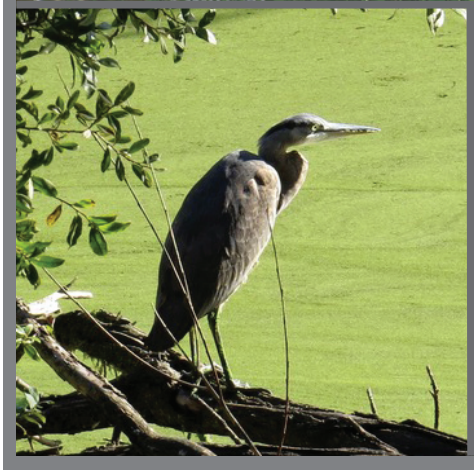
Caring for Your Large Pond

and the Wildlife that Use it



WEST MULTNOMAH
Soil & Water Conservation District

Scappoose Bay
WATERSHED COUNCIL

SAUVIE ISLAND
HABITAT PARTNERSHIP

10 easy things to do (or not do) to make your pond better habitat

1 Be messy

Tidiness is NOT next to godliness when it comes to habitat. Fallen leaves and branches, some tall grasses, etc. are all useful for a variety of species.

2 Leave some downed wood in and around your pond

Salamanders hang out under logs and the insects that scurry around under wood and bark are food for a variety of other species.

3 Leave snags

Standing dead trees provide perches for raptors as well as songbirds. They also are places where woodpeckers excavate nests and hunt for bugs. Woodpeckers create new nest cavities each year, leaving last year's holes for songbirds and swallows.

4 Leave some areas of bare soil.

Turtles lay their eggs in sparsely vegetated soil, especially on gentle south-facing slopes that get lots of sunshine. Many native bees nest in bare soil, too.

5 Leave or plant a thicket

Native shrubs like Nootka rose, snowberries and Oregon grape provide places our native brush rabbits and songbirds can scurry in to when predators are nigh.

6 Put up some nest boxes

Tree and violet green swallows, wood ducks and hooded mergansers, chickadees and nuthatches will all make use of bird boxes you make or buy. If you are in the right area, you might

even put up gourds to attract purple martins! Be sure to research the correct hole sizes and heights preferred by various species.

6 Pile up a few rocks

Small critters will use the spaces between them. Put them in a sunny place and garter snakes will enjoy them as choice places for basking.

8 Leave a brush pile

Lots of critters use brush piles for shelter and places to hide from predators. If you don't have one, consider building one, just for wildlife.

9 Get rid of invasive plants

(OK. This one isn't easy, but it's good exercise, and you can just do a little every week.)

10 Plant natives!

Meet your pond-loving neighbors

Green herons

Great blue herons and great egrets are kind of hard to miss, but you might not notice the smaller green herons that skulk around in the shadowy, brushier areas.

Black-headed grosbeaks

These colorful, orange and black birds with thick beaks show up in May and are often attracted to nest near ponds.

Cedar waxwings

These crested birds, with yellow tips on their tails, love to flit back and forth between the willows on your pond. If you really want to attract them, plant red elderberries, cascaras and other native plants with berries.

Purple finches

These are a little larger and overall rosier than the more common house finches, and they have a beautiful, fluty song. They like nesting in willows around ponds.

Red-winged blackbirds

The males are hard to miss with their bright scarlet epaulets with yellow trim. If your pond's surroundings are really in good shape, you might have a chance to get yellow-headed blackbirds as well.

Wood ducks and Hooded Mergansers

Both of these gorgeous species nest near ponds, and will readily use nest boxes that are just their size.

Red-legged frogs

You've seen and heard the little green (or sometimes brown) Pacific chorus frogs, but the larger red-legged frogs are more uncommon. They are always brown and have a pinkish color on the bottom sides of their legs that may or may not be obvious when they are just sitting around.

