Chapter 13

SPECIAL PROJECTS IN MOSQUITO CONTROL

There are a large number of special projects which may be implemented to increase the effectiveness of an integrated mosquito management (IMM) program. These projects and special tasks are often expensive, but when funding permits they are frequently included in IMM programs. Some of these special projects aid in protecting citizens from mosquito borne diseases and others help reduce dependence on insecticides. Special projects in mosquito control may include public education and public information efforts, specially designed mosquito surveillance projects, mosquito borne disease surveillance programs, and insecticide resistance monitoring. A brief description of each of these special projects is included below.

Public Information And Public Education Projects

Mosquito control personnel are often invited to make presentations to schools, civic associations, homeowner associations and other groups. And media personnel frequently ask for information about mosquitoes following rain events, hurricanes, storms or disease outbreaks. Most mosquito control programs take advantage of these and other opportunities to distribute information and educate the public on basic mosquito control. When citizens understand basic mosquito biology and act to reduce mosquito breeding sites around their homes, it results in fewer mosquitoes and less dependence on insecticides. It may also reduce the incidence of mosquito borne disease.

Mosquito control personnel often initiate contact with these and other groups to open lines of communication. Contact groups may include the following: local television stations; local radio stations; area newspapers; subdivision newsletter editors; civic associations (Lions Clubs, Rotary Clubs, Kiwanis Clubs); 4-H clubs; Boy and Girl Scout troop leaders; YMCA; local libraries; computer clubs; public schools; private schools; universities, and; day care centers. By initiating contact with these groups before, it usually opens lines of communication that can be very helpful in ensuring that you are able to disseminate information in a timely manner following storm events or disease epidemics. Some examples of special projects in public education and public information that are used by mosquito abatement programs in Louisiana include the following:

Television/Radio Commercials: Some mosquito abatement districts produce “spots” for television, radio and pay for airtime for the “spots” during times of greatest disease potential or following large or extended rain events. The information is intended to call citizens to action to reduce mosquito-breeding sites around their homes and to encourage them to take precautions against disease bearing mosquitoes. And some mosquito abatement districts make use of public access television channels on local cable television. The television specials are productions for local cable television and can be very effective in giving information to the public about mosquitoes, mosquito borne diseases and control methods.

The paid “spots” or commercials are generally aired during times when you want to get specific information to the public quickly. Generally, local cable television presentations cannot be used to disseminate special information quickly. But these programs frequently run several times throughout the course of the year and provide a good medium for disseminating information on mosquitoes, mosquito biology, mosquito borne diseases and control techniques that citizens can implement around their homes.

Press Releases: Many mosquito abatement districts issue press releases to local media when they wish to convey information and motivate the public to action quickly. Press releases should be brief. Always give your name, address and phone number so media personnel can contact you for follow-up. Press releases often result in other contacts from media personnel and frequently result in expanded coverage of the information you are attempting to disseminate. The press releases should be sent to all newspaper, television and radio stations in your area at the same time.

Schools: Most mosquito abatement districts cultivate relationships with public and private schools in their area and make presentations whenever possible. Some mosquito abatement districts disseminate mosquito kits and teaching plans for teachers to use to teach special projects; such as, complete metamorphosis.
A mosquito kit consists of a clear plastic container that holds water in the bottom, so the students can observe the larvae; and is screened on top to help keep adult mosquitoes from escaping. Often, specific instructions on how to use the kit, mosquito eggs and larvae food, and appropriate teaching plans accompany the mosquito kit to aid the classroom instructor. Some mosquito control agencies have worked with classroom teachers to develop grade specific teaching plans for grades K-12. And some agencies have developed teaching plans for biology, physics, history, geography, etc. One of the great values of mosquito kits is that the teaching aid stays in the classroom throughout the entire developmental period of the mosquito (from egg to larvae to pupae to adult). This helps to reinforce messages and to imprint in the student's mind that mosquitoes develop slowly, and that the student should make routine inspections around the home to locate breeding mosquitoes.

**Science Projects:** Many mosquito abatement districts promote science fair projects in area schools and provide information and materials for students who wish to compete in science fairs. The LMCA offers cash rewards and plaques to students who place 1st, 2nd and 3rd at the state science fair each year with mosquito related projects. This is a good way to create a sustained interest in mosquito control among science teachers and goes a long way toward educating the public about mosquito biology and mosquito control.

