

MOSQUITO SURVEYS

I. PURPOSE

Surveys form the basis for all mosquito control activities. Random larviciding or weekly adulticiding may seem easier to manage, but this approach is expensive and often ineffective. Surveys assess the need for and evaluate the effectiveness of a control program by determining:

- Location of breeding sites
- Species present
- Distribution and abundance of mosquitoes

Surveys are also used to collect and test mosquitoes for the presence of arboviruses, thereby assessing the potential for disease outbreaks and risk to the public health. The best surveillance programs are long-term, proactive projects, gathering data and analyzing trends over time to use as a basis for program decisions.

Mosquito surveillance is comprised of two basic activities:

- Identifying, mapping and monitoring larval habitats
- Monitoring adult activity

II. LARVAL SURVEYS

Mapping and monitoring larval habitats gives early estimates of future adult densities and provides the information necessary to eliminate mosquitoes at the source.

A. LOCATING AND MAPPING BREEDING SITES:

1. Use maps and aerial photos to locate and mark places where mosquito breeding is likely to occur, e.g., where water is likely to be retained:
 - a. low-lying vegetated areas
 - b. marshes
 - c. ponds
 - d. riverbeds and backwaters
 - e. valleys
 - f. bogs
 - g. irrigated fields and pastures
 - h. wooded areas
 - i. areas of poorly drained soils
 - j. grasslands and meadows
 - k. in urban areas, note: ditches, culverts, catch basins, street gutters, waste lagoons, swimming pools
2. Choose maps that show urbanized areas, outdoor recreation sites, major features, topography, vegetative cover and water resources. U.S.G.S. topographic maps are recommended; the 7½ minute maps (covering 7½

minutes of latitude and longitude) are in an easy-to-use scale of 1:24,000 where 1 inch = 2,000 feet.

3. Other useful maps are soil maps, vegetation maps, irrigation conservancy district strip maps, and aerial photos. On aerial photos, darkly shaded areas often indicate permanent water sites. Lightly shaded areas around these are usually cattails or grasses. Always check the dates the maps were made; man-made features can change.
4. Survey potential sites found on the map to confirm and measure mosquito-breeding productivity (this is called "ground-truthing"). **IDENTIFY AND RECORD PRODUCTIVE BREEDING SITES ON YOUR MAP.** Doing so has several advantages:
 - a. It provides a permanent record to provide for program continuity.
 - b. Maps serve to orient field personnel.
 - c. They can show the magnitude of the problem at a glance and serve as the basis for budgetary requests.
 - d. When numbered and/or named, the mapped sites provide a common terminology for use by all mosquito control program personnel.
 - e. Supervisory personnel can establish program priorities by showing which sites are closest to human habitation.
 - f. It is helpful to have two sets of identical maps: one for the office to use as a wall display, and a working set to carry into the field.
5. Use the "Mosquito Surveillance and Insecticide Usage Report" form (included in this section) or one of your own creation to record the name and location of each breeding site (corresponding to your maps), access to the site, approximate size in acres, and a description of its characteristics (refer to example). Identify the site so that anyone reading the information could also find it.
 - a. In urban areas, use street intersections, residential and business addresses, park names, etc.
 - b. In rural areas, use other approved systems, such as the township, range and section method. Identify sites in regard to easily identified points of reference such as highway intersections, lakes, streams, hilltops, or other natural features.
 - c. The most accurate way to locate a site is using Global Positioning System receivers that record the latitude and longitude. Hand held receivers are not nearly as expensive as they once were and give accurate readings to within a few yards.
6. Additional record-keeping devices are:
 - a. Graphs and charts to show mosquito population densities over time;
 - b. Photographs of breeding sites mounted in loose-leaf binder.