Northwestern and long-toed salamanders

You might come across these while moving downed wood or even just digging in soil. Like frogs, they make their way to your pond the winter to lay their eggs. Northwesterns are all espresso colored and long-toeds have a khaki colored stripe down their back.

Rough-skinned newts

These showy little salamanders have bright orange bellies and dark brown backs.

Western painted and Western pond turtles

Both of our native turtle species are getting rare these days, so if you have some living in your pond, consider yourself to be very, very lucky. Go to www.oregonturtle.org to find out what you can do to make them more at home.

Dragonflies and damselflies

From skimmers and meadowhawks to bluets and forktails, these colorful fliers are voracious predators as both adults and nymphs.

Water striders

keeping the pond clean, these long-legged bugs scoot around on the water, scavenging other insects that have gotten trapped on the surface.

Snails

Slow and steady, these shelled grazers scrape algae off of rocks and other firm surfaces.

Backswimmers

These boat-shaped, pale-backed bugs use their oar-like legs to propel themselves at high speed on their backs and are great fun to watch--and as a bonus, they love to eat mosquito larvae!

Predaceous diving beetles

Shiny streamlined beetles that dart to the surface to capture fresh oxygen, then dash below to return to the hunt for aquatic insects.

Native Plants for Northwest Ponds

(There are many great plants that work around ponds, but here are some excellent choices.)

Trees that don't mind having wet roots 💧💧💧	**Trees that don't mind soggy soil** 💧💧
Sitka Willow *(Salix stitchensis)* Oregon Ash *(Fraxinus latifolia)*	Black cottonwood *(Populus trichocarpa)* Black hawthorn *(Crateagus douglasii)* Suksdorff hawthorn *(Crateagus suksdorffii)* Pacific Willow *(Salix lucida var. lasiandra)*
Trees that can take it a little wet 💧	**Upland trees that support pond wildlife**
Western red cedar *(Thuja plicata)* Scouler willow *(Salix scoulerii)*	Bigleaf maple *(Acer microphyllum)* Cascara *(Rhamnus purshiana)* Grand fir *(Abies grandis)* Oregon white oak *(Quercus garryana)*
Shrubs that can take winter flooding 💧💧💧	**Shrubs that can take soggy roots** 💧💧
Douglas spiraea *(Spiraea douglasii)* Red-twig dogwood *(Cornus sericea)*	Snowberry *(Symphoricarpus albus)* Red elderberry *(Sambucus racemosa)*
Shrubs that can take a little wet 💧💧	**Upland shrubs that support pond wildlife**
Pacific ninebark *(Physocarpus capitatus)* Osoberry *(Oemleria cerasiformis)* Swamp rose *(Rosa pisocarpa)* Nootka rose *(Rosa nutkana)*	Red-flowering currant *(Ribes sanguineum)* Mock orange *(Philadelphus lewisii)* Oregon grape *(Berberis aquifolium)*
Shoreline plants 💧💧💧	**Forbs that don't mind soggy roots** 💧
Slough sedge *(Carex obnupta)* American brooklime *(Veronica americana)* Common rush *(Juncus effusus)* Marsh cinquefoil *(Potentilla palustris)*	Stream violets *(Viola glabella)* Stinging nettles *(Urtica dioica)* Lady fern *(Athyrium filix-femina)* Horsestails (*Equisetum spp.)* Small-flowered forget-me-nots *(Myosotis laxa)*