**Day Care Centers:** Some mosquito abatement districts spend time during the summer making presentations to children at day care centers about mosquitoes and mosquito control. Day care personnel are always looking for ways to keep children occupied and entertained during the summer. So some mosquito abatement districts send their personnel to the day care centers to make presentations or invite the children to their facility for presentations and tours. Some mosquito abatement districts hire and train local school teachers to make the presentations to day care workers and children during the summer. This frees up mosquito abatement personnel to do mosquito control and utilizes the skills of professional teachers to convey the mosquito control message to the youngsters. Instructor's hand out mosquito inspector badges, coloring books, crossword puzzles or other items to reinforce the mosquito abatement message. Frequently, the instructor will give day care children a checklist to take home so they can have their parents help them inspect around their homes to locate and destroy mosquito breeding habitats. The youngsters receive a “mosquito inspector badge” when they complete the assignment. Information about these programs is available from many of the larger mosquito abatement districts in Louisiana.

**Video Presentations:** In addition to producing “spots” for television, some mosquito abatement districts also produce educational materials in House. These productions may cover biology, disease, prevention, control methods, or other items of special interest. They are made available to schools, video stores and local television stations to promote good mosquito control in the area. These presentations may be produced and directed by mosquito control personnel, or the mosquito abatement district may hire a professional firm to produce a specific product.

**Educational Booklets and Other Materials:** Some mosquito abatement districts prepare and disseminate booklets, coloring books, bookmarks, pencils, book covers and other educational material in their community. These materials are distributed through the schools, daycare centers, libraries, and civic associations or at public events where the district sets up displays. One of the great advantages of using materials like this is that it frequently stays around the home, in the classroom or with the student throughout the course of the year. The constant presence of the educational tools reinforce the mosquito control message and is more likely to result in the person taking action on a regular basis to control mosquitoes.

**Displays:** Many mosquito abatement districts set up displays at festivals, fairs, earth day events, home and garden shows, public shopping centers or at other community gatherings in their area. These events often attract people that would not be present at schools, day care centers or civic association meetings. Mosquito control personnel can reach the community with mosquito control messages and communicate information to citizens in unusual and very productive ways by having displays that are very interactive.

**Web Sites:** Many mosquito abatement districts have developed web sites that include educational materials, contact information and other items that will assist the citizen and motivate people to work with the local mosquito control program to help reduce mosquito populations in the area. Often these web sites contain links to other informational web sites. The links may include the Louisiana Mosquito Control Association, American Mosquito Control Association, Centers for Disease Control (CDC), Environmental Protection Agency (EPA), LSU Extension Service, Louisiana Department of Health and Hospitals (LDHH) or other organizations that have helpful information on mosquitoes, mosquito control, mosquito-borne diseases, pesticides, pesticide safety information, insect repellents and other matters of interest.
Mosquito-borne Disease Surveillance

Mosquito-borne diseases pose an ever increasing threat to the citizens of Louisiana due to the introduction of exotic mosquito species, the introduction of new mosquito-borne diseases, changes in land use patterns and increased emphasis on outdoor recreation.

The Asian tiger mosquito (*Aedes albopictus*) was introduced into Louisiana in the 1980’s, and specimens positive for eastern equine encephalitis (EEE) virus were first collected in East Baton Rouge Parish in 1999 during one of the worst outbreaks of EEE in Louisiana history. Thus, a newly introduced mosquito species became a bridge vector and moved a disease that historically had been associated with the forest and marshes in Louisiana into an urban area. Unlike other mosquito species that are involved in EEE virus transmission, the Asian tiger mosquito is an opportunistic feeder and will readily bite people. So, the detection of EEE in the Asian tiger mosquito demonstrated an increased risk of transmission of this very dangerous disease to people in urban areas. Other exotic mosquitoes, *Aedes japonicus* for example, are being discovered with ever increasing frequency in the United States and this increases the potential for increased transmission of native diseases by new species or the introduction of new mosquito-borne diseases into Louisiana.