B. MONITORING LARVAL HABITATS:

1. Conduct routine larval surveys every 7 to 14 days, depending on rainfall, characteristics of the site and its history. The standard equipment for larval surveys is the dipper, a white enamel or plastic cup attached to a 3-4 ft. long wooden dowel.
 - a. Take a minimum of 10 dips per acre.
 - b. Determine average number of larvae and pupae per dip and record on "Mosquito Surveillance and Insecticide Usage Report" form (see example).
 - c. Collect larvae for species determination; at least a 10-power dissecting microscope and identification key (Mosquitoes of North America North of Mexico, Darsie and Ward) are required. Alternately, specimens may be sent to the Zoonoses Program in Santa Fe for identification (see "Specimen Submission", below, for details).
2. Factors in determining which mosquito breeding sites should be controlled are:
 - a. Number of breeding acres
 - b. Productivity (average dip count)
 - c. Flight range of mosquito species found (to determine what percentage are likely to reach the human population)
 - d. Number of broods that will come from the breeding site (based on your knowledge of the characteristics of the site and the bionomics of the mosquito species)
 - e. Vector and pest potential of species present

III. ADULT SURVEYS

Adult mosquito surveys have several purposes. They can determine:

- Species composition
- Relative density
- Population age structure
- Arbovirus infection rates
- Seasonal and spatial distribution of vectors.

Data from adult mosquito surveys can be used to schedule control efforts (when and where adulticiding should be conducted) and evaluate the efficacy of the control program. This is true for larval as well as adult surveillance.

A. SAMPLING RESTING POPULATIONS

Adult mosquitoes are usually inactive during the day, resting in shady, cool, humid areas. These mosquitoes can be collected and counted using a vacuum aspirator. Sampling the resting adults usually provides a representative sample of the population: the sample will include males, newly hatched adults, un-fed as well as blooded and gravid females. This would not be the survey method of choice for arbovirus

surveillance; it does however give an index of the population density. Sampling resting populations is usually time consuming, especially when looking for natural resting sites.

An artificial resting site can be constructed and placed in a shaded, humid location near breeding sites. A wooden box, one cubic foot in size with one side open and painted red on the inside, has been used successfully in many areas.

B. LANDING/BITING COUNTS

Landing counts give a more accurate index of what the public is actually exposed to. Landing counts should be taken at the time of peak mosquito activity, between sunset and one to two hours after sunset. Collectors should be chosen carefully, as some people are more or less attractive to mosquitoes than others. Landing counts are generally done for a two to five minute period during which the collector stands in one spot and with a vacuum aspirator collects all mosquitoes that land on him or her during the pre-determined time interval. Landing counts must be done in a standard, consistent manner, with collections made at the same time of day, in the same place, for the same amount of time, using the same collector. During an encephalitis outbreak, potential health risk to the collector must be considered.

C. LIGHT TRAPS

Many mosquitoes are attracted to light, although some species are repelled by it and therefore light traps are not effective for all species. Light traps are useful for collecting *Culex tarsalis*, the primary encephalitis vector in New Mexico. Dry ice should be added as an attractant; wrap a block of dry ice in several layers of newspaper or in a padded envelope and suspend it above the trap. (CO₂-baited or animal-baited traps disproportionately attract host-seeking females; therefore these methods are preferred for arbovirus surveillance).

Trap placement is important. Competing light sources (including moonlight, street and house lights) affect performance. Suspend the trap about six feet above the ground, in open areas near trees and shrubs. It should be 30 feet or more from buildings. Avoid strong winds and sources of smoke or fumes. Operate the trap from just before dark until just after daylight.

Two popular models of light traps are the New Jersey light trap and the CDC miniature light trap. The CDC trap is easily portable and is operated with four D cell batteries or one 6-volt battery. See "Sources of Equipment for Mosquito Surveillance", below.

D. OVIPOSITION TRAPS

Oviposition traps selectively sample blood-fed adult females. The CDC gravid mosquito trap is one example: it attracts pregnant (gravid) females searching for a place to lay their eggs (oviposit) and collects them in a net similar to the miniature light trap. Since the mosquitoes collected in this trap have already fed at least once, these

individuals are more likely to be infected.

