

West Nile Virus (WNV) – Mosquito Control

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Revised May 2005

Introduction

Since the threat of the West Nile virus (WNV), a mosquito borne virus, has arrived in Oregon, there are things that we can do to help reduce the potential threat to humans, horses and birds. In 2006, Oregon documented the virus in 73 humans, 35 horses and 25 birds. Since the West Nile Virus is transmitted by mosquitoes, to help prevent its movement, the control of either the mosquito itself or its environment is needed to slow its spread. Prevention is the best action to take.



Photo courtesy of CDC.

General Information

Controlling the WNV has become a multi-agency effort in the states where it has become a problem. Various state and county advisory groups are developing integrated pest management approaches to mosquito control. Most experts agree that control of the larvae or pupae stages of the mosquito through water management can be effective in reducing mosquito populations, thus minimizing the risk posed to people and animals from the adult mosquitoes and from pesticides.

An integrated pest management approach means using ALL control methods available, incorporating both larvae and adult strategies. Mosquito controls need to minimize public and animal exposures and risks. Most programs won't control mosquitoes completely, but will lower their numbers and the risk of disease transfer.

WNV has been found in central and West Asia, Africa and the Middle East. It is not known how it was introduced to the United States. West Nile Virus was first detected in the United States in 1999 and moved from New York, across the eastern and southern United States. More recently it has moved to the Pacific Northwest. Human cases of the virus have been isolated in Washington, California, Idaho, Montana, and Oregon.

History

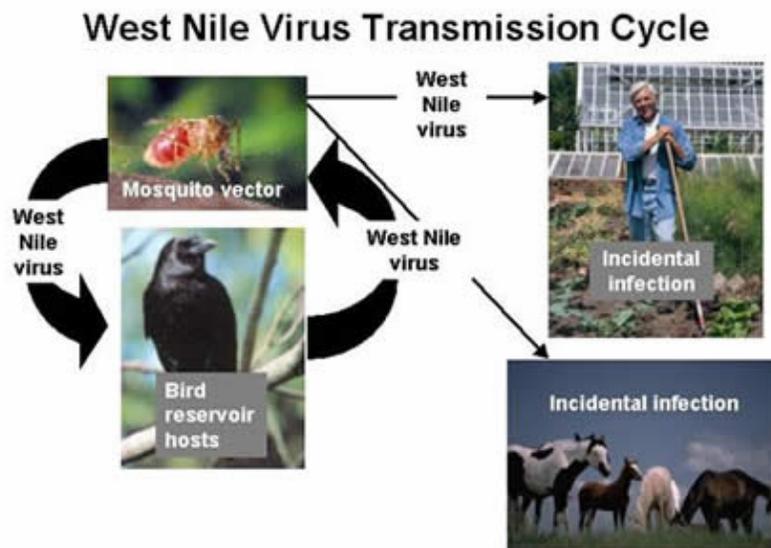
On September 14, 1999, the United States Department of Agriculture (USDA) isolated the virus from a flamingo and pheasants from the Bronx zoo and crows from New York City. The Center

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for Disease Control and Prevention (CDC) confirmed the virus and connected it to an encephalitis outbreak that killed 7 people and infected at least 55 people in New York City in 1999. The virus has been identified in horses, mosquitoes and wild birds (mostly crows), blue jays, and raptors in all 48 continental states. Seven Canadian provinces, Mexico, Puerto Rico, the Dominican Republic, Jamaica, Guadeloupe, and El Salvador also have detected the virus (USGS).

Transmission

The WNV cycle is transmitted by 24 different species of mosquitoes and many birds. Mosquitoes become infected when they feed on bird blood containing the virus. After 10-14 days, the virus can be transmitted to another bird, person or animal that the mosquito bites. The virus is passed by mosquito saliva while the mosquito is blood-feeding. The virus multiplies and may cause illness. Humans and animals do not develop enough virus to infect mosquitoes. It generally is not spread human to human or horse to horse.