The introduction of West Nile virus (WNV) in 2001 and the WNV epidemic of 2002 and persistent human cases statewide in 2003 and 2004 underscore the increased risk of mosquito-borne diseases in Louisiana. The introduction of this new disease, which resulted in 329 human cases and 25 deaths in 2002, an additional 124 cases in 2003 and 109 cases in 2004, clearly demonstrated the increased level of risk. Therefore, there is an ever increasing need for good disease surveillance programs that will provide early warnings for mosquito control personnel, so appropriate control activities can be initiated, and, so that citizens can be warned in time to take appropriate action to control mosquitoes around their homes and initiate personal protective measures.

The increasing emphasis on the preservation and restoration of wetlands, the continued development of residential areas adjacent to swamps, marshes and other wetlands and construction of storm water retention structures near residential areas has also expanded the potential for transmission of arboviruses to domestic animals and people. With increasing frequency home sites are being developed in areas adjacent to wetlands. This obviously places people closer to sites where EEE and other mosquito-borne diseases have been endemic for many years. Also, as evidenced by the recent increase and the number of LaCrosse encephalitis cases, people are being placed at greater risk to this disease because more homes are being built in or near forested locations and wetland areas. And storm water retention structures, which are now required for new residential developments, often breed mosquito species that may transmit EEE, SLE and WNV to people.

Another factor that increases the risk of mosquito-borne disease transmission to people is increased use of outdoor recreational facilities by retirees. People in the older age groups are more susceptible to most mosquito borne diseases. So, as more and more people in the older age groups make greater use of outdoor recreational facilities and engage in more outdoor activities around their homes the risk from mosquito-borne diseases increase.

Dr. Thomas P. Monath, (St. Louis Encephalitis: 1980, p. 45, American Public Health Association) in discussing the 1966 epidemic of SLE in Dallas, Texas, stated that it was clear that the ULV malathion treatment has drastically reduced the number of infected vectors and that further transmission had suddenly been virtually halted. Although aborting the epidemic may not have been rigorously proved, the aerial spraying was shown to be a potentially effective means of combating urban SLE outbreaks”. Subsequent scientific studies have confirmed that timely aerial ULV applications of insecticides over endemic swamps can also prevent EEE cases in adjacent upland areas in central New York (*The Arboviruses: Epidemiology and Ecology*, vol. III, p. 13, C.D. Morris). And ULV applications of Naled and Resmethrin interrupted the WNV cycle in *Culex quinquefasciatus* in East Baton Rouge Parish in 2003 and 2005 (unpublished data).

In his analysis, Dr. Monath clearly indicated that aerial ULV applications could abate arboviral diseases. Almost all mosquito abatement districts collect mosquitoes as part of their arbovirus surveillance program. Collection methods are largely determined by the virus the district is attempting to monitor and the amount of funding available for surveillance. Mosquito collection methods include: gravid traps, CDC traps, Fay Prince traps, box traps, sentinel box traps, FMEL traps, garbage cans, aspirators, and backpack collection devices.

**Gravid Trap**: The gravid trap, invented by Reiter (1983), makes use of the fact that female mosquitoes skip around the surface of the water tasting its composition with a spine (chemoreceptor) on the
hind tarsal leg before ovipositing. By doing this, the female can tell whether the water is suitable for the survival of its larval progeny, e.g. is it saltwater or freshwater, polluted or not polluted, etc. This makes the gravid trap an excellent device for monitoring for WNV, SLE, and to a lesser extent, EEE viruses in mosquitoes because it collects mostly gravid mosquitoes that have had at least one blood meal and, therefore, have had an opportunity to ingest a virus, especially from an infected bird. CDC gravid traps and some modification of those traps are highly attractive for ovipositing *Culex quinquefasciatus*, and since this species is a very important vector of WNV and SLE, these traps provide an effective surveillance method for detecting these viruses in an area. *Culex quinquefasciatus* mosquitoes infected with EEE virus also have been collected on a few occasions using gravid traps (unpublished data) in East Baton Rouge Parish.

The gravid trap (Fig. 32) is basically an inverted CDC miniature light trap without the light source that is held in place over a pan of water with the fan blade creating an updraft into a collecting bag rather than the usual downdraft used by light traps. The water is made attractive for ovipositing females by mixing it with additives such as hay infusion, fish oil emulsion fertilizer, or some other kind of matter that is attractive to mosquitoes. The mixture generally increases the attractiveness for a few days after the initial preparation and then becomes less attractive necessitating the replacement of the water mixture each week. Most of the mosquitoes captured by the gravid trap are *Culex quinquefasciatus* mosquitoes, but occasionally smaller numbers of other species will be collected, so they too can be sent to a laboratory for arbovirus testing, for Louisiana this is the LSU Veterinary Medical Diagnostic Laboratory in Baton Rouge Parish.