E. USING THE PUBLIC IN MOSQUITO SURVEILLANCE

Citizen complaints can be an effective surveillance tool, especially if the program does not have the resources to conduct weekly landing rate counts or light trap collections. Some uses of complaints are:

1. Complaints may point the way to new or unknown breeding sites.
2. Complaints may indicate when and where adult control is needed.
3. Complaints can be used to verify other surveillance techniques, such as landing rate counts or light trap data.
4. Complaints may be employed to determine the effectiveness of a treatment program.
5. Responding to a complaint gives program personnel the opportunity to educate the public about mosquito biology and control, thus gaining support for the program and enlisting their help in eliminating mosquito harborage and breeding areas.

Another way of involving the public is by administering a questionnaire to help pinpoint areas of historically severe mosquito infestation, and to determine the local tolerance level of the citizens.

IV. SPECIMEN SUBMISSION

Any larval mosquitoes collected may be submitted to the Zoonoses Program of the New Mexico Department of Health for identification (see "Collection and Processing of Mosquitoes for Arbovirus Isolation", below, for details on submitting adult mosquitoes for disease testing).

Mosquito larvae are removed from the dipper using an eyedropper and placed in collecting tubes with rubber stoppers. Old vacutainer tubes work well for this. Remove as much water as possible and replace with ethyl or isopropyl alcohol. **LARVAE MUST BE PRESERVED WITH ALCOHOL OR THEY WILL DISINTEGRATE IN THE TEST TUBE AND MAKE IDENTIFICATION IMPOSSIBLE.** Place a small wad of cotton down on top of the larvae to reduce movement. Data to include with the specimens:

1. Date and time of day of collection
2. Name and phone number of collector
3. Detailed information on locality as described under II-A #5, above under larval surveys.
4. Type of habitat, i.e., roadside ditch, pond from leaking irrigation pipe, etc.
5. Indication of abundance -- number of larvae per dip.

Submit the above information in one of three ways:

1. Write data in pencil on piece of paper, and put the paper in the collecting tube with the specimens, OR
2. Write data in pencil on piece of paper and wrap it securely around the outside of the collecting tube, OR
3. Number each collecting tube and submit a detailed list of collecting data matched to the tubes.

Securely pack the tubes with bubble wrap, styrofoam peanuts, or other material to reduce chance of breakage, place in shipping container and send via mail or UPS to:

Zoonoses Program
New Mexico Department of Health
Epidemiology & Response Division
1190 St. Francis Dr., Rm N1352
Santa Fe, NM 87505

V. BASIC EQUIPMENT FOR LARVAL SURVEILLANCE

1. Dippers
2. Collecting tubes with rubber stoppers (leak-proof!)
3. Cotton
4. Ethyl or isopropyl alcohol
5. "Mosquito Surveillance and Insecticide Usage Report" forms
6. Large syringe with rubber bulb (turkey baster) – for small areas (tree holes, tires) that a dipper can't reach
7. Maps
8. Notebook and pencil
9. Eyedropper
10. Test tube rack
11. Rubber boots or waders

VI. COLLECTION AND PROCESSING OF MOSQUITOES FOR ARBOVIRUS ISOLATION

1. EQUIPMENT NEEDED:

1. Light traps, gravid traps and batteries (either 4 D-cells per trap or one 6-volt – rechargeable or lantern batteries locally available)
2. Vacuum aspirator with collecting tubes
3. Ice chest
4. Refreezable ice packs (blue ice)
5. Dry ice (10-15 lbs.), for attracting mosquitoes to light traps and to immobilize mosquitoes after collection
6. Padded envelopes or newspaper, rubber bands and string for wrapping and hanging dry ice
7. Thick gloves, hammer and chisel for breaking and handling dry ice
8. Sample vials with caps
9. Thick styrofoam shipping containers with outer cardboard carton
10. Forceps for handling mosquitoes
11. Triethylamine (TEA) or chill table for immobilizing mosquitoes (optional)

2. TRAPPING SUGGESTIONS:

- a. Mosquitoes should be collected alive in light traps or gravid traps set out overnight in

suitable areas (see previous Section III-C). Set out traps on Monday night (if weather conditions are right) to allow adequate time for shipping, identification, and transport to the lab.

