Vector Control and Pest Management

Introduction

• Importance of control
• Control measures available in disaster events
• Pest management practices (IPM)
• Biology and characteristics of disease vectors
Learning Objectives

By the end of this module, participants will:

• Increase understanding of the impact of vector control in disaster events
• Increase understanding of control measures needed in disaster events
• Increase understanding of the role of environmental health practitioners in addressing vector control issues
• Be able to identify key response partners

Environmental Health Functions

• Assess the situation to determine the extent of vector problems
• Determine measures of control needed
• Act as conduit for information to partners and the public
• Serve as a resource for local officials regarding temporary shelters, mass feeding, refuse disposal problems, etc.
Reasons for Concern

- Diseases transmitted to humans & animals
- Population growth
- Environment for population increase
- Frequency of natural disasters
- Introduction of new diseases
- Lack of funding for control programs

Key Partners

- Emergency management agency
- State and local departments of environmental health, housing, mosquito control, rodent control
- Centers for Disease Control and Prevention
- Emergency Support Functions (ESF)
  - 8, Public Health and Medical Services
- Industry
- Media
Roles

- Assessment
- Consultation
- Environmental monitoring
- Public information
- Preparation
- Planning activities
- Leadership
- Support activities
- Liaison activities

Priority Activities

- Assess effects of the disaster on vector populations
- Assess damage to transportation and communication systems and how it will affect vector control operations
- Assess staff status and availability of personnel for vector control operations
- Apply appropriate vector control measures
- Establish surveillance programs to determine control measures
- Apply long-term vector control measures as needed
Injury Prevention/Safety

Safety Is Job #1

- Personal sanitation
- Electrocution
- Carbon monoxide
- Musculoskeletal hazards
- Thermal stress
- Structural instability
- Hazardous materials
- Confrontations
- Fire
- Drowning, mechanical
- Personal protective equipment: use it!
- Driving, animals, insects, slips/falls
- Stress, fatigue
- Confined spaces: must be trained
“As more and more residents return to their flooded homes, they're having to reclaim their urban and suburban realms from nature, in all its creeping, crawling, slithering grandeur. They're finding large wharf rats and their smaller, more common cousins, Norway rats; swarms of mosquitoes and millions of voracious Formosan termites; marauding raccoons, opossums and armadillos; and snakes.

And, of course, alligators.

Rats appear to be a frontrunner in breeding and nesting in homes.”
Why Be Concerned About Rodent Control After a Disaster?

- Rats and mice are responsible for more human illness and death than any other group of mammals.

Rodentborne Diseases

Rats and mice are responsible for the spread of a number of diseases

- Directly – by contamination of food, water and air with their urine and feces
- Indirectly – by way of rodent fleas and mites

<table>
<thead>
<tr>
<th>Direct</th>
<th>Indirect</th>
</tr>
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<tbody>
<tr>
<td>Rat bite fever</td>
<td>Plague</td>
</tr>
<tr>
<td>Salmonellosis</td>
<td>Scrub typhus</td>
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<tr>
<td>Leptospirosis</td>
<td>Murine typhus</td>
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<tr>
<td>Hantavirus</td>
<td>Tularemia</td>
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<tr>
<td>Lymphocytic choriomeningitis</td>
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</table>
Integrated Pest Management

“Integrated Pest Management (IPM) is a science-based decision-making approach to managing pests that combines biological, cultural, physical, low-impact chemical tools and available technology to reduce pest populations in an effective, environmentally sensitive, and sustainable manner while minimizing economic, human health and environmental risks through a reduction of more hazardous pest control products.” (CDC/EPA IPM Work Group)