**CDC light traps**: These traps often enhanced with CO2 are also used to collect mosquitoes for disease surveillance. CDC light traps attract many species of mosquitoes not attracted to gravid traps. However, unlike the gravid trap, they attract many mosquitoes seeking their first blood meal and, therefore, have not had an opportunity to bite a bird and become infected with an arbovirus. When gravid females are collected, this trap is just as useful as the gravid trap for surveillance and the early detection of some mosquito borne diseases.

**Box traps**: These traps are frequently used to collect *Culiseta melanura* mosquitoes, which are very important enzootic vectors of EEE. Box traps are black wooden boxes with red interiors, approximately one foot square with one end open. They are usually placed in areas where *Culiseta melanura* mosquitoes are known to occur. Inspectors visit the boxes on a regular schedule and aspirate any mosquitoes that are resting on the inside of the box. Collecting *Culiseta melanura* mosquitoes is very difficult and this method has proven to be one of the better ways to collect infected specimens for EEE surveillance. It is labor intensive, and in general, only one or two mosquitoes are collected per box even in the most successful operations.

**Garbage cans**: Containers have on occasion been placed into areas to collect *Anopheles* mosquitoes. The garbage cans are generally oriented with the opening to the west so that they are attractive to mosquitoes that are seeking a resting place in the early morning. Dr. Lamar Meek and Dr. Roxanne Rutledge successfully collected *Anopheles* mosquitoes in Louisiana and Arkansas using this type of container.

**Sentinel box traps**: These traps are used by some mosquito control programs to collect *Culex* mosquitoes that have fed on chickens. These are simply boxes built around or over sentinel chicken cages. *Culex* mosquitoes, and occasionally other species, will feed on the sentinel chickens and then rest on the inside of the box trap. Inspectors visit the box traps on a regular basis and aspirate the mosquitoes that are resting on the inside of the box and submit them for testing. Since mosquitoes transmit the virus to the chickens, the virus may be detected in the mosquitoes quite some time before the chicken blood tests positive for antibody.

**Aspirators**: Hand-held, backpack aspirators, and other devices are sometimes used to collect mosquitoes from inside discarded tires, as mosquitoes come to land on inspectors, from vegetation, from inside tree holes, or as they rest in other structures. These devices are generally used to collect a specific species of mosquito for virus testing. For example, the Asian tiger mosquito is very difficult to collect by other methods and aspirator collections are frequently used to collect large number of this species for arbovirus surveillance.

**FMEL traps**: Baited traps can be used as surveillance tools. The mosquitoes that are collected in the traps, and the birds that are used as an attractant, can be tested for the presence of arbovirus or antibody, and this information can give early warning of arboviral activity in an area and information on which mosquito species may be transmitting the virus. This collection method is more time consuming, labor intensive and expensive. It is generally reserved for research studies, but on occasion it may have some utility in organized mosquito control programs as an
FMEL traps were first used by the Florida Medical Entomology Laboratory (Dr. Roxanne Rutledge) to collect mosquitoes to determine the vectors of WNV in Florida. These were modifications of the lard can technique, first used by Dr. Mike Service and others, to collect mosquitoes as they came to feed on sentinel animals. A sentinel chicken or other animal is placed inside the trap and the mosquitoes enter a small opening to feed on the animal. The mosquitoes are unable to exit the trap and are then collected and tested for the presence of virus.

**Arbovirus Surveillance In Birds**

Many mosquito control programs monitor bird populations to detect mosquito-borne viruses. Usually this involves bleeding sentinel chickens or wild birds to detect antibodies for mosquito borne diseases. Both methods are expensive and labor intensive, but both surveillance techniques give results that cannot be obtained by other means. The southern house mosquito (Culex quinquefasciatus) an important vector of SLE and WNV, and (Culiseta melanura), which maintains EEE in acid water swamps in Louisiana, prefer to feed on birds. So, these mosquito-borne diseases may sometime be detected in chickens or wild birds long before they cause infections in humans or horses. Sentinel chickens also be useful in monitoring WNV in an area.