- b. Make sure that the traps are operating properly with fresh batteries and that the traps are shielded from the morning sun.
- c. A 1-2 lb chunk of dry ice wrapped in newspaper and suspended just above the light trap can increase the number of mosquitoes caught (not needed for gravid trap).

3. COLLECTING THE MOSQUITOES:

- a. The traps must be checked as soon as possible the next morning, as heat rapidly kills the mosquitoes.
- b. Remove the collecting net from the trap before turning off the power, tie the sleeve in a loose knot and then remove the net from the trap.
- c. Label the net with the trap number/collection site and “L” or “G” to distinguish whether from a light trap or gravid trap.
- d. It is important to keep the mosquitoes cold when in transport from the field to your shop. Place the nets in the ice chest with any remaining dry ice. If dry ice is not available “blue ice” or “freeze packs” may be used in the ice chest. This method of using temperature to anesthetize the mosquitoes is **recommended**. Alternately, a few drops of TEA can be placed on a gauze pad, and the gauze pad and net put into a plastic bag for a few minutes to anesthetize the mosquitoes. Then, thoroughly air out the nets (the mosquitoes will not wake up) before putting them into the ice chest or bringing them into your shop. Only use TEA out of doors!
- e. If the mosquitoes are not anesthetized by the time you get back to your shop, put them in the freezer until they stop moving. Empty each net onto a large sheet of white paper and quickly separate the immobilized FEMALE mosquitoes from the "trash" insects and male mosquitoes. Place female mosquitoes from the same trap into one sample vial (no more than 50 mosquitoes per vial). Be careful not to break off legs, remove scales or otherwise mangle the mosquitoes, which will make identification more difficult. Label the vial with your identification number which includes the two-letter code for your program (see table below), and sequential numbering beginning with “1”. (You can add the year if you start with “1” each year). If there are more than 50 mosquitoes from one trap, label all the vials from that trap with the same vial number.
- f. Use the “Mosquito Collection Data Form” in this chapter to record all collection information including the date, detailed location information, the type of trap or aspirator, and the collector’s name, address and phone number. Use a separate form for each separate vial number. You no longer need to complete the SLD form, unless you are identifying the mosquitoes yourself and sending them directly to the state lab.

- g. Keep a logbook with collection date, type of trap used, collection location, vial number, and number of mosquitoes collected.

PROGRAM CODES FOR IDENTIFICATION NUMBERS

Chaves Co CH	Hidalgo- Animas SD HD	Rio Arriba RA
Cibola Co CB	Hobbs HB	San Juan Co SJ
Clovis-Curry Co CL	Jemez Pueblo JE	Sandoval Co SA
Colfax Co CF	Laguna Pueblo LP	Santa Fe Co SF
Deming DM	Las Cruces LC	Shiprock SH
Doña Ana Co DA	Lea Co LE	Silver City SV
Eddy Co ED	Los Alamos LA	Socorro Co SC
Española ES	Mesilla MS	Sunland Park SP
Farmington FA	Navajo Nation NN	Truth or Consequences TC
Hatch HT	Philmont PH	Valencia Co VA

4. SHIPPING THE MOSQUITOES:

- a. Place the sample vials and data forms in a properly insulated and reinforced styrofoam container with sufficient refreezable ice packs to keep the specimens COLD for at least 24 hours. Pack newspaper, bubble wrap or styrofoam peanuts in the container to protect the vials during shipment. Place the forms in a plastic bag next to the vials. Currently the NMDOH has a contract with UPS for Overnight express service that must be used for shipping. Call the Zoonoses Program in Santa Fe for the UPS account number.

