Mosquito's and Arbovirus of the Intermountain West

OSU Entomology Short Course

Gary Page, Malheur County Vector Control District

The most disliked creature on Earth

Presentation Features

- Mosquito Biology
- Six species most common in the Intermountain West
- Control and Management Strategies
- Vectored Diseases

Mosquitos and Crops

- Mosquito's have no known negative effects on plant physiology
- They do not transmit any pathogenic disease or vector any parasitic organisms
- They do however have a definite net positive effect. Mosquitos can and do act as pollinators

Mosquitos as Pollinators?

- As they feed on mainly flower nectars they transfer pollens
- They are major pollinators of certain orchid species in the arctic regions.
- They are also important pollinators of tropical orchids

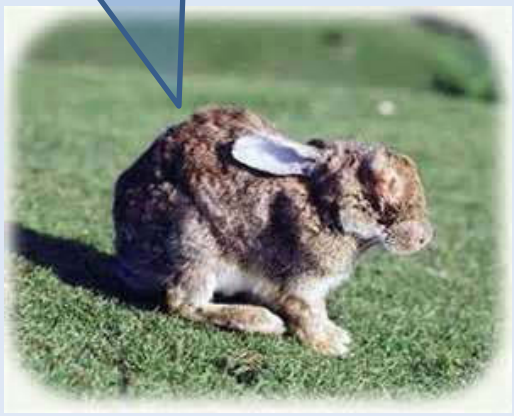
Mosquito’s and their effect on Poultry Livestock & Milk Production

Mosquitos & Wildlife

General irritation and annoyance for big game

Mostly a problem for upland game birds from WNv

Myxoma virus in rabbits



The Worlds Most Dangerous Animal

- According to the WHO, close to 2 million humans are killed by mosquito bites each year with about 800,000 people worldwide die each year from malaria. Nearly 70 million people are affected by some kind of mosquito transmitted disease annually