Integrated Pest Management

IPM uses a variety of common sense pest management techniques that focus on

- Pest prevention
- Pest reduction below threshold levels
- Elimination of conditions that lead to pest infestations
<table>
<thead>
<tr>
<th>Pest Management</th>
<th>Nonintegrated Pest Control</th>
<th>Integrated Pest Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program strategy</td>
<td>Reactive</td>
<td>Preventive</td>
</tr>
<tr>
<td>Customer education</td>
<td>Minimal</td>
<td>Extensive</td>
</tr>
<tr>
<td>Potential liability</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Emphasis</td>
<td>Routine pesticide application</td>
<td>Pesticides used when exclusion, sanitation, etc., is inadequate</td>
</tr>
<tr>
<td>Inspection and monitoring</td>
<td>Minimal</td>
<td>Extensive</td>
</tr>
<tr>
<td>Pesticide application</td>
<td>Regular schedule</td>
<td>Only as needed</td>
</tr>
<tr>
<td>Insecticides in occupied spaces</td>
<td>Sprays and aerosols</td>
<td>Baits and gels</td>
</tr>
<tr>
<td>Application of sprayed insecticides</td>
<td>Surface treatment</td>
<td>Crack-and-crevice treatment</td>
</tr>
<tr>
<td>Use of insecticide space spraying and fogging</td>
<td>Extensive</td>
<td>Minimal</td>
</tr>
<tr>
<td>Use of nonchemical controls</td>
<td>Minimal</td>
<td>Extensive</td>
</tr>
<tr>
<td>Positive identification of Pests</td>
<td>Sometimes</td>
<td>Required</td>
</tr>
<tr>
<td>Use of pest thresholds</td>
<td>Minimal</td>
<td>Extensive</td>
</tr>
<tr>
<td>Outcome evaluation</td>
<td>Sometimes</td>
<td>Required</td>
</tr>
</tbody>
</table>

**Integrated Pest Management**

The foundation of IPM is managing the environment to eliminate pest access to
- Food
- Water
- Harborage
NPMA Recommendations

Five steps for an IPM program
1. Inspection
2. Identification
3. Establishment of threshold levels
4. Employment of two or more appropriate control measures
5. Evaluation of effectiveness.
Domestic Rats and Mice

Biological factors

- Domestic rodents – include Norway rats, roof rats, and house mice
- Commensal – live at humans’ expense, eating their food, living in their homes, and sharing diseases without contributing anything beneficial to the relationship

Norway Rat

- Burrowing rodent; largest domestic rat
- Also known as the brown rat, house rat, barn rat, sewer rat, and wharf rat
- 7-18 ounces (200-500 grams)
- Length of head and body, 6-8.5 inches
- Total length w/tail, 13-18.6 inches
- Usually brown with coarse fur, whitish belly, blunt nose
- Small ears rarely over ¾ inch long
Norway Rat

- Large droppings, up to ¾ inch long capsule shaped
- Sexual maturity in 3-5 months after birth
- Gestation period, averages 22 days
- 12-18 young per litter
- Approx. 4-7 liters per year
- Average life span is about 1 year
- Range is about 100-150 feet

Harborage

**Outdoors** – burrows in the ground, under building foundations, in rubbish/garbage dumps and in sewers

**Indoors** – between floor and ceilings, in walls, enclosed spaces, cabinets, shelving, appliances, and other spaces concealed from view
Norway Rat

Food
- Garbage, meat, fish, vegetable, fruit, and cereal baits are well accepted; daily requirement, ¾ to 1 ounce of dry food, more of moist food

Water
- Daily requirement, ½ to 1 ounce

Roof Rat
- Smaller than Norway rat and a more agile climber
- Slender and graceful
- Body weight 4 -12 ozs.
- Length, head and body 6.5 – 8 inches.
- Tail, 7.5 – 10 inches long, longer than head plus body
- Total length, 14-18 inches
Roof Rat

- Fine body fur, variable colors
  - black to slate-gray
  - brownish above and grayish –white below
  - brownish above and white-to-lemon-yellow below
- Pointed nose, large eyes, large prominent ears (> ¾ in.) can be pulled over eye.
- Dropping medium size, up to ¼ inch

Roof Rat

- Sexual maturity, 3 to 5 months after birth.
- Gestation period, average is 22 days
- Young: 6-8 per litter
- Usually 4-6 litters per year
- Life span, ~1 year
- Range 100-150 feet
Roof Rat

- Harborage - above ground level
  - Indoors – in attics, between floors and ceilings, in walls and in enclosed spaces of cabinets and shelving
  - Outdoors – in trees and dense vine growth
- Food – vegetables, fruits, and cereal grains preferred. Daily requirement ½ to 1 ounce of dry food, more if moist
- Water – up to 1 ounce each day

House Mouse

- Found throughout the world
- Slender and graceful
- Weight – ½ to ¾ ounces
- Length of head and body: 2 ½ - 3 ½
- Tail: 3 – 4 inches long
- Fur: fine, brownish-gray on back, gray on belly
- Nose: pointed
- Ear: large, prominent, with some hairs, can be pulled over eye
House Mouse

- Eye: large
- Droppings: small, up to ¼ inch
- Sexual maturity: reached 1½-2 months after birth
- Gestation period: averages about 19 days
- Young: 5-6 per litter
- Number of litters: as many as 8 per year
- Length of life: maximum less than one year

House Mouse

- Food: cereal grained preferred, but most types of edible materials; a nibbler; daily requirement 1/10 ounce
- Water: daily requirement, 3/10 ounce; can use metabolic water in food to survive
Rats Feed

Rat Bread
You may hear “There is an explosion in the rat population!” or “The rats are taking over!”