- b. Ship the mosquitoes to the City of Albuquerque Vector-borne and Zoonotic Diseases Division for identification. They will identify the mosquitoes and transport the specimens to SLD. It would be helpful if you include a return address shipping label to facilitate getting your container back. The shipping address for the City of Albuquerque is:

**Albuquerque Environmental Health Department
Vector-borne and Zoonotic Diseases Division
ATTN: Mark DiMenna
One Civic Plaza, Room 3023
Albuquerque, NM 87102
Phone: 505-452-5301**

SOME SOURCES OF EQUIPMENT USED IN MOSQUITO SURVEILLANCE

BioQuip Products
2321 Gladwick St.
Rancho Dominguez, CA 90220
(310) 667-8800, Fax (310) 667-8808
www.bioquip.com
Dippers, hand-held aspirators, field notebooks, light and gravid traps

B & G Chemical and Equipment, Inc.
10539 Maybank
Dallas, TX 75354-0428
(800) 345-9387
Dippers, aspirators, gravid and light traps

Clarke Mosquito Control Products, Inc.
159 Garden Ave
Roselle, IL 60172
(800) 323-5727
www.clarkemosquito.com
Dippers, light traps

Hausherr's Machine Works
1186 Old Freehold Rd.
Toms River, NJ 08753
(732) 349-1319
Light and gravid traps, dippers, hand-held vacuum aspirators

John W. Hock Co.
P.O. Box 12852
Gainesville, FL 32604
(352) 378-3209
home.acceleration.net/jwhock
Light and gravid traps, backpack aspirator

Holmans, Inc.
6201 Jefferson St. NE
Albuquerque, NM 87109
(505) 265-7981
U.S.G.S. topographic maps, field notebooks

Public Health Equipment and Supply (distributor for Clarke)
PO Box 10458
San Antonio, TX 78210
(800) 284-0106
www.phesco.com
dippers, light trap

MOSQUITO SURVEILLANCE AND INSECTICIDE USAGE REPORT

Name and/or number of site R-12-- Hole # 6 Overflow pond Location of site Raton Golf Course, Country Club Dr.:
overflow pond from water storage pond near Hole #6; reached by dirt road from entrance to golf course ca. 1/4 mi. from gate

Description and size of site in acres Overflow pond ca. 10' yds. W of storage pond; frequently dry, but often filled after
heavy rain or snowmelt; max. size 50' X 25' = 1250 Sq. ft. = 0.03 acres

Date & Time of Day	Average No. of Larvae and Pupae Per Dip	Adult Landing rate Per Minute	TREATMENT			REMARKS:
			No. of Gambusia Stocked	Name, Concentration* and Formulation of Chemical Used	Amount of Liquid Concentrate, dust, or granules applied	
3/30/90 2:30 PM	5 L	--				1. Name of applicator; 2. Wind speed and direction; 3. Air temperature; 4. Other remarks FA Higgins; 5 mph - S; 62°F; pond ca. 15 X 10' from snowmelt; 1st inst. Ae. vexans
4/4/90 10:00 AM	150 L	--		Bactimos 2 1/2% G, 1/2 - 1 oz.		FAH & P Sandoval; 15 mph; 75°F; pond ca. 50 X 25' from rain; 100 Ae. vexans, 50 dors
4/5/90 4:00 PM	2 L	--				PS; 10 mph; 66°F; Pond ca. 25 X 10'; most L dead, 2 Ae. dors. 1st inst.
4/21/90 11:45 AM	-0-	----				FAH & PS; 45 mph; 85°F; pond dried up

*lbs. of technical grade insecticide per gal. of concentrate or percent active ingredients in dusts or granules (usually printed on label)

MOSQUITO SURVEILLANCE AND INSECTICIDE USAGE REPORT

Name and/or number of site _____ Location of site _____

Description and size of site in acres _____

Date & Time of Day	Average No. of Larvae and Pupae Per Dip	Adult Landing rate Per Minute	TREATMENT				REMARKS:
			No. of Gambusia Stocked	Name, Concentration* and Formulation of Chemical Used	Amount of Liquid Concentrate, dust, or granules applied	Actual lbs. of technical grade insecticide applied	
							1. Name of applicator; 2. Wind speed and direction; 3. Air temperature; 4. Other remarks

*lbs. of technical grade insecticide per gal. of concentrate or percent active ingredients in dusts or granules (usually printed on label)