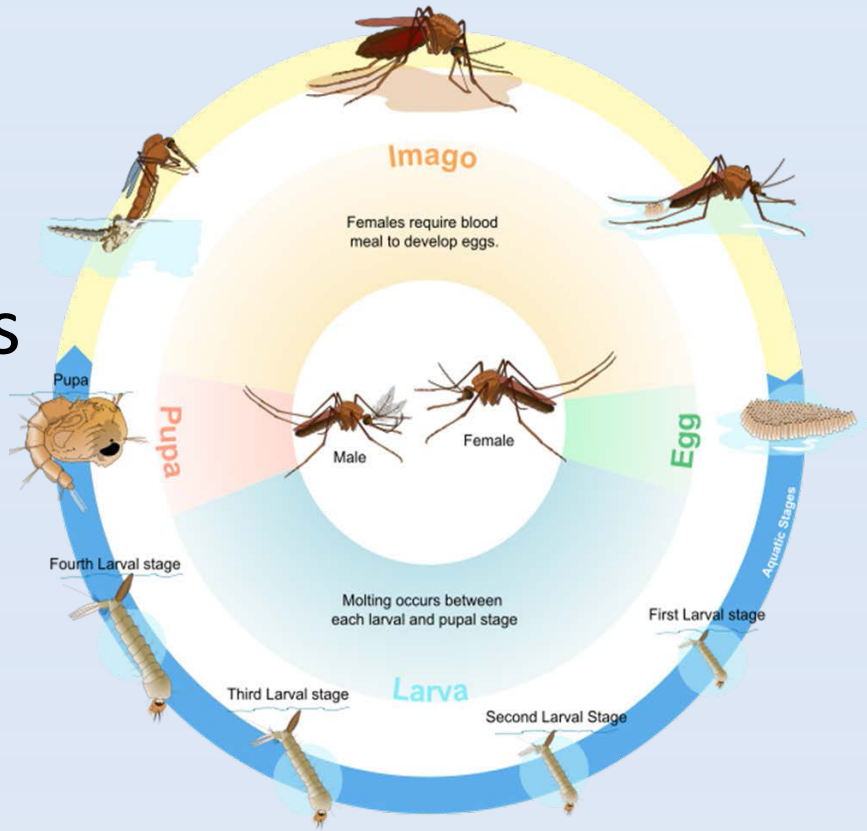
Mosquito biology

Mosquito Biology

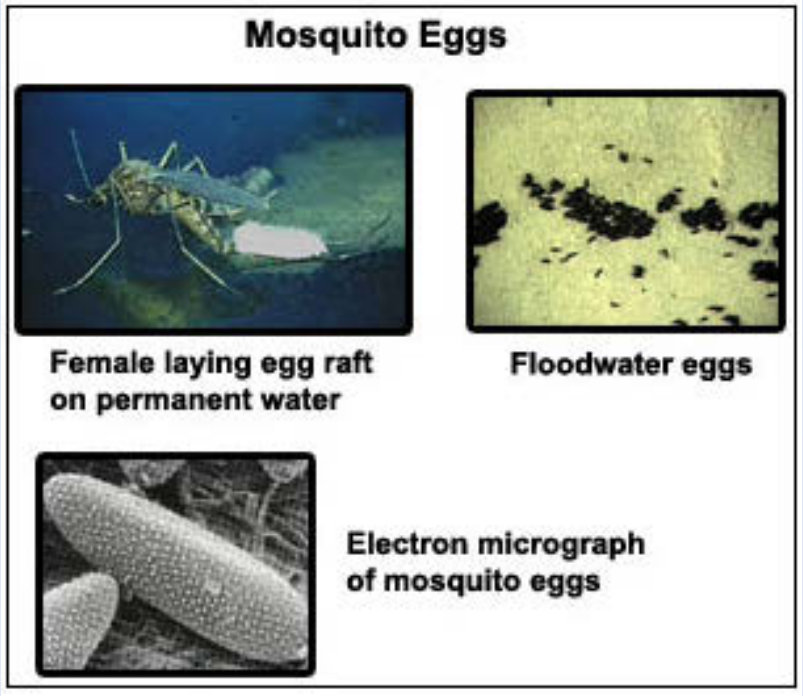
- Mosquitoes belong to the insect Order Diptera (“true flies”)
- Mosquitoes are all in the Family Culicidae. Insects belonging to this family possess paired scaled wings, slender bodies, and long jointed legs.
- Only female mosquito’s need blood. They use the proteins and lipids to mature their eggs
- They usually rest for two or three days after a blood meal to allow the eggs to develop
- The female abdomen can expand at least three times in size and weight

Mosquito Biology

- Mosquitoes must have water to complete their life cycle
- They like all flies progress through 4 distinct stages in their life cycle (Complete Metamorphosis)
  - Egg / Larva / Pupa / Adult

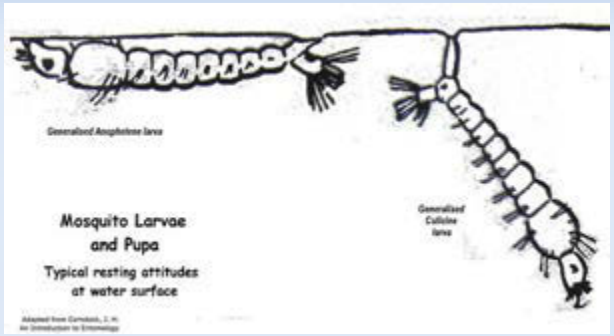


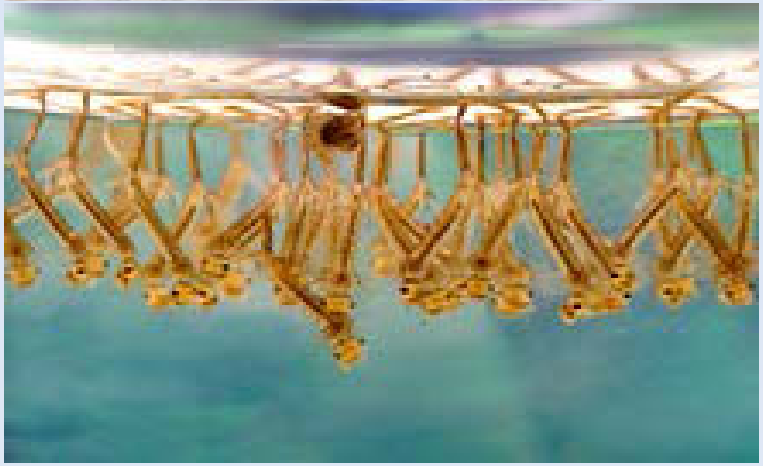
Mosquito Biology



- Oviposition varies greatly among species.
- Culex species lay eggs in a raft where as many as 200 eggs may be attached.
- Anopheles and many other mosquitoes lay their eggs singly on the water surface. *Aedes* and *Ochlerotatus* mosquitoes lay their eggs singly, sometimes on damp soil.
- Most species can lay as often as every 3rd night