Flow chart courtesy of CDC.

Symptoms

Most people who are infected with the WNV don't have symptoms. Some people may become sick in 3-15 days after being bit. Mild infections result in fever, headache, body ache and sometimes swollen glands and skin rash. Occasionally WNV is severe, causing encephalitis, an inflammation of the brain. Only a small number of cases have been fatal.

West Nile virus Activity – Statistics, Surveillance & Control

The following data is from the CDC, Fort Collins and Atlanta:

- 1999: 62 diagnosed cases and 7 deaths
- 2000: 21 diagnosed cases and 2 deaths
- 2001: 66 diagnosed cases and 9 deaths
- 2002: 4,156 diagnosed cases, 284 deaths
- 2003: 9,862 diagnosed cases, 264 deaths
- 2004: 2,539 diagnosed cases, 100 deaths
- 2005: 3,000 diagnosed cases, 119 deaths
- 2006: 4,269 diagnosed cases, 177 deaths
- Total: 23,975 diagnosed cases, 942 deaths**

Statistics from the National Communicable Disease Control 2006 activity report show the following WNV numbers for Pacific Northwest states: Washington – 3, California – 278, Idaho – 996, Montana – 34, Oregon – 69. (Check the CDC or Cornell web sites for the most current data.)

Infected raptors and wild birds have had very high WNV mortality. In the human population, elderly persons and those already sick with other diseases are most likely to be seriously affected. Humans with uncompromised immune systems are less likely to die from the WNV. Annually there are approximately 36,000 influenza related deaths. On the other hand, there have been only a total of 942 deaths from WNV related causes since 1999. Each year more than 400,000 people die from cigarette smoking, and 40,000 people are killed in car accidents. Hikers have a greater chance of getting Giardia or Lyme disease than WNV. The general population who are most at risk spend more time out of doors including workers such as landscapers, parks and recreation employees, forestry personnel, the farming community, construction workers, roofers, street pavers, etc.

Treatment

Mosquitoes acquire the virus from birds and pass it onto other birds, horses and people. Current information shows that infected horses cannot spread the virus to uninfected horses or other animals. There is a vaccination for horses. There is no immunization to prevent the virus for humans. Severe infections may require hospitalization. Most of the WNV infects occur around populated areas rather out in the wood and in wooded camping sites.

Controls

Mosquitoes lay their eggs in stagnant or standing water. Many methods are used to control mosquito populations. These include habitat manipulation and/or elimination and control of larvae and adults.

Habitat Manipulation and/or Elimination - Mosquitoes breed in water that is undisturbed for 4 days. To control mosquitoes, there may need to be a minor or major habitat change. Is there a need to fill or drain natural or native wetlands or drain ditches, ponds or lakes? What are the different risks?

The following are ways to minimize or eliminate standing or stagnant water:

- Reduce flooding and manage irrigation areas.
- Eliminate and prevent standing water in and around containers such as: buckets, plant saucers, cans, tires, troughs, flower-pots, barrels, wheel barrows, etc.
- Maintain or drain livestock watering devices, pools, tubs or birdbaths (every two days). Pools can be maintained by cleaning regularly and adding chlorine. Be aware that even pool covers can collect enough water for mosquitoes to breed.
- Clean and drain roof drains and gutters.
- Prevent stagnant water from collecting in and around water pumps, pools, fountains or birdbaths.
- Drill holes in large objects that cannot be moved or emptied.
- Re-landscape low lawn areas so water does not collect.
- Manure lagoons
- Keep hoses from leaking.
- Fill in ruts and low spots in the property.

More difficult areas to control:

- Storm and sewer drains.
- Ditches, abandoned property, unconcerned neighbors, wetlands, marshes, lakes or pond edges.