In reality...
- Rats and mice endure suffering similar to humans during disasters
- Populations are frequently decimated
- Survivors are often displaced and will wander to new areas (including homes and buildings) in search of food and shelter
- May be fearful, disorganized and aggressive after disaster events

It will take time for rodents to regroup, reorganize their social behavior, become familiar with their new environment, find safe haven, locate food and water and memorize their movements.

- Colony building and reproduction will only begin when their new ecosystem has stabilized
  - Typically takes 6-10 months under favorable conditions
Rodent Control Activities
After A Disaster

• Keep an up-to-date epidemiologic map of the geographical area, indicating where rodentborne infections have been detected
• Identify the areas most vulnerable to access by rodents and contact with people (shelters, food storage areas, garbage dumps, abandoned vehicles, etc.)
• Search for indications of growth of rodent populations
• Capture and study rodents to determine potential health threats
  – Should include examining for the presence of fleas, mites, and lice and any illnesses they may carry
  – Should only be performed by specialized personnel and if time and funding is available

Excellent record keeping is critical – your records and FEMA
Rodent Control Activities After A Disaster

- Protect food from rodents. Encourage storage of food in metal boxes or tightly sealed heavy-gauge plastic containers.
- Remove food sources.
- Encourage proper solid waste disposal. Remove trash piles including damaged furniture, mattresses, etc. from homes as soon as possible.
- Promote good general hygiene and sanitation practices.
- Urge anyone bitten by a rat to wash the wound thoroughly with soap and water and see a doctor immediately.

Rodent Control Activities Following A Disaster

- **Educate, educate, educate!** Rodent control activities without community support will be ineffective.
  - Get the message out by all forms of available media
  - Develop or use existing flyers on rodent control and distribute to neighborhoods, shelters, and civic groups.
  - Meet with local policy makers and community leaders to discuss vector control strategies.
Recognizing Rat and Mouse Signs

**Gnawings:** Rat incisor teeth grow 4 to 6 inches a year. Must gnaw each day to keep their teeth short.

Fresh droppings are usually moist, soft, shiny, and dark. Old droppings are dull and grayish, easy crumble and are often moldy or covered with fungi. Under magnification, hairs are usually visible.
Recognizing Rat and Mouse Signs

Burrows: Norway rats prefer burrows for nesting and harborage. Often found in earthen banks, under concrete slabs, along walls, and under rubbish. If in use, its entrance will be free of cobwebs and debris. Fresh fragments of food or freshly dug earth at burrow entrance also indicates recent usage. Burrows are seldom far from a source of food and water.

Recognizing Rat and Mouse Signs

Runways: Paths consistently used by rodents between food, water, and harborage. Outside runways are narrow pathways of beaten earth swept clear of debris. Inside, greasy runways are found along walls, steps, and rafters.
Recognizing Rat and Mouse Signs

Rub marks: Dark markings rodents make with their bodies along runway walls. Fresh marks are soft and will smear if rubbed. As grease ages, it dries, gathers dust and will flake off.

- Norway rat: along runways near ground level
- Roof rat: overhead as swing marks beneath beams and rafters
- Mice: no rub marks unless heavy infestation

Recognizing Rat and Mouse Signs

- **Visual sightings**: An obvious sign, the presence of live or dead rodents
- **Rodent Sounds**: High-pitched squeaks
- **Rodent Odors**: Odors produced from urine and body glands. Especially apparent and more noticeable in enclosed rooms with heavy infestations.

EHTER – Vector Control
Never underestimate rodent ingenuity…
Infrastructure Damaged:

Trash piles grow
Solid waste collection systems may be down or severely impeded after a disaster. The EH responder should work with local authorities to develop alternative strategies for solid waste storage and removal until collection systems are fully operational.

- Open dumps generated from the disaster should be removed and the site cleaned immediately.
- Check with local public health authorities for solid waste disposal recommendations. For some disasters, burning and/or burial may be temporarily authorized.
Animal rescue groups
Often uncooperative with local SPCA
2 tons of food/day
Well organized

Control of Rodent Populations

Basic principles
• Controlling rodent populations, not individual rats or mice, is key to a successful rodent-control program in a community
• Permanent reduction of one or more vital factors (food, water, and harborage) will result in a permanent reduction in the rodent population
• A rodent population cannot be greater than the capacity to support it
• Environmental sanitation is the first and foremost requirement for permanent rodent control
**Important**: Rodent extermination without environmental improvements, particularly good sanitation, will be ineffective.