**Sentinel chicken flocks:** Chicken flocks (and sometimes quail, pheasant or other birds) are often retained in cages placed in strategic sampling areas and bled periodically to monitor arbovirus activity. These birds are commonly called sentinels and may provide valuable information about arbovirus activity in a specific area, since they do not travel outside of the confines of the cage. The sentinel birds should be raised in a mosquito free environment and tested before they are placed in the sampling area. If, having tested negative on the initial bleeding, the sentinel bird tests positive after being placed at the sampling site it is an indication of arbovirus activity in that area. Once the bird tests positive it should be removed and replaced with a bird that has not been exposed to arbovirus. A supply of unexposed birds should be readily available to replace those infected with the virus at the sampling sites. There should be a minimum of two chickens at each sampling site and a minimum of one chicken from each sampling site should be bled and the blood tested each week.

**Sentinel chicken flocks can yield a considerable amount of information about arbovirus activity in a specific location.** Many sentinel flocks are needed to sample large areas adequately so this method can be very costly. Infections with mosquito borne viruses can take place a week or more before the antibody activity is detected in the chicken. So, depending on the bleeding schedule and the testing schedule, quite some time may elapse between the initial infection and the detection of antibody in the chicken. However, the problem with the delay and detection of antibodies is somewhat offset by the fact that many of the mosquito species that are effective vectors of arboviruses prefer to feed on chickens and other birds and are more likely to infect the birds long before they resort to feeding on humans. Also, the
birds are exposed twenty-four hours a day seven days a week so they are more likely than humans to be bitten by infected mosquitoes in the area.

Wild birds: Bird populations can be sampled on a regular basis to detect mosquito borne encephalitis activity in an area. Mosquito control workers trap and bleed wild birds on a regular basis. Samples of blood for each bird are sent to the LSU Veterinary Medical Diagnostic Laboratory in Baton Rouge for testing. If the bird has been infected the test will return positive. However, a positive result does not indicate the time of exposure or the location where the bird was exposed to the virus. The test detects antibody, not virus, so the bird could have been infected anytime during its lifetime. Therefore, information from hatching year birds or birds that have previously tested negative is helpful in assessing a positive result. However, a sudden shift in the number of birds testing positive in an area, regardless of their age, is informative and may constitute a call for increased surveillance and/or mosquito control in the area. And high titer responses in the wild birds may indicate recent viral activity, especially if large numbers of birds are positive.

There are a variety of methods available for collecting wild birds: young birds can be taken from the nest, bled and returned to the nest; juvenile and adult birds can be captured alive using mist nets, baited traps or cannon nets; and, for some special studies, birds may be shot. One must obtain the appropriate state and federal permits before collecting birds with any of these methods. Furthermore, banding permits are required if one wishes to band birds before they are released.

The success of any of these collecting techniques is largely dependent on thoughtful pre-trapping preparation and the observational skills of the person doing the work. Persons attempting to collect wild birds for arbovirus studies should pay close attention to established flyways and areas already frequented by birds, since its very difficult to lure birds into new areas or away from areas where they are already feeding. It is also important to note the time of day that birds are active at the site. Pre-baiting the area with grain or other foods that are attractive to the species of birds that you hope to trap can be very helpful in increasing the collection success. Some workers also use recorded birdcalls and/or decoys to lure wild birds into their nets. Mechanical birdcalls and decoys may also be useful during the mating season or for trapping species that are very territorial. Gregarious species may respond to other kinds of birdcalls or larger numbers of decoys.

Mist nets: These nets are perhaps the most common means of collecting wild birds in Louisiana. The most popular nets are about 40 feet long and seven feet high. They are commonly attached at either end to metal poles and are suspended four to five feet above the ground. These nets are made of materials that are difficult for birds to see so they fly into the nets and become entangled in the fibers. Mosquito control workers remove the birds from the net, draw a blood sample and release the birds at the collection site. Mosquito control workers may also band the birds prior to release. This is helpful in the event the bird is collected again at a later date. If the bird tests negative on the first bleeding and then tests positive when it is collected a second time the worker knows that virus was active in the bird population during that sampling window. The amount of blood required and handling procedures change from time to time as laboratory test methods change and/or, improved. If you are interested in establishing a wild bird surveillance program contact a mosquito abatement district that does this routinely for procedures and instructions. The LSU Vet School Diagnostic Laboratory can also give information on protocol and procedures to follow in submitting blood samples for arbovirus testing.