Biological Control

- Fish can be added to larger water areas for biological control of mosquitoes. Use predatory fish, *Gambusia affinis sp*, if the water area does not come in connect with other larger water bodies. See pages 10-13 for more details on biological controls and regulations.
- Encourage bats, swallows and other insect eating birds.
- A bacteria that attacks insects, *Bacillus thuringiensis var. israelensis*, with the common names of Dunks, Bactimos, Vectobac, or Teknar is available. Check with local garden stores to see if they carry these products.

Avoidance

Prevent water from collecting (this may be difficult in the Willamette Valley), but this is the best way to prevent the breeding and hatching of mosquitoes. Empty on a bi-weekly basis anything that will collect water. (See the Control sections for more details.)

The following are ways to minimize contact with mosquitoes:

- Install close-fitting window and door screens
- Use good mosquito netting.
- Limit outdoor activities where and when mosquitoes are most active, i.e., in the morning and at dusk.
- Wear long sleeved shirts, long pants and socks. Some mosquitoes will bite through thin clothing.
- Avoid areas where mosquitoes live, such a marches, ponds and stagnant water during June, July and August.

Repellents

There are many brands of insect repellents. A short list of some of the different repellents follows. For further information, look on different medical web sites such as:
<http://www.acponline.org/journals/annals/01jun98/mosquito.htm>

The use of repellents will help reduce being bitten by mosquitoes if applied properly. "DEET," a common ingredient of products such as "Off™," has been shown to be very safe IF USED PROPERLY. Don't use high concentrations of DEET on children. Don't use high concentrations of DEET for too long, or for too often. Don't use DEET on sore or irritated parts of the skin. Repellents containing citronella, permethrin and soybean oils have repellent properties, but they do not work as well as DEET. Herbal materials like catnip, pennyroyal and other organic oils may also repel insects. Check with herb books for more information. A computer search found over 25,000 hits for different mosquito repellents. Historically, some people thought that not bathing would help in repelling mosquitoes, however, this does not work.

The more DEET a topical repellent has, the longer it will last. However, a recent study showed that a concentration over 50% did not increase the length of protection. Care must be taken when applying repellents to children, avoid around eyes and mouth. Do not put on the hands of children either. Don't use DEET on children younger tan 2-years old. Use repellents in addition to wearing long pants and long sleeved shirts, plus thick socks.

Chemical Controls

When mosquito population reduction via water management is not feasible or has not been effective, chemical or biological controls may be needed. Chemical treatment can be aimed at both larvae and adult stages.

Larvacides: Larvae can be controlled with chemical and biological products. Controlling the larvae at immature stages helps to prevent adults and decrease mosquito populations. Larvacides need to be used after surveillance has located a site. They must be properly applied and formulas properly mixed.

Products available:

- *Bacillus thuringiensis* var. *israelensis* (Bt), a bacteria
- methoprene (Altosid), a growth regulator
- temephos (Abate), insecticide
- oil with a light paraffinic base, suffocate
- petroleum and mineral based oils, suffocate

Adulticides: Adult mosquitoes can be killed with chemicals and biological controls. Adulticides are used when disease transmission is taking place, however, they are less effective at controlling mosquitoes than are larvacides. Adulticides are usually applied by ultra low volume sprays of insecticides, applied by air or truck mounted equipment. The insecticide needs to be placed into the area of adult mosquitoes habitation. Adult insecticides can be extremely toxic. Be careful and follow directions carefully.

Products available:

- Malathion
- Natural pyrethrin
- Synthetic pyrethrin (permethrin, resmethrin, sumithrin)
- dibrom (Naled)

Animals

Protecting Animals

Mosquito vectors (carriers) become infected with the West Nile Virus (WNV) by feeding on infected wild birds. Occasionally, infected mosquitoes can transmit the virus to horses when biting to consume blood. Horses are thought to be incidental hosts. Incidental hosts are animals that once infected cannot be a source of infection for mosquitoes or other animals. The only vector proven to be involved in West Nile Virus outbreaks in the U. S. is the mosquito. Remember infection with this virus does not always lead to disease. Horses tend to be infected with the virus more than other animals.