**Poisons and baits**
- Multidose poisons
- Single-dose poisons
- Sterilants (usually not recommended)

<table>
<thead>
<tr>
<th>Rodenticide</th>
<th>Formulation</th>
<th>Effect</th>
<th>Concentration (%)</th>
<th>WHO hazard classification (Class)</th>
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<tbody>
<tr>
<td>Bromifluorin</td>
<td>Bait, wax block</td>
<td>Anticoagulant</td>
<td>0.005</td>
<td>Ia</td>
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<tr>
<td>Bromadiolone</td>
<td>Bait, oil-based, wax block, powder concentrate</td>
<td>Anticoagulant</td>
<td>0.005</td>
<td>Ia</td>
</tr>
<tr>
<td></td>
<td>Tracking powder</td>
<td></td>
<td>0.1-2.0</td>
<td></td>
</tr>
<tr>
<td>Bromethalin</td>
<td>Bait, Acute</td>
<td></td>
<td>0.005-0.01</td>
<td>Ia</td>
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<tr>
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<tr>
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<td>Ia</td>
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<td>Oil-based concentrate</td>
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<td>Tracking powder</td>
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<td>0.20</td>
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<tr>
<td>Coumatrelalyl</td>
<td>Wax block, Anticoagulant</td>
<td>0.0375</td>
<td>Ib</td>
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<tr>
<td></td>
<td>Tracking powder</td>
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<td>0.75</td>
<td></td>
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<tr>
<td>Difenacoum</td>
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<td>0.005</td>
<td>Ia</td>
<td></td>
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<tr>
<td>Difenphithalione</td>
<td>Wax block, Anticoagulant</td>
<td>0.0025</td>
<td>Ia</td>
<td></td>
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<tr>
<td>Diphenacinone</td>
<td>Powder concentrate, Anticoagulant</td>
<td>0.1-0.5</td>
<td>Ia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water soluble concentrate</td>
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<td>0.1-2.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bait, Anticoagulant</td>
<td></td>
<td>0.005-0.05</td>
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<td>Floccumafin</td>
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<td>Ia</td>
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<td>Warfarin</td>
<td>Concentrate, Anticoagulant</td>
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<td>Tracking powder, Bait</td>
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<tr>
<td>Zinc phosphide</td>
<td>Bait, Acute</td>
<td></td>
<td>1.5</td>
<td>Ib</td>
</tr>
</tbody>
</table>

*a* = extremely hazardous; *b* = highly hazardous; NA = not available

*b* Second generation anticoagulant
Rodent Extermination

Multidose poisons
- Anticoagulants
  - Hydroxycoumarin series
    - Fumarin
    - Warfarin
    - Coumarin
  - Indandione series
    - Diphacinone
    - Pival
    - PMP
- Must be eaten for several consecutive days
- Causes internal bleeding
- Provides a margin of safety for humans and animals

Multidose baits
- Bait blocks
- Pellets
- Toss packs
- Tracking powders
Single-dose poisons
- Fatal to rodent after a single feeding
- Lethal after 15 minutes to 2 days, dependent on type of poison
- Generally fatal to humans and pets

Single-dose poisons*
- Red squill
- Zinc phosphide
- Strychnine
- Sodium fluoroacetate
- Fluoroacetamide
- Vacor
- Norbormide

*Generally not recommended for postdisaster application
Baiting recommendations
- Be generous with bait
- Place baits out of reach of children and pets
- Maintain wholesome and attractive fresh bait
- Place baits in areas where rodents frequent
- Use bait stations where applicable

Trapping
- Place trap in areas rodents frequent

When to trap
- When poisons fail or are too risky
- If the odor of unrecovered rodents is a problem
- To capture rodents for parasite and blood sample studies
Rodent Extermination

PPE for trapping
- Gloves and DEET in open areas
- Minimum of N-95, gloves, and DEET in confined areas

PPE for rodent processing
- Minimum of N-95 (N-100 or PAPR if hantavirus is suspected)
- Full body protection (Tyvek or other) plus DEET
- Double latex gloves and eye protection

Note: Fit testing and training required for respirators

Precautions for Building Entry After a Disaster

- Homes and other buildings that were damaged or abandoned may be infested with rodents
- If the building has been abandoned for an extended period of time, it may be helpful to let it air out for 2-3 days before reentering
- If signs of rodent activity are present, a thorough cleaning will be necessary
Precautions for Building Entry After a Disaster

- Do not vacuum or sweep rodent urine, droppings or contaminated surfaces until they have been disinfected.
- Spray urine and droppings with a disinfectant or a 1:10 chlorine solution until thoroughly soaked.
- Remove urine and droppings with a paper towel and discard outdoors in a sealed container.
- For heavy infestations or where hantavirus has been identified, respiratory protection will be needed (N-100 or PAPR).