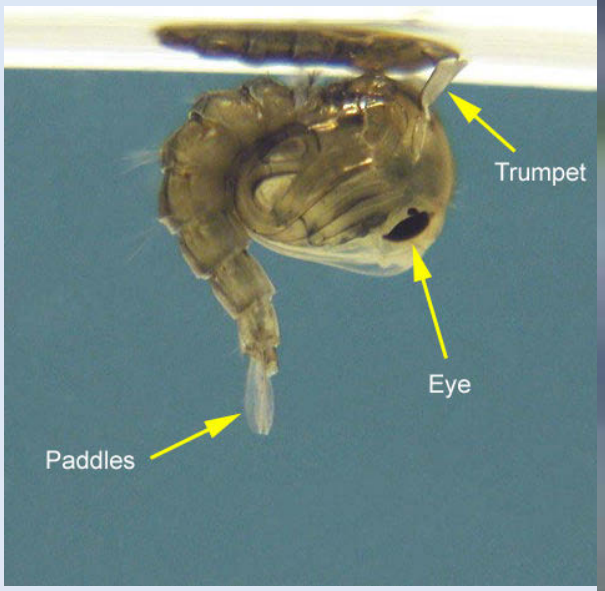
Mosquito Biology
Laval Stage





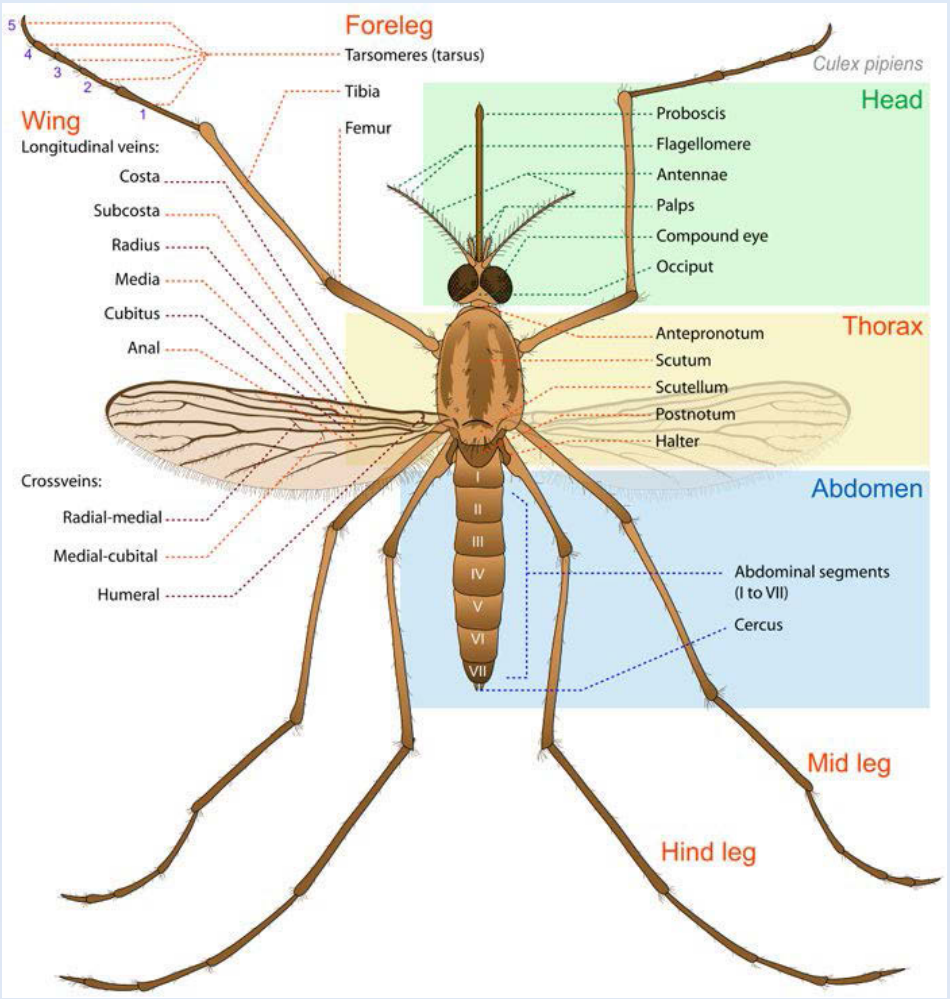
- Mosquito larva have well developed heads with mouth brushes used for feeding, a large thorax with no legs, and a segmented abdomen
- Larvae breathe through spiracles located on the eighth abdominal segment, or through a siphon, they must come to the surface frequently
- Larvae eat constantly feeding on algae, bacteria and microbes at or very near the water surface
- When disturbed they will dive below the surface