Clinical Signs

The West Nile Virus infects the central nervous system of animals and people. Infected horses showing clinical signs of disease will eventually show signs of nerve and brain inflammation. The clinical course of the disease will progress from non-specific signs such as fever, loss of appetite, and depression to severe neurological signs. Neurological signs are related to damage to the central nervous system. These signs may include behavioral changes, ataxia (wobbliness), head pressing, excitability, teeth grinding, uncoordination, muscle tremors of face or neck, blindness, inability to swallow, seizures, and coma. It is important to remember that other serious diseases like Eastern Equine Encephalitis, Western Equine Encephalitis, and rabies can cause similar symptoms in a horse. A blood test is necessary to confirm a diagnosis of WNV infection in the live horse.

Treatment and Prevention

Only supportive therapy can be used to treat horses infected with WNV because there is no specific treatment for this viral infection. It is critical to accurately diagnosis the cause of equine encephalitis since it can be a vector-borne disease. The occurrence of West Nile encephalitis indicates that there are mosquitoes in the area that are infected with the virus.

- Mosquito control and vaccination of horses may significantly reduce the incidence of this disease. Vector (mosquito) control is the most important step that can be taken to prevent the spread of this virus to people and other animals.

Another aspect of mosquito control is reducing exposure of horses to mosquitoes. There are several steps that can be taken to minimize exposure. Topical application of insect repellants applied according to manufactures' label instructions should reduce exposure. Insect repellants should not be the only protection used to prevent exposure to mosquitoes. If possible, horses should be stalled at night in barns with well-maintained insect window screens and fans. During evening and night hours, avoid using yellow incandescent lights because mosquitoes are attracted to this type of lighting. Also, fogging horse premises in the evening may help minimize the adult mosquito population. FOLLOW directions carefully to avoid poisoning. There are numerous wild bird species that are potential reservoirs for the West Nile Virus, so another aspect of prevention is to eliminate areas where birds might roost around horse housing.

Vaccine

Although mosquito and bird control measures are helpful in reducing a horse's risk of West Nile encephalitis, a newly available equine vaccine offers a first line defense against the disease. The vaccine is a killed virus product given in the muscle. Two vaccinations administered by a veterinarian are given 3 to 6 weeks apart, followed by an annual booster. If a horse develops symptoms of illness suggestive of West Nile encephalitis, it may not be possible to differentiate between a vaccinated horse and a horse naturally infected with WNV. Therefore, it is critical that accurate vaccination records are maintained for each horse receiving the vaccine. The vaccine is restricted to veterinary use only. Contact your local veterinarian about using the WNV vaccine to protect your horses.

Finding Dead Birds

People finding dead birds need to follow specific procedures. The following procedure is from Lane County Public Health. Handle all specimens with extreme care. Blue jays, crows and raptors are most frequently affected by WNV. **Call Lane County Environmental Health (682-3497) to report dead crows or blue jays, and for more information.**

They will take your information about the dead birds and contact the state veterinarian. If your specimens are approved for inspection, you will be notified as to how to send them to Oregon State University (OSU). This must all take place within 24 hours of the bird's death. Specimens are only accepted Monday through Thursday. See attached Dead Bird Submission Form.

Some restrictions for which dead birds will NOT be accepted:

- 1- birds found near highways, windows or predators (cats.)
- 2- more than ONE bird is needed.
- 3- Once the virus arrives in Oregon, the surveillance will cease.