*Note: Fit testing and training required for respirators.*

Removal of Dead Rodents

- Check traps regularly.
- Spray dead rodents with a disinfectant or chlorine solution.
- Using gloves, remove rodent from trap and place in double-sealed bags.
- Discard rodent in a sealed outdoor waste receptacle.
- Disinfect gloves if they will be reused.
  - After removing gloves, wash hands thoroughly with soap and water (or use a waterless alcohol-based gel).
- Decontaminate traps before reusing.
Snakes

- Floods may force snakes into homes and other buildings
- Before reentry into homes or beginning clean-up, search thoroughly for snakes
- Be alert for snakes in any type of building, piles of debris, building materials, or trash
- Wear heavy leather or rubber high-top boots and heavy gloves
- Use rakes, pry bars, or other long-handled tools when removing debris
- Keep a heavy stick or long-handled tool nearby
- After dark, carry a strong light

Snakes

- Block openings where snakes might enter buildings
- If you realize you are near a snake, remain still. If it doesn’t move away after a few minutes, slowly back away.
- Explain the dangers of snakes to children along with precautions they should take (e.g., no playing around debris.)
- Do not kill snakes indiscriminately
  - If a poisonous snake is killed, use a long-handled tool or stick to remove it for disposal
- Seek medical attention immediately if bitten
Displaced Animals

Plague Control
After 1906
San Francisco
Earthquake
Plague Control
After 1906
San Francisco Earthquake

Questions?
VECTOR CONTROL
Part 2

Mosquito Life Cycle

- Adult
- Egg
- Larva
- Pupa
What is Integrated Mosquito Management?

- Surveillance
- Disease Surveillance
- Biological Control
- Physical Control
- Chemical Control
- Resistance Management
- Education and outreach
- Legal channels

Preventing mosquito breeding through habitat manipulation

- Ditching can be used to facilitate drainage and also movement of predators such as fish.
- Flood water mosquito breeding can be prevented by the use of dikes to keep tidal areas flooded so there is no soil available for egg laying.
- Removal of standing water
Mosquito fish can be used to control mosquito larvae in semi-permanent water bodies by placing them in newly flooded areas that have not had time to develop natural fish populations. This can be an effective means of biological control.

30-50 Gambusia affinis/pool

Live bearers – 75 young/female
New brood/6-8 weeks
Omnivorous

Other Program Elements

Arbovirus Monitoring

Resistance Monitoring

Public Education
Integrated mosquito management targets the larval mosquito stage first since successful control of this stage will prevent biting adult mosquitoes altogether.

Surveillance for mosquito larvae begins with monitoring rain and tide data to know the most likely sources of water that will stimulate flood water mosquito breeding.
Mosquito larvae are located by using a white dipper to sample water habitats. The stage of development, temperature, and species will indicate how much time is left before they become adults.

Larvicides applied to larval breeding areas

• Larvicides include biological pathogens, such as *Bacillus sphaericus* and *Bacillus thuringiensis israelensis* (Bti).

• Larvicides include other materials, such as juvenile hormones, monomolecular films, and oils.
It takes a district years to map sites to effectively use lavaciding and reduce adulticiding. A disaster can completely alter the landscape and create new breeding sites.

Adult mosquito surveillance can be accomplished with several different types of traps as well as landing rate observances.

- CDC Light
- New Jersey Light Trap
- Truck Traps
- Landing Rate Counts
- Gravid Trap
Adult mosquitoes are collected, identified, counted and mapped to prioritize areas of needed control.

Mapped Mosquito Abundance

Service requests are mapped as an additional indicator of where to concentrate surveillance and control efforts.

Lee County, FL
Service requests are mapped as an additional indicator of where to concentrate surveillance and control efforts

City of New Orleans

2006 and 2007 Mosquito Service Requests with Fog Zones

Ground Adulticiding

- Accomplished using a ULV (Ultra Low Volume) fogger mounted onto a vehicle
What is Ultra Low Volume?