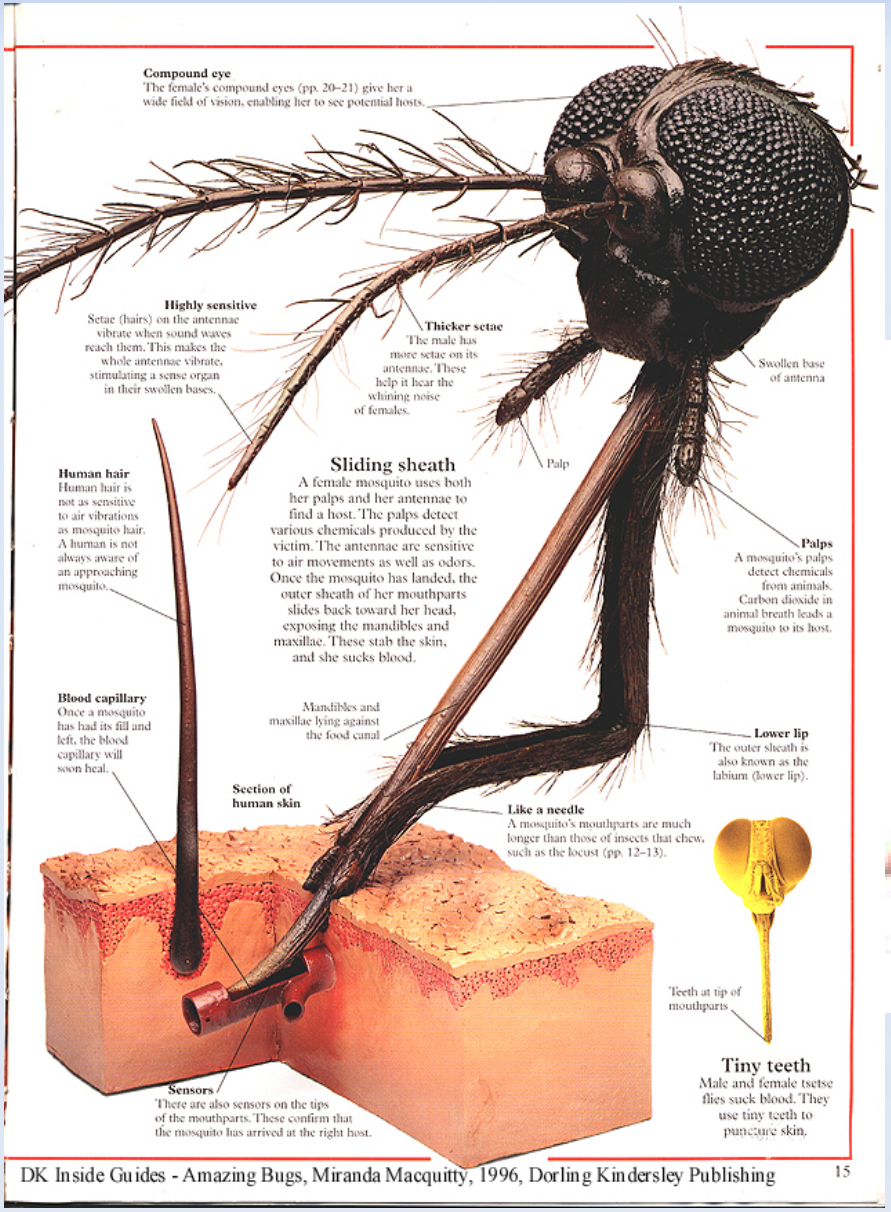
Mosquito Biology
Pupa Stage



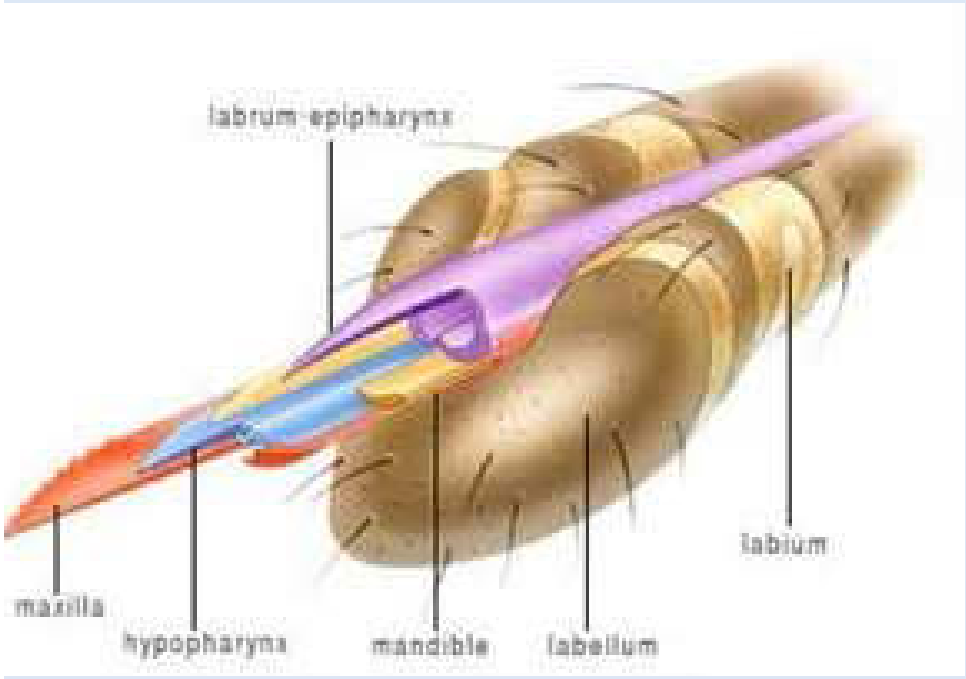
- Commonly called tumblers because of their swimming action
- Pupa don’t eat and unless disturbed rest at the surface
- Breathes through respiratory trumpets on the dorsal side
- Pupa stage lasts from 1 – 3 days assuming warm temps

Mosquito Biology
Adult Stage





DK Inside Guides - Amazing Bugs, Miranda Macquitty, 1996, Dorling Kindersley Publishing 15



Common Mosquito's of the Intermountain West

- Aedes vexans (Inland Floodwater Mosquito)
- Culex tarsalis (Western Encephalitis Mosquito)
- Ochlerotatus dorsalis (Pale Marsh Mosquito)
- Anopheles freeborni (Western Malaria Mosquito)
- Culex pipiens complex (Common House Mosquito)
- Ochlerotatus nigromaculis (Common Pasture)