The Lane County website contains more information concerning health issues:
http://www.lanecounty.org/CAO_PIO/westnilevirus/wnv_main.htm

Web Sites:

www.cdc.gov/ncidod/dvbid.westnile/

www.dhs.state.or.us then search for WNV, which will bring up this site:

<http://www.dhs.state.or.us/publichealth/acd/wnile/index.cfm>

<http://www.dhs.state.or.us/publichealth/acd/wnile/birdform.pdf>

www.oda.state.or.us/pesticide/ then search for WNV, which will bring up:

www.ohd.hr.state.or.us/acd/wnile

www.cfe.cornell.edu/erap/WNV

http://www.lanecounty.org/CAO_PIO/westnilevirus/wnv_main.htm

<http://npic.orst.edu/wnv/mosquito.htm>

http://www.dfw.state.or.us/IE/pdfs/West_nile_virus.pdf

Also, go to one of the general search engines and type in: West Nile Virus. This will bring up over 1,320,000 articles.

Public Health Departments:

Lane County - Public Health: (541) 682-4041

Linn County - Health Department: 1 (800) 304-7468

Benton County – Health Services: (541) 766-6835

Information Sources:

Oregon Department of Agriculture

Pesticide Division – Advisories

635 Capitol St., NE

Salem, OR 97301

(503) 986-4635

FAX: (503) 986-4735

Oregon Department of Human Services

Health Services

800 NE Oregon Street

Portland, OR 97232

1 (800) 422-6012

FAX: (503) 731-4078

TTY: (503) 731- 4031

West Nile virus info line 1-866-703-4636

Oregon State Veterinarian

(503) 986-4760

USDA, APHIS Veterinary /Service

4700River Road, Unit 41

Riverdale, MD 20737-1231

(301) 734-8073

FAX: (301) 734-7817

Centers for Disease Control and Prevention

Public Inquiries/MASO

Mailstop F07

1600 Clifton Road

Atlanta, GA 30333

Public Inquiries: 1 (800) 311-3435

Centers for Disease Control and Infection

PO Box 2087

Fort Collins, CO 80522

1 (888) 232-3228

Recommendations for the Collection of Birds by County Health Departments, Vector Control Agencies, Fish and Wildlife, and State Department of Agriculture

At a time of increased public awareness of West Nile Encephalitis (WNE), Oregon State University Veterinary Diagnostics Laboratory has been funded to test Corvids (crows, jays and magpies) for WNE. Due to the limited amount of funding available, we have set guidelines to assist in the collection and testing of birds.

- We are focusing on **crows, jays and magpies** (Corvidae family) that have been **dead no more than 24** hours to ensure accurate results.
- The birds to be tested **must be part of a continuous die-out** (2-3 days) among birds of the species mentioned.
- Birds killed on the road, in parking lots, or deaths related to possible pesticide spraying or injury from other animals will not be tested.
- **It is up to the local jurisdiction to determine if they will pick up birds or request assistance from the public** to deliver them to a specified place. *No funding is available for this purpose.* All specimens submitted to the state for testing must first be approved (see below).

Specimen collection instructions:

- Wear gloves when handling dead birds, or use a plastic bag if gloves are not available.
- Prevent contact between yourself and the dead birds, or the birds and any other animal.
- Invert a plastic bag over the bird to pick it up, and then seal it.
- Place the package in a second plastic bag and seal it again.
- The double-sealed package should be placed in a leak-proof container with enough sealed ice or blue ice packs to keep it refrigerated until it reaches the laboratory.
- It must be shipped to the lab within 24 hours.
- Several specimens can be shipped in the same container but should be kept in separate bags.

Shipment instructions

- Only approved testing is free. Specimen collection requests from the general public must be approved by the local public health authority, which must get approval from the State before submitting specimens to the lab.
- **Before submitting any specimen, call your local health department.** If the specimen is approved, agencies will be given a FedEx account number to use.
- **Fill out the “Dead Bird Submission Form” (on reverse)** for each bird. Be sure to correctly identify each sample with its corresponding form.
- The shipment should be overnight-shipped to the lab on general business days and be guaranteed to arrive no later than Friday noon, unless arrangements are made for someone to be at the lab to accept the shipment. Check with your shipper for labeling requirements for shipping diagnostic wildlife specimens.