- ULV spraying involves the creation of a cloud of drops of concentrated material in a very specific micron size range designed to contact and kill flying mosquitoes.
- Very small volumes are used to cover large areas. The application rates usually range from a few ounces to less than an ounce per acre.

VMD

- Volume Median Diameter
- Measurement of droplet size in microns
- Half of the volume contained droplets smaller than VMD and other half contained larger than VMD
- Ideally there is an optimum droplet size range that offers the most efficient mosquito mortality (7-22 microns)
How small is a micron?

The volume of one BB shot would yield...

9,761,000 droplets of 20 microns

74,088,000 droplets of 10 microns

Aerial mosquito adulticiding is ideally done at night when weather conditions are most favorable and vector species are active. Missions are flown using night vision goggles and satellite navigation systems.
Aerial adulticiding can also be done at first light in the morning or at dusk if night time navigation is not possible.

Mosquito Control Post Emergency Event

- The need for mosquito control is primarily a recovery issue that is going to occur several days to weeks after a flooding event.
- Normal breeding cycles can be disrupted but conditions may be present that will facilitate a rapid buildup of tremendous numbers of mosquitoes.
Survey

- Lost most traps
- CDC
- Landing rates virtually no mosquitoes one month after disaster
- Find our trucks with ULV units
C130 Hercules US Air force Reserve
910th Airlift Wing at Youngstown Air Reserve Station, OH

September 13-23, 2005

• Capacity 60,000 acres/day

• Dibrome (naled)
  ½ and ¾ ounce/acre

Staff Sgt. Jacob N. Bailey

September 21, 2005
Filth Flies:
Green bottle fly
• Low numbers of mosquitoes in flooded areas in September
• Ground treatments began in October
• Unattended swimming pools (Nov.)
High populations of this mosquito

Tan Salt Marsh Mosquito (*Aedes sollicitans*)
~ 54,000 mosquitoes from 1 light trap run 1 night

Backyard pools, ponds, and fountains could have become major breeding sites if not addressed

Inspect and treat

*Larvicide
*Use of mosquitofish
Holding tanks

Sidewalk survey
“311”
Real estate database
Aerial photos
Identify pools

Locate/inspect pools

Locate/inspect 6,000+ pools
Re-visits indicate fish survival in over 90% of the pools

pools removed
Volunteers
- Non-profit organization
- Purchased fish for NOMTCB
- Purchased larvicides
- Began 4/17/2006 in New Orleans
- Approximately 200 pool/day

HOW LONG??
Water inside structures

Containers remain a problem. If the clean-up is slow, the potential for mosquito breeding exists.
# Natural Disasters and Arboviral Encephalitis in the U.S. 1975-1994

<table>
<thead>
<tr>
<th>Year</th>
<th>Event/Area</th>
<th>Activity</th>
<th>Human Cases</th>
<th>Vet. Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>Red River, ND and MN</td>
<td>WEE in mosq.</td>
<td>55 WEE, 12 SLE</td>
<td>281 WEE</td>
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<td>1989</td>
<td>H. Hugo, SE U.S.</td>
<td>EEE in mosq.</td>
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<tr>
<td>1992</td>
<td>H. Andrew, FL, LA</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>1993</td>
<td>Gila R. Flood, AZ</td>
<td>SLE, WEE in mosq.</td>
<td>None</td>
<td>None</td>
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<tr>
<td>1993</td>
<td>Midwest flood, 13 states</td>
<td>WEE in SD, SLE in IL</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>1994</td>
<td>T.S. Alberto, AL, FL, GA</td>
<td>EEE in AL, FL</td>
<td>None</td>
<td>EEE in emus &amp; horses</td>
</tr>
</tbody>
</table>


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# Natural Disasters and Arboviral Encephalitis in the U.S. 1995-1997

<table>
<thead>
<tr>
<th>Year</th>
<th>Event/Area</th>
<th>Activity</th>
<th>Human Cases</th>
<th>Vet. Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>Winter/Spring floods, CA</td>
<td>WEE, SLE in sentinel flocks</td>
<td>None</td>
<td>WEE</td>
</tr>
<tr>
<td>1996</td>
<td>Winter flood, CA</td>
<td>WEE, SLE in chickens, mosq.</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>1996</td>
<td>Winter flood, OR, WA</td>
<td>(No surveillance)</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>1996</td>
<td>H. Fran, NC</td>
<td>EEE in mosq.</td>
<td>1 EEE</td>
<td>EEE in horses</td>
</tr>
<tr>
<td>1997</td>
<td>Summer flood, CO</td>
<td>WEE in chickens</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>1997</td>
<td>Red River flood, ND, MN</td>
<td>None reported</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Initial Assessment Checklist