Baited traps: These traps are usually made of wire and designed to trap birds from a specific study area. A variety of traps have been designed to do this and they may be placed on the ground or on stands. The bait (grains, seed, insects or some combination) is scattered around and inside the trap to attract the birds. Additional bait is usually placed at the site for several days prior to the expected collection date to condition the birds to the traps and to lure them inside. The birds enter the trap through a small hole to get the bait and then cannot find their way out because of the trap design. The birds enter through a small hole on some traps, to get the bait and then cannot find their way back out because of the trap design. Bait traps are usually equipped with large hinged openings so that the birds can be easily removed. Elevated bait traps may be more attractive to some species of birds and they can be used if cats or other predators pose a threat to the trapped birds. Bait traps may be especially useful in trapping sparrows, grackles, doves, quail and pigeons.

Nestling birds can provide especially useful information to mosquito control workers. An obvious advantage to bleeding nestling birds is that the age and travel history of nestlings are known and therefore positive results can be tied to a very narrow time frame and a specific geographical location. In addition, they are easy prey for mosquitoes because they cannot move from the site and because they do not have many
feathers to prevent the mosquito from feeding on them. However, locating and gaining access to the nests can be difficult. Many species of birds are very good at hiding their nests. And other species, like house sparrows, construct nests in areas that are difficult to reach. Timing of the collections is also critical. The birds must be bled only after they are old enough to withstand the bleeding and before they fly away from the nests. Timing the bleeding to coincide with this narrow window of opportunity is not easy. In addition, close observation of the nest can also attract the attention of cats and other predators that may eat the young birds before a blood sample can be taken.

Cannon nets: These devices that can be used to collect large numbers of birds very quickly and they may be the only realistic way to capture some species alive. Cannon nets are designed so that one edge is anchored to the ground and the other is attached to rocket projectiles that carry the net over feeding birds. This method can be used to collect black birds, pigeons, ducks, egrets, grackles and other birds that travel and feed in large flocks. Areas where cannon nets are used may be pre-baited for those species of birds that will come to feed on grains or other baits. Knowing where and when to place the cannon nets for other species can be different since these birds may not feed in the same area for more than one day. Cannon nets are also expensive to purchase and use. In addition, several people must be available to remove birds quickly from the nets to avoid injury to the birds. This is one of the least used methods to collect wild birds due to the cost and safety factors involved.

Shooting birds: Occasionally this method can be used to collect information on specific groups for arbovirus surveillance. This method may be used for blackbirds, waterfowl or other species that are migratory or move daily from one place to the other. This method is expensive, time consuming, and requires that the collector purchase the appropriate hunting license. Furthermore, all game laws must be obeyed and collections can only be made during regular hunting seasons. In addition, since the birds are killed, non-specific blood reactions may occur with the tests that are being performed to detect arbovirus. This technique may yield valuable information for research projects but has limited value in routine surveillance programs.

Communicating Disease Surveillance Information

The Louisiana Department of Health and Hospitals (LDHH), Tulane University, LSU School of Veterinary Medicine Laboratories, mosquito control workers, other interested agencies, and individuals share mosquito borne disease surveillance data regularly in Louisiana. This is done so that action plans can be implemented on a timely basis to prevent disease transmission across the state. Sharing information on a timely basis across professional and political boundaries ensures timely advisories to the public so citizens can take preventative and protective action and enables mosquito control workers to implement timely control strategies. LDHH and Tulane University maintain a web site (arbo.net.caeph.tulane.edu) that includes arbovirus surveillance information on dead birds, sentinel chickens, mosquitoes and wild birds. Information on this web site is updated regularly so that mosquito control workers can be apprized of what is going on in surrounding areas. This is a valuable resource for mosquito control workers and citizens. Other helpful internet sites are: the LMCA (www.lmca.us), the LSU Ag Center (www.agctr.lsu.edu) and the CDC (www.cdc.gov). The CDC web site tracks arbovirus surveillance data from all over the United States. The LMCA and LSU Ag Center web sites both have useful links and often have timely information relative to mosquito borne diseases in Louisiana.

References