Ship to: **Oregon State University, Veterinary Diagnostic Laboratory**
30th and Washington Way
Magruder Hall – Room 134, PO Box 429
Corvallis, OR 97339-0429

Oregon DHS Health Services, Office of Disease Prevention and Epidemiology
Acute and Communicable Disease Prevention
800 NE Oregon St, Room 772, Portland OR 97232
Phone 503-731-4024 Fax 503-731-4798

OREGON WEST NILE VIRUS SURVEILLANCE
Oregon DHS Health Services, Office of Disease Prevention and Epidemiology

DEAD BIRD SUBMISSION FORM

**Birds should only be submitted for testing if the specimen is fresh --
<24 hours since death. See instructions for submission on reverse.**

Submission Information

Name _____ Telephone: _____

Agency _____

Address _____

Specimen Information

Species _____ Specimen ID Number _____

Date of collection _____ County _____

City _____ Zip Code _____

Description of Location _____

Weather Conditions _____

Coordinates _____

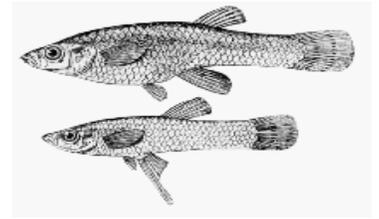
Results

Test performed _____

Results _____

Confirmation? _____

The Effectiveness and Risks of Using Mosquitofish for Mosquito Control



Biology and Habitat

Mosquitofish (*Gambusia affinis* and *G. holbrooki*) are benthopelagic, non-migratory, viviparous fish that inhabit freshwater or brackish waters. Mosquitofish inhabit standing to slow-flowing water, are most common in vegetated ponds and lakes, backwaters and quiet pools of streams. Mosquitofish feed on zooplankton, small insects, larval fish and amphibians, and detritus.

Native Range

Gambusia affinis and *G. holbrooki* are native to southern and eastern USA in the Atlantic and Gulf Slope drainages from southern New Jersey to Mexico and in the Mississippi River basin from central Indiana and Illinois south to Gulf. *Gambusia holbrooki* is native to Atlantic and Gulf Slope drainages as far west as southern Alabama; *G. affinis* occurs throughout rest of the range.

Introduced *Gambusia* and Questions Regarding Their Effectiveness for Mosquito Control

Where mosquito-borne diseases pose a threat to human health, stocking water bodies with mosquitofish has been used for mosquito control. Mosquitofish have been stocked routinely and indiscriminately around the world. In the United States the first known introductions of mosquitofish took place in the early 1900's (Krumholz 1948). Mosquitofish were commonly and widely introduced during the following decades because they were thought of as an effective and inexpensive means of combating malaria (Krumholz 1948). In some areas range extensions have occurred through natural dispersal far from sites where originally introduced.

However, the effectiveness of *Gambusia* as a mosquito control agent is unclear. Recent critical reviews of the world literature on mosquito control have not supported the view that *Gambusia* are particularly effective in reducing mosquito populations or in reducing the incidence of mosquito-borne diseases (Courtenay and Meffe 1989; Arthington and Lloyd 1989). Introduction of mosquitofish into mosquito source habitats containing other mosquito predators, particularly larvivorous fishes or insects, may result in the reduction or replacement of the native larvivores by the mosquitofish and consequently may have no positive effect on mosquito control (Hoy et al. 1972). Despite their name, mosquitofish do not show a consistent preference for eating mosquito larvae (Miura et al. 1979). *Gambusia* may prefer to consume macro-invertebrates other than mosquito larvae and some of these macro-invertebrates consumed may include species which also prey on mosquito larvae. In addition, presence of predatory species such as largemouth bass or green sunfish has been found to limit the abundance of mosquitofish and reduce their ability to control mosquitoes (Blaustein 1992).

