	0	13	1	0	0	0	0	0	0
SAN SALVADOR	168	4	0	0	247	0	0	0	59	0	0	0	0	0	0	0
CUSCATLAN	5	0	0	0	23	0	0	0	15	0	0	0	0	0	0	0
LA PAZ	122	4	0	0	60	1	0	0	28	0	0	0	0	0	0	0
CABAÑAS	19	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAN VICENTE	51	2	0	0	7	0	0	0	6	0	0	0	0	0	0	0
USULUTAN	444	2	0	0	41	0	0	0	21	0	0	0	0	0	0	0
SAN MIGUEL	212	5	0	0	29	0	0	0	31	2	0	0	0	0	0	0
MORAZAN	25	1	0	0	0	0	0	0	6	0	0	0	0	0	0	0
LA UNION	272	9	0	0	137	1	0	0	27	0	0	0	0	0	0	0
PRIORIDAD																
- 1	1,869	37	0	0	1,016	5	0	0	307	8	0	0	0	0	0	0
- 2	21	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-3	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0
-4	277	2	0	0	36	0	0	0	12	0	0	0	0	0	0	0
->5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REGIONES																
Occidental	466	33	0	0	123	2	0	0	59	5	0	0	0	0	0	0
Central	361	30	0	0	387	1	0	0	15	1	0	0	0	0	0	0
Metropolitana	168	4	0	0	247	0	0	0	59	0	0	0	0	0	0	0
Paracentral	197	7	0	0	90	1	0	0	52	0	0	0	0	0	0	0
Oriental	853	17	0	0	207	1	0	0	135	2	0	0	0	0	0	0

Agrupacion 1991	....Colaborador voluntario...				.....Busqueda Activa.....				.....Servicio Medico.....				.....Encuestas Especiales...			
	Lam.Exa.	Vivax	Falci.	Asoc.	Lam.Exa.	Vivax	Falci.	Asoc.	Lam.Exa.	Vivax	Falci.	Asoc.	Lam.Exa.	Vivax	Falci.	Asoc.
Semana	2,187	41	0	0	1,054	5	0	0	320	8	0	0	0	0	0	0
M e s	7,086	292	0	0	3,412	14	0	0	1,164	21	0	0	260	0	0	0
A n o	33,643	1,810	6	0	12,274	121	1	0	5,221	106	0	0	12,764	42	0	0

Agrupacion 1990	....Colaborador Voluntario...				.....Busqueda Activa.....				.....Servicio Medico.....				.....Encuestas Especiales...			
	Lam.Exa.	Vivax	Falci.	Asoc.	Lam.Exa.	Vivax	Falci.	Asoc.	Lam.Exa.	Vivax	Falci.	Asoc.	Lam.Exa.	Vivax	Falci.	Asoc.
Semana	2,793	116	0	0	729	12	0	0	359	8	0	0	0	0	0	0
M e s	9,325	422	0	0	3,290	26	0	0	1,252	19	0	0	0	0	0	0
A n o	44,126	2,422	7	0	20,779	104	1	0	5,868	112	0	0	1	0	0	0

Mes de Tora:	Muestras del Mes...				.Muestras del Mes Anterior..				.Muestra.de hace 2 ó + Meses			
	Lam.Exa.	Vivax	Falci.	Asoc.	Lam.Exa.	Vivax	Falci.	Asoc.	Lam.Exa.	Vivax	Falci.	Asoc.
Occidental	207	49	0	0	35	0	0	0	8	0	0	0
Central	859	18	0	0	222	13	0	0	2	1	0	0
Metropolitana	247	1	0	0	75	0	0	0	2	1	0	0
Paracentral	308	3	0	0	31	0	0	0	0	0	0	0
Oriental	1,130	17	0	0	149	2	0	0	16	1	0	0
T o t a l	3,001	87	0	0	512	15	0	0	28	2	0	0

65

June 3, 1991

DEPARTAMENTO DE MALARIA, MINISTERIO DE SALUD, EL SALVADOR
Reporte Semanal por Departamento y sus Localidades