Aedes vexans

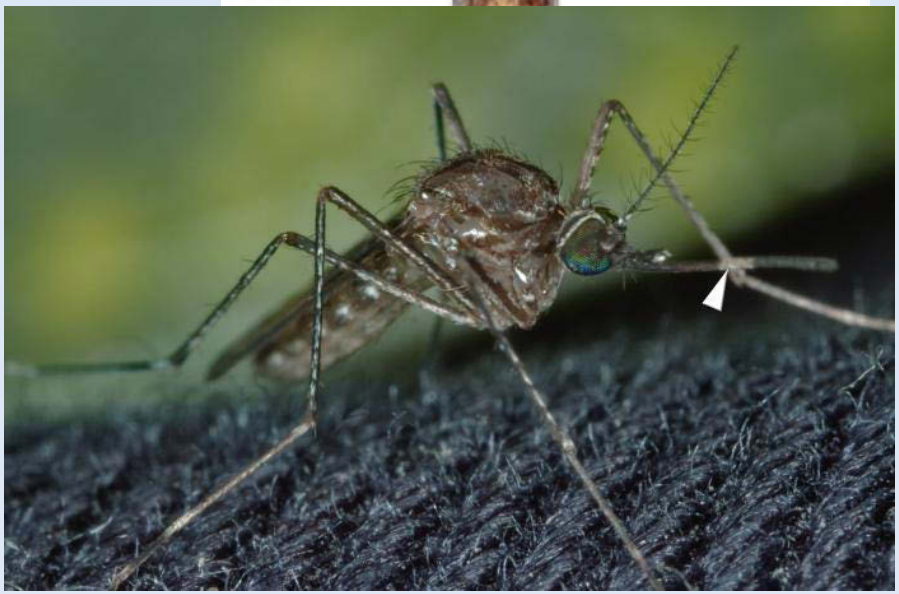
(Inland Floodwater Mosquito)

- Probably the most common species in the temperate regions of the northern hemisphere .
- Ranges from New Mexico to the Canadian Border
- Generally considered a floodwater mosquito, but oviposition habits can vary widely
- Seems to have no host preference
- While it does not vector WNv, it does tranmit Dog heartworm and Myxoma virus

Culex tarsalis

(Western Encephalitis Mosquito)

- Culex tarsalis is a dark medium sized mosquito distinguished by a white band on its proboscis, as well as white bands on its tarsal joints.
- One of the most important vectors of disease in North America
- Not a particularly aggressive biter of humans prefers bird hosts
- Tends to seek out dirty warm waters with high organic matter content to lay eggs
- Adult females spend the winter in protected places usually carrying fertilized eggs



Ochlerotatus dorsalis

(Pale Marsh Mosquito)

- Occurs worldwide in the Northern Hemisphere
- Some years we don't see great numbers
- Sometimes called Salt & Pepper mosquitos
- These mosquitoes are known for their incredible migration distances of 20-30 miles
- Eggs can remain dormant for several years waiting for water
- Ferocious biter mainly feeds on humans or domestic animals bites are particularly painful
- Weak transmitter of WNv and several other encephalitic virus plus Myxoma virus to Rabbits

Culex pipiens/quinquefaciatus

(Northern House Mosquito)

- Found worldwide in the temperate regions of both hemispheres
- Over winters as adults, very cold tolerant prefers cooler climates
- Capable of breeding in all kinds of still water sources, but seeks water that is dirty or high in organic matter
- A major vector of West Nile and other encephalitic virus
- As is common with most Culex species it prefers birds for blood meals

Anopheles freeborni

(Western Malaria Mosquito)

- It is the principal vector of malaria in the arid western United States. Also vectors various other diseases
- Prefers rabbits and small mammals but will bite humans. Major vector of Myxoma virus in rabbits
- Appear to have longer legs and tends to arrange their legs in a wider stance
- Feeds at a steep angle to the host

Ochlerotatus nigromaculis

(Common Pasture Mosquito

- One of the most common pests of pastured livestock
- Slightly larger than the usual local mosquito
- Tend to prefer shallow warm water with lots of vegetation in and around the water
- Usually prefers to bite in coolest part of the day and on cloudy days
- Overwinter as eggs

Control and Management

Control and Management
Formation of Mosquito Control Districts

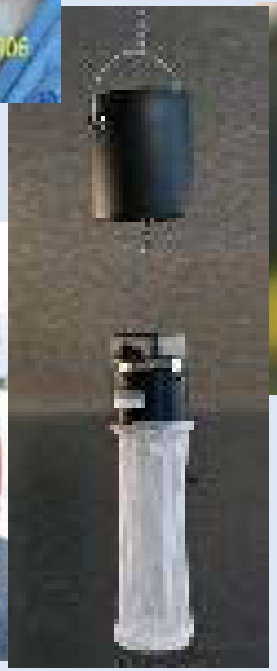
- Usually one of three reasons why districts are formed, look at the name
  - If the name contains the word vector then that district was probably formed primarily to manage for disease making that district a public health entity
  - If the name describes it a “mosquito control district then it is usually formed to control the nuisance factor
  - It might have also been formed to protect livestock.

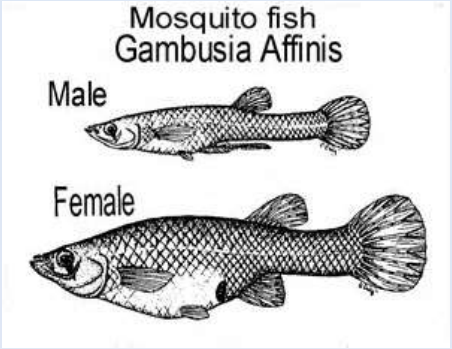
Control and Management

Formation of Mosquito Control Districts

- Vector Control District by statute could mean control of any animal that poses a health risk to humans or domestic animals
- District authority is given by ORS 452.XXX
- Districts can either be a department of a county government, or an independent taxing district. In either case the district is managed by a board of trustees
- Oregon is a bit unique in that Boards or County Courts can levy a tax without a vote of the citizens of the district