Documented Negative Impacts of Introductions on Native Species

According to Courtenay and Meffe (1989), mosquitofish have had the greatest ecological impact by far of any of the introduced poeciliids. Because of their aggressive and predatory behavior, mosquitofish may negatively affect populations of small fish through predation and competition (Courtenay and Meffe 1989). Meffe (1983, 1985) found that mosquitofish are very aggressive, even toward larger fish. They often attack, shred fins, and sometimes kill other species. Mosquitofish are known to prey on eggs, larvae, and juveniles of various fishes and on the adults of smaller species (Meffe 1985; Courtenay and Meffe 1989). Once introduced, mosquitofish may be impossible to remove (Meffe 1985; Courtenay and Meffe 1989).

In some habitats, introduced mosquitofish reportedly displaced select native fish species regarded as better or more efficient mosquito control agents (Courtenay and Meffe 1989). Introduced mosquitofish have been particularly destructive in the western United States where they have contributed to the elimination or decline of populations of federally endangered and threatened species (Courtenay and Meffe 1989). Specific examples of their negative effects include a habitat shift and a reduction in numbers of the threatened Railroad Valley springfish *Crenichthys baileyi* in springs in Nevada (Deacon et al. 1964),

the local elimination of the endangered Sonoran topminnow *Poeciliopsis occidentalis* in Arizona (Meffe et al. 1983, Meffe 1985), and local displacement of plains topminnow *Fundulus sciadicus* and other species with their aggressive behavior (Whitmore 1997). The mosquitofish was implicated in the elimination of the least chub *Lotichthys phlegethontis* in several areas of Utah (Whitmore 1997). Scheerer (2002) found mosquitofish were the most common nonnative species collected in habitats preferred by endangered Oregon chub (*Oregonichthys crameri*) in the Willamette River, Oregon and may be detrimental to the conservation and recovery of this species.

Introducing mosquitofish also can precipitate algal blooms when the fish eat the zooplankton grazers (Hurlbert et al. 1972), and can increase in the number of mosquitoes when they eat the mosquitoes natural invertebrate predators (Hoy et al. 1972). Mosquitofish are likely partially responsible for the decline of the Chiricahua leopard frog *Rana chiricahuensis* in southeastern Arizona (Rosen et al. 1995) and have been found to cause the extinction of California newt *Taricha torosa* populations (Gambradt & Kats 1996). Red-legged frogs were found to weigh 35% less when grown with mosquitofish (Lawler et al. 1999).

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Fast Facts About West Nile Virus, Mosquito Fish (Gambusia), and Alternatives for Mosquito Control

February 28, 2003

Natural resource agencies are working with public health officials to recommend appropriate mosquito control measures to protect humans and domestic animals from West Nile Virus (WNV), while also protecting fish and wildlife that could be affected by control measures. Mosquito fish are not native to Oregon and must be used with caution and only in appropriate locations.

Q: What are mosquito fish and where are they effective in controlling mosquitoes?

A: Mosquito fish are nonnative predator fish that were brought into Oregon from the eastern and southeastern U.S. Mosquito fish (Gambusia) are one tool to reduce mosquito numbers in contained ponds where no other natural controls are present. **By law mosquito fish can only be used in locations described below.**

There is no way to totally eliminate mosquitoes, which also play an important and beneficial role in the food web.

Q: What other methods exist for mosquito control?

A: Prevention, the natural food web and chemical treatment.

Prevention: Eliminate or limit the number of places available for mosquitoes to lay their eggs by removing containers that collect standing water such as buckets and old tires. Keep gutters clean and clean out birdbaths and pet water bowls weekly.