SEMANA: 21
DEPARTAMENTO: LA LIBERTAD

LOCALIDAD	ESTA SEMANA				ULTIMAS 4 SEMANAS				ACUMULADO ANUAL			
	FAL	VIV	POS	LAM	FAL	VIV	POS	LAM	FAL	VIV	POS	LAM
SN. LUIS EL GUI	0	0	0	0	0	0	0	0	0	0	0	2
LA REDONDA	0	0	0	0	0	0	0	0	0	0	0	4
EL JICARO	0	0	0	0	0	0	0	0	0	1	1	1
CAS. EL ROSARIO	0	0	0	0	0	0	0	2	0	1	1	9
STA. MARIA	0	0	0	0	0	0	0	0	0	0	0	6
LA SHILA	0	0	0	0	0	0	0	0	0	0	0	5
EL SITIO	0	0	0	0	0	0	0	0	0	0	0	12
CAS. EL COMBO	0	0	0	0	0	0	0	1	0	0	0	11
SANTA ISABEL	0	0	0	0	0	0	0	2	0	0	0	3
EL CENTRO	0	0	0	0	0	0	0	2	0	0	0	2
EL CALVARIO	0	0	0	0	0	0	0	1	0	0	0	3
AGUACAYO	0	0	0	0	0	0	0	0	0	0	0	2
EL ANGEL	0	0	0	0	0	0	0	1	0	0	0	3
LAS PENITAS	0	0	0	0	0	0	0	1	0	0	0	1
SANTA LEONOR	0	0	0	1	0	0	0	1	0	0	0	1
EL CAMPAMENTO	0	1	1	3	0	2	2	6	0	4	4	25
EL PITAL	0	0	0	0	0	0	0	0	0	2	2	20
EL MIZATA	0	0	0	0	0	0	0	0	0	0	0	6
TEXICIO	0	0	0	0	0	0	0	3	0	1	1	25
CANOAS	0	0	0	1	0	0	0	2	0	0	0	24
ULATA	0	1	1	2	0	1	1	2	0	3	3	10
SAN BENITO	0	0	0	0	0	0	0	1	0	0	0	2
SAN MARCOS	0	0	0	0	0	0	0	1	0	0	0	1
EL RIYON	0	1	1	2	0	1	1	8	0	1	1	19

June 3, 1991

DEPARTAMENTO DE MALARIA, MINISTERIO DE SALUD, EL SALVADOR
Reporte Semanal por Departamento y sus Localidades

SEMANA: 21
DEPARTAMENTO: LA LIBERTAD

LOCALIDAD	ESTA SEMANA				ULTIMAS 4 SEMANAS				ACUMULADO ANUAL			
	FAL	VIV	POS	LAM	FAL	VIV	POS	LAM	FAL	VIV	POS	LAM
LA VEGA	0	0	0	2	0	0	0	3	0	1	1	27
LA PLAYA	0	0	0	5	0	0	0	7	0	4	4	25
HDA.VIEJA	0	0	0	0	0	0	0	1	0	0	0	19
LA CEIBITA	0	0	0	0	0	0	0	0	0	0	0	6
LA CEIBA	0	0	0	0	0	0	0	0	0	0	0	3
CACHO DE ORO	0	0	0	0	0	0	0	4	0	0	0	4
EL CENTRO	0	0	0	0	0	0	0	1	0	0	0	7
EL CALVARIO	0	0	0	0	0	0	0	1	0	0	0	7
AMAQUILCO	0	0	0	0	0	0	0	0	0	0	0	10
LA ESPERANZA	0	0	0	0	0	0	0	0	0	0	0	5
LA LIMA	0	0	0	0	0	0	0	2	0	0	0	13
EL ALMENDRAL	0	0	0	0	0	0	0	2	0	0	0	4
LOS ANGELES	0	0	0	0	0	0	0	1	0	0	0	1
OJOS DE AGUA	0	0	0	0	0	0	0	0	0	0	0	4
LOS LOTES	0	0	0	0	0	0	0	5	0	0	0	12
TILAPA	0	0	0	0	0	0	0	7	0	0	0	24
EL CENTRO	0	0	0	0	0	0	0	0	0	0	0	4
EL CALVARIO	0	0	0	0	0	0	0	0	0	0	0	1
SAN SEBASTIAN	0	0	0	0	0	0	0	0	0	0	0	2
EL MOJON	0	0	0	0	0	0	0	0	0	1	1	1
LA JAVIA	0	0	0	0	0	0	0	1	0	0	0	1
LAS FLORES	0	0	0	0	0	0	0	0	0	0	0	1
EL CASTILLO	0	0	0	0	0	0	0	1	0	0	0	5
CASA BLANCA	0	0	0	0	0	0	0	0	0	0	0	2