IPM and Mosquito Management





The First Step

- A good surveillance program
- Determine the source of their origin

The Second Step Larva Control

- Controlling larva is the key component of most vector control operations
  - Two Reasons
- Stopping the cycle before biting adults emerge is critical to success
- Captive organisms that can't fly away

The Second Step Larva Control

Altosid® XR
EXTENDED RESIDUAL BRIQUETS

A SUSTAINED RELEASE PRODUCT TO PREVENT ADULT MOSQUITO EMERGENCE (INCLUDING THOSE WHICH MAY TRANSMIT WEST NILE VIRUS)

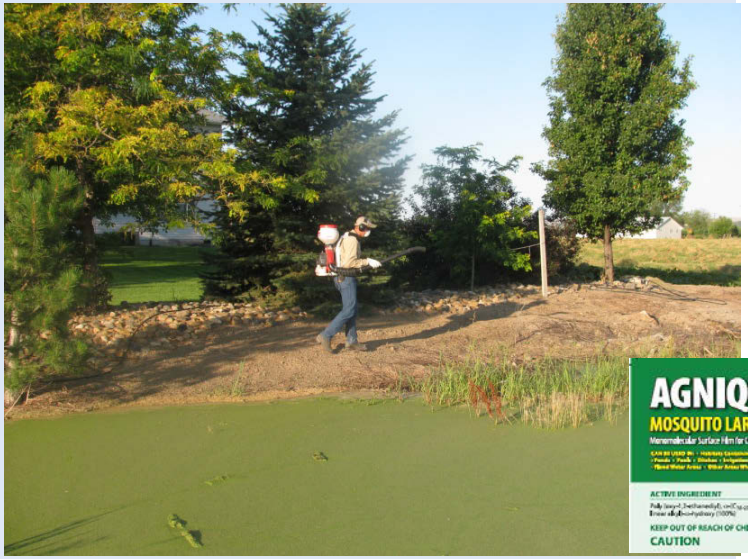
SPECIMEN LABEL

ACTIVE INGREDIENT:
(S)-Methoprene (CAS #65733-16-6)
(Dry Weight Basis) 2.1%
OTHER INGREDIENTS: 97.9%
Total . . . 100.0%

This product contains water; therefore the weight of the briquet and percent by weight of active ingredient will vary with hydration. The ingredient statement is expressed on a dry weight basis.

NOTE: (S)-methoprene insect growth regulator has no effect on mosquitoes which have reached the pupal or adult stage prior to treatment.

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION



SPHERATAX SPH (50 G)

ACTIVE INGREDIENT:
Bacillus sphaericus, Serotype H5a5b, strain 2362*.....5.00%
OTHER INGREDIENTS: 95.00%
TOTAL: 100.00%

* Equivalent to 50 Bacillus Sphaericus International Toxic Units (BS ITU) per mg of product (0.023 billion BS ITU per lb of product). Potency units should not be used to adjust rates beyond those specified in the Directions for Use Section. Note: The percent active ingredient does not indicate product performance and potency measurements are not federally standardized.

KEEP OUT OF REACH OF CHILDREN
CAUTION

The Third Step

- Trapping adult mosquitos
- Testing for the presence of West Nile virus and other arbovirus.

Adult Mosquito Control Applications

PUBLIC NOTICE

This area is scheduled to be sprayed with pesticide for mosquito control

West Nile virus has been detected in the Harper Valley and Little Valley areas. Aerial applications of pesticide are scheduled (weather permitting) for the evening of

Saturday July 14th

Applications will begin after 9:00pm

If you have questions or concerns please call

Malheur County
Vector Control District
541-473-5102 or 541-473-2307

Adult Mosquito Control

- The main workhorse is Synthetic Pyrethroids
  - Permethrin
  - Resmethrin
  - Sumithrin
- A few Organophosphate Chemistries still used
  - Malathion (Fyfanon)
  - Naled, (Dibrom Trumpet)

Unconventional Methods

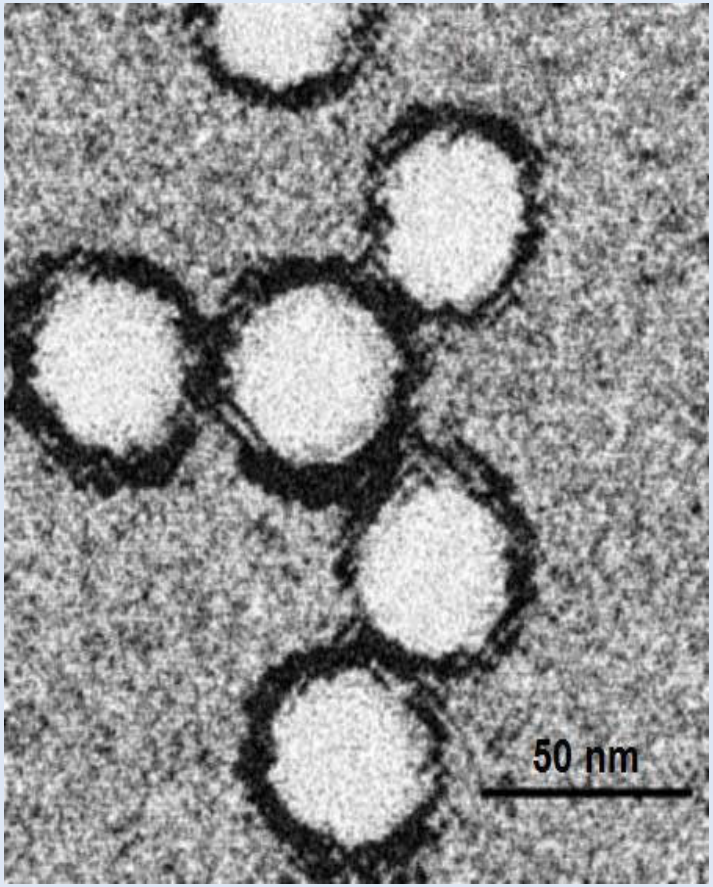
- Since they need plant sugars why not spray sugar solutions laced with pesticide
- Genetically modify them in such a way that limits their capacity to reproduce
- Reengineer their DNA over time to make it less likely they can transmit disease
- High Speed Lasers deployed as a screen
- Research the few species that don’t require blood meals to mature eggs