Natural Food Web: Fish, wildlife and insects that eat immature mosquitoes (larvae) in the water or flying adults may already be present. Amphibians such as frogs and salamanders, dragonflies and many aquatic insects feed on mosquitoes. A variety of birds such as swallows consume numerous mosquitoes, and bats eat thousands of mosquitoes in a night. For information on how to encourage these mosquito-eaters, contact an Oregon Department of Fish and Wildlife (ODFW) wildlife biologist. If you have questions about whether mosquito fish are appropriate for your situation, contact a county vector control agent or an ODFW fish biologist.

Chemicals: These control methods can have significant environmental impacts and should be considered very carefully before use. "Larvicides," such as *Bacillus thuringiensis israelensis* (B.t.i.), kill mosquito larvae in the water and are currently considered to have less impact to the environment than products that target adult mosquitoes.

Some county health departments will be applying a phased approach to mosquito control depending on the types of mosquitoes in an area and results from testing mosquitoes and birds for WNV. For more information, check with your county health department or county vector control district.

Q: Where can I legally use mosquito fish for mosquito control?

A: To protect Oregon's native fish and wildlife, Oregon law (ORS 498.222) allows mosquito fish to be stocked only in "aquaria," defined as self-contained systems that are not fed or drained by natural waterways, such as ornamental ponds and stock troughs. Natural waterways include creeks, streams, sloughs, ponds, lakes and ditches if connected to natural waterways. Ponds located in floodplain areas are not considered "aquaria" and should not receive mosquito fish, because flooding could allow them to enter natural waterways.

Q: Why can't mosquito fish be placed in natural waterways?

A: They may eat or harm small or young native fish, young frogs and salamanders, and beneficial aquatic insects. They also may out-compete these native species for available food and habitat. In addition, their presence may reduce some natural mosquito control provided by native fish, wildlife and aquatic insects. Mosquito fish predation and competition have contributed to the elimination or decline of federally threatened and endangered fish species in the western U.S. and may be detrimental to the conservation and recovery of the federally endangered Oregon chub in the Willamette Valley.

Q: Where can I get mosquito fish?

A: Mosquito fish (*Gambusia*) are available from some pet shops, garden stores, pond supply stores, nurseries, and some county vector control districts. Before purchase, check with an ODFW fish biologist to determine if your site is suitable for mosquito fish and whether a fish transport permit is required.

Q: Can I transport mosquito fish from one water body to another?

A: No. Oregon law prohibits the transport of any live fish or live eggs from one water body to another or into the state without a permit from ODFW (OAR 635-007-06000). This is to prevent placing fish in waters where they might harm or adversely affect other species of fish and wildlife.

Mosquito fish are classified as "aquaria" fish. Purchasers do not need a permit to transport them from a retail store to an appropriate self-contained pond or other structure unconnected to natural waterways as described above. County vector control districts that supply mosquito fish operate under an ODFW fish transport permit and will provide a receipt that allows transport of fish to private property.

Q: Do all mosquitoes carry WNV?

A: No. Of the 53 known mosquito species in the northwest United States, only a small number may have the potential to carry WNV. The virus is transmitted to humans, horses, and some other mammals and birds from the bite of an infected mosquito. There is no evidence that mammals or birds can transmit WNV to people.

Q: How likely am I to get West Nile Virus?

A: According to the national Centers for Disease Control and Prevention (CDC), the chance of being bitten by a mosquito carrying the virus is very low, even in areas where the virus has been reported. Most people who become infected will develop no symptoms or mild symptoms. In a few rare cases (less than 1 percent), people can develop severe or life-threatening illnesses. Individual prevention measures described below are the most effective way to avoid mosquito bites and potential infection.

Q: How can I protect myself from WNV?

A: In addition to prevention measures described earlier, the national Centers for Disease Control (CDC) recommend the following:

- Apply recommended mosquito repellents and wear protective clothing when outdoors.
- Add or maintain screens on windows and doors.
- Check the CDC website at www.cdc.gov or call your local county health department for more information.

Q: How can I protect my horse and pets from WNV?

A: Check with your veterinarian about protecting horses and other domestic animals and pets.