- Citizen complaints about mosquito activity
- Container breeding survey
- Swimming pools stagnating
- Screens compromised
- Repellent availability
- Large acreage of debris laden standing water
- Adult mosquito landing rate counts
- Trap counts
- Mosquito control capabilities
- Financial resources/outside assistance
- Disease risk assessment
- Transportation/accessibility issues

Evaluate Pre-existing Mosquito Control Program Capabilities and Limitations

- What kind of program if any is in place?
- Who is in charge?
- What is the organizational structure?
  - Independent District
  - County/Parish Program (PW or Health)
  - Private Contractor
  - Other small programs, ie. Cities, Home Owners Associations, Golf Courses
Have Operations Been Disrupted?

- Physical damage to facilities and equipment
- Disrupted infrastructure (communication/fuel/supplies)
- Lack of food/water and shelter for employees
- Safety issues due to debris/power lines/wildlife
- Employees must also deal with personal issues

Understand the hierarchy

- Will State or locals direct Control?
- Mosquito control in place
  - In house program
    - How program is set up dictates how they can interact with FEMA
  - Private Contract program
    - Who will call the shots? Government official or contractor?
- No mosquito control in place
  - Local officials as point of contact or State?

Don’t assume vector control has been included in local response plans!!!!
Examples

- **Florida** – State Dept. of Agriculture handles vector control. They have a plan with pre-existing contracts for supplemental vector control.

- **Mississippi** – Katrina response was directed at State level. State Dept. of Health handled contracting supplemental vector control.

- **Louisiana/Texas** – Katrina/Rita supplemental control contracts at discretion of Parish government, Federal involvement directed by State.

Know Target Species Biology

- *Aedes aegypti* and *Aedes albopictus*, domestic sp., anytime biter, short flight, container breeding survey
- *Culex sp.* Arbovirus vector, night activity, stealthy biter, dirty water breeder, need light trap data
- Salt marsh sp. (*Ochlerotatus*) Anytime biter, aggressive, long flight range, recovery stopper, landing rate or trap data
- Fresh water flooding sp. (*Ochlerotatus* and *Psorophora sp.* Aggressive biters, recovery stopper, landing rate or trap data
- *Anopheles sp.* Malaria vector, permanent water breeder, need trap data, can use landing rates.
Plan for Prioritization

- Date of request
- Local capabilities
- Surveillance data
- Disease threats
- Recovery operations
- Cost constraints
- Resource limitations
- Re-treatments

Control Options

- Daylight spraying
  - Not effective against some species
- Switching to aerial applications
  - Resistance from general public
- Foot patrols for larvaciding/hand spraying
  - Manpower and time consuming
  - Access to private property issues
Control Obstacles

• Unusual issues
  – Disruption of navigation
  – Drivers/pilots unfamiliar with area
  – Training/licensing issues
  – Safety – unlit streets and towers
  – Impassible streets

Public Issues:

* Notification of control activities
* Concerns about pesticide use
* Demands for rapid response
* Prioritization explanation
* Education on personal protection
* Bee Keepers/Organic Farmers
Naled can be used for public health mosquito control programs without posing unreasonable risks to the general population when applied according to the label.

EPA has estimated the exposure and risks to both adults and children posed by ULV aerial and ground applications of naled. Because of the very small amount of active ingredient released per acre of ground, the estimates found that for all scenarios considered, exposures were hundreds or even thousands of times below an amount that might pose a health concern.

**CDC: Mosquito spraying doesn’t harm humans**

Pesticide levels aren’t increased, findings conclude

Friday, April 4, 2003 Posted: 125 PM EST (1926 GMT)

ATLANTA, Georgia (AP) — A mosquito spraying method that health officials say is central to fighting West Nile virus does not increase pesticide levels in humans, federal officials said.

The Centers for Disease Control and Prevention examined the potential health dangers of exposure to mosquito spray from fogger trucks after a request by Mississippi state health officials in September.

Officials interviewed and took urine samples from 142 residents of four cities in Mississippi. Two of the cities used truck foggars for mosquito control. The study concluded that such mosquito control activities did not lead to increased pesticide levels.

The use of pesticides to fight the spread of West Nile virus has been controversial, said George Luder of the CDC, and mosquito spraying has been a central aspect in prevention.