Arbovirus

(**AR**thropod-**BO**rne viruses)

in the Intermountain West

Arbo-Virus
West Nile virus



- West Nile virus (WNV) originated in Africa (Uganda) and was first detected in Europe in 1937. It has since spread to every continent
- Similar to other encephalitic disease, it is cycled between birds and mosquitoes and transmitted to mammals
- It first appeared in North America in 1999 in New York with 62 confirmed cases and 7 human deaths. Nine horses died in New York in 1999
- Currently, 65 mosquito and 300 bird species have tested positive in the United States for this virus.

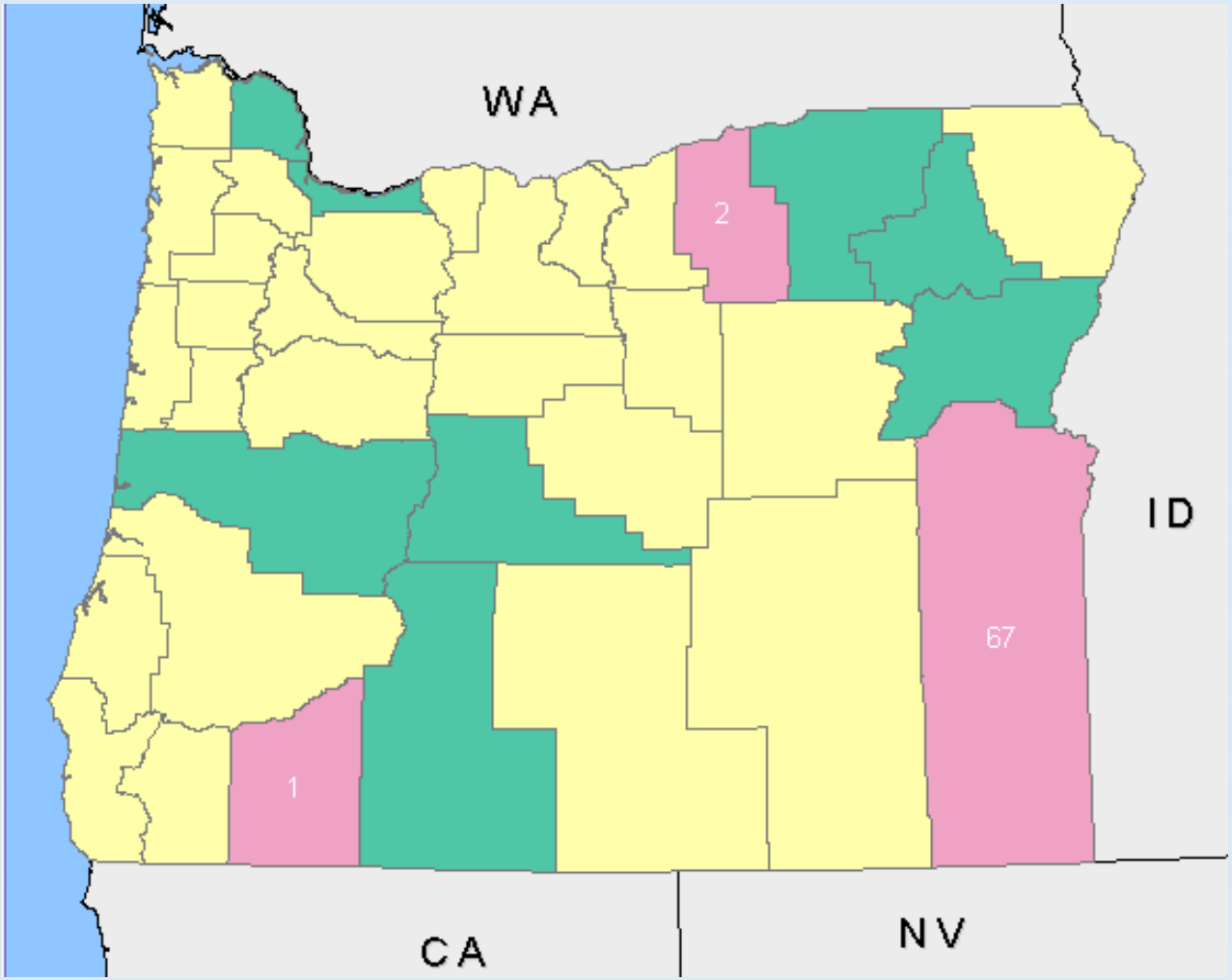
West Nile Virus

- WNV is primarily an avian virus most deadly to all Corvid species.
- Three distinct degree of symptoms in humans.
  - Asymptomatic, no detectable symptoms
  - Febrile, flu symptoms develop, rash, fever, headache, chills, sweats, swollen glands, nausea, diarrhea, lasting 7-10 days –
  - Encephalitis, meningitis symptoms, same early symptoms, rapidly increasing fever with decreasing consciousness, rapid involuntary muscle movement. Symptoms can linger for months or years
- Of the 341,000 human cases of West Nile Fever in the USA, over 12,000 progressed in neuro-invasive stage with 1200 plus fatal cases
- Majority of confirmed cases effect women and people over 50 years old or those with compromised immune systems

History of West Nile virus in Oregon

- 2004 had the first detected human case in Malheur County with 3 known cases in Oregon
- 2005 Oregon had 7 human cases with 4 in Malheur County
- 2006 Oregon had 69 human cases about half were in Malheur County with 2 fatalities
- 2007 Oregon saw 26 human cases again about half in Malheur County no fatalities
- 2008 Oregon had 16 human cases with 14 in Malheur County but no fatalities
- 2009 Oregon had 11 human cases 7 in Malheur County no fatalities
- 2010 Oregon had 1 human case in Malheur County
- 2011 Oregon had no human cases with the only detectable (mosquito pools) West Nile Virus in Malheur County.

WNv Positive Mosquito Pools in 2012

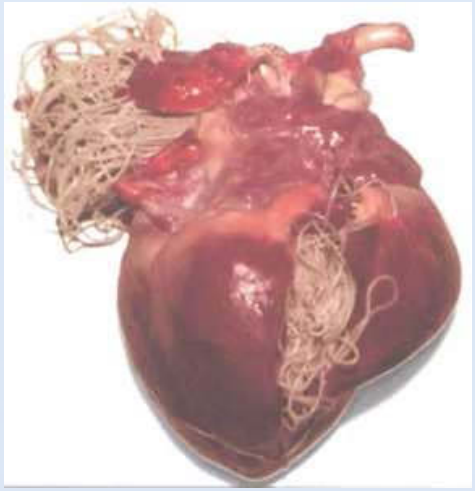


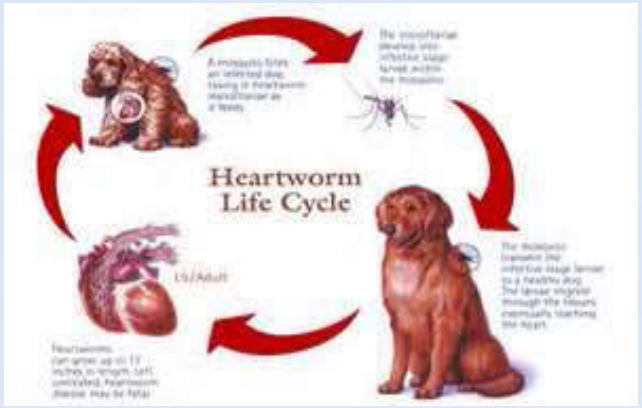
- Malheur County had 67 positive samples out of over 640 (32000 mosquito's)
- Malheur had 3 confirmed positive human cases, Coos County had one
- Klamath County had one positive horse

West Nile Virus
Observed Symptoms in Horses

1. Slight tremors around the head. May seem to be chewing constantly, eyes may blink uncontrollably, ears may be twitchy.
2. General lethargy progressing to a near sleep state from which they can't be awakened.
3. Later they will begin to stumble and wobble and seem to be unable to control their legs and feet.
4. Eventually they will become recumbent and won't be able to eat or drink.
5. Between 30% and 50% of horses diagnosed will die or be euthanized

Dog heartworm
(Dirofilaria immitis)





- Dog heartworm is caused by the transmission of the filarial nematode by mosquitoes.
- The adult worm will live in the right ventricle of the canine heart and pulmonary arteries.
- Leading to decreased cardiac output to the lungs, weakness, lethargy, chronic coughing, and ultimately congestive heart failure.
- The larva of the worm exit out of the mosquito's mouthparts during feeding and drops to the dog's skin, then enter the skin through the hole made by the mosquito.
- In 70-90 days, the larva will reach the dog's heart where it will stay and develop into an adult.
- Preventative measures are the best way to control dog heartworm, drugs can be administered after infection but these are costly and very painful for the animal.

Potential Arbovirus Outbreaks

- Malaria – As late as 1934 there were 125,566 cases in the US. Without mosquito control, malaria might reestablish from tourism and immigration
- Yellow fever – summer outbreaks in coastal cities along Gulf Coast and Atlantic seaboard north to Boston, into upper Mississippi River valley throughout the 19th century.
- Dengue fever – current problems along Texas border, powder keg awaiting movement northward from the Caribbean.
- Rift Valley Fever and Chikungunya virus are currently spreading to Europe and elsewhere. Species of mosquitoes that transmit these diseases are commonly found in the United States.
- Not specific treatments for these diseases. Not usually fatal symptoms can last for many months or occasionally for years

BE SAFE
Use Repellent

Gary Page
Malheur County Weed/Vector Dept
541-473-5102