The finding was seen as good news by health officials who have been on the front line of battling against the virus. West Nile made more than 4,100 people ill and killed 277 last year in the United States.

Dr. Wayne, associate professor of medical entomology at Tulane University, said the study alleviates some fears about increasing insecticide use in the face of an outbreak. She said spray trucks have been effective when used during peak mosquito activity against the type of mosquito responsible for the spread of West Nile virus.

"The doses that are sprayed for mosquito control purposes are calibrated to be just enough to kill mosquitoes and... to be safe for humans," she said. "This verifies those data (calibrations) are accurate in the first place.

**Does Naled Pose Risks to Human Health? (EPA)**

Does Naled Pose Risks to Human Health? (EPA)
National Resources

- Centers for Disease Control
- Environmental Protection Agency, Office of Pesticide Protection
- United State Department of Agriculture
- United States Military
  - USAF aerial spray wing

CIVILIAN EMERGENCY RELIEF

1989- SC: Hurricane Hugo: Mosquito
  (855,552 acres)

1992- FL: Hurricane Andrew: Mosquito
  (279,168 acres)

1999- NC & VA: Hurricane Floyd: Mosquito
  (1.7 million acres)

2005- LA & TX: Flies & Mosquitoes
  (2.88 million acres)
Evaluating Control Measures

- Pre and Post Treatment Counts (can be misleading if mosquitoes are constantly emerging)
- Droplet sampling in spray zone to see if material is hitting the target and the drops are the right size
- Syndromic Surveillance, have you had any effect on disease transmission?

What can citizens do to minimize risks from mosquito bites? – Public Education

**Dusk and Dawn:** Avoid outdoor activity at dusk and dawn if possible since this is when many mosquitoes are most active

**5-Ds**

- **DEET:** Apply insect repellent containing deet, picaridin or lemon eucalyptus
- **Dress:** Wear long sleeves and long pants to cover up
- **Drain:** empty cans, old tires, bird baths, etc. of any standing water
Physical barriers

Physical barriers such as window screens are very effective ways of preventing mosquitoes from gaining access to a blood meal.

Unfortunately, in many disasters, the windows and screens that can keep mosquitoes out of a structure are damaged or lost..

Also, windows are often left open during a power outage because the air conditioning is not on.

References

- American Mosquito Control Association (AMCA) - http://www.mosquito.org
- Centers for Disease Control (CDC) Pesticides Used in Mosquito Control Page - http://www.cdc.gov/ncidod/dvbid/westnile/qa/pesticides.htm
- Centers for Disease Control (CDC) Hantavirus Pulmonary Syndrome (HPS) - www.cdc.gov/ncidod/diseases/hanta/hps/index.htm
References

• CDC Rodent Control: Seal Up! Trap Up! Clean Up! 
  www.cdc.gov/rodents

• CDC’s Division of vector Borne Infectious Diseases - 
  www.cdc.gov/ncidod/dvbid

• CDC’s Emergency Preparedness and Response: Natural Disasters and Severe Weather page - www.bt.cdc.gov/disasters

• CDC’s Emergency Preparedness and Response: Protect Yourself from Animal and Insect Related Hazards After a Disaster - www.bt.cdc.gov/disasters/animalhazards.asp

• CDC’s Hantavirus Pulmonary Syndrome (HPS) - information on hantavirus: www.cdc.gov/ncidod/diseases/hanta/hps/index.htm

References

• World Health Organization (WHO) : Emergency Preparedness and Response, South-East Asia Earthquake and Tsunami, Rodent Control in Disaster Settings page: 
  http://www.searo.who.int/EN/Section23/Section1108/Section1835/Section1864_8625.htm

• Pan American Health Organization (PAHO) Rodents in Disasters page: 
  www.paho.org/english/dd/ped/te_rdes.htm

• The PAHO site - www.paho.org/english/dd/ped/te_rdes.htm - is valuable in that it shows how to prioritize vector and rodent control programs after a disaster

• National Library of Medicine (NLM) and National Instititues of Health (NIH) Animal Diseases and Your Health page: 

• Returning Home After a Disaster: Be Healthy and Safe - 
References

Displaced Animals References

• NIOSH Interim Guidance on Health and Safety Hazards When Working with Displaced Domestic Animals - www.cdc.gov/niosh/topics/flood/pdfs/displacedanimals.pdf

• Protect Yourself from Animal and Insect Related Hazards After a Natural Disaster - http://www.bt.cdc.gov/disasters/animalhazards/


QUESTIONS