Upland forbs for sun that support pond wildlife	**Upland forbs for shade that support pond wildlife**
Canada goldenrod *(Solidaga elongata)* Douglas aster *(Symphotrichum subspicata)* Camas - common and greater *(Cammasia spp.)* Oregon bee plant *(Phacelia nemoralis)* Oregon sunshine *(Eriophyllumn lanatum)* Yarrow	Fringe cup *(Tellima grandiflora)* Piggy back plant *(Tolmiea menziesii)* Woodland strawberry *(Fragaria vesca)* Sword ferns *(Polystichum munitum)* Small-footed sedge *(Carex leptipoda)* Cow parsnip *(Heracleum lanatum)*
Rooted plants in the pond water 	**Floating plants in the pond water** 
Lanceleaf water plantain *(Alisma triviale)* Wapato *(Sagittaria latifolia)* Spike rushes (Eleocharis spp.) Common mare's tail *(Hippuris vulgaris)* Water smartweed *(Polygonum hydropiperoides)* Small-footed bulrush *(Scirpus microcarpus)* Spatterdock *(Nuphar polysepala)*	Common duckweed *(Lemna minor)* Giant duckweed *(Spirodela polyrrhiza)* Watermeal (*Wolffia columbiana)* Water pennywort *(Hydrocotyle ranunculoides)*
Submerged plants 	
Coontail *(Ceratophyllum demurum)* Canadian waterweed *(Elodea canandensis)* Leafy pondweed *(Potamageton foliosus)* Leafy water buttercup *(Ranunculus aquatillis)*	

Pondscaping for Humans

Mow a path

If you can easily stroll all the way around your pond, you are more likely to do so. And if you stroll around frequently, you are more likely to keep an eye on things and get inspired to improve them.

Plant a bench

Then plant yourself on it frequently with your morning coffee or your evening glass of wine. While you are sitting, you can listen to the birds, watch the dragonflies and contemplate your next wildlife habitat or pond improvement project.

Hang a hammock

After all your hard work making habitat for wildlife, you'll need a place to take a nap or read a book. Hint: Hammocks made from polyethylene rope hold up better than those made of cotton.

Turn spaces into places

Big expanses have big charm, but smaller spaces are often cozier. Look for "spaces" around your pond that have to potential to develop into cozy "places." Find a picnic table on Craig's List, create some seats out of rounds from an old tree trunk….or maybe this is where you hang the hammock.

Create some windows

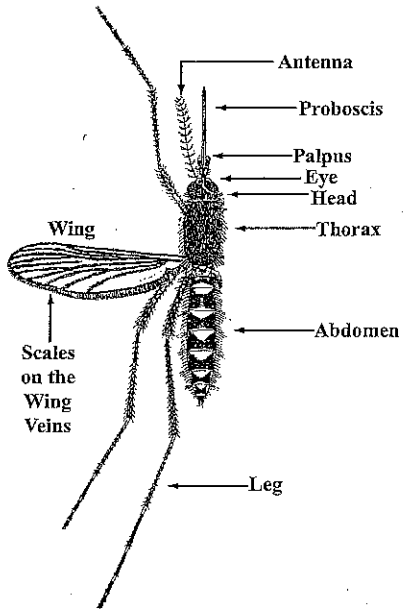
It's great to have a lot of willows and shrubs around your pond. But if they grow too much, you may need to clear out a "window" here and there so you can enjoy looking at the water and see into the pond's interior spaces.

Make space for art

Get creative on your own or support your local artists or craftspeople. Wonderful and inexpensive outdoor art abounds at summer festivals, or just do a search for garden art on Etsy.com.

MOSQUITO FACTS

Adult Female Mosquito



How Far Do Mosquitoes Fly?

Most mosquitoes fly only short distances from were they hatch. Some species can fly many miles from where they hatch.

Riding on a airplane, a mosquito can fly many thousands of miles. Airlines spray to kill any hijacking mosquitoes, preventing species from invading other countries.

Why Do Mosquito Bites Itch?

When a mosquito bites, it injects chemicals to prevent the blood from clotting and reduce pain. These chemicals cause irritation

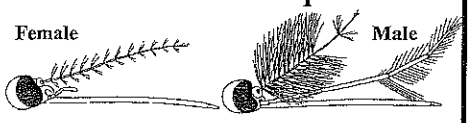
How Do Mosquitoes Choose Who to Bite?

Mosquitoes are attracted by CO_2 (Carbon dioxide) in our breath. They can detect this from great distances.

When the female mosquito gets close, she makes a final choice using skin temperature, odor and other chemical or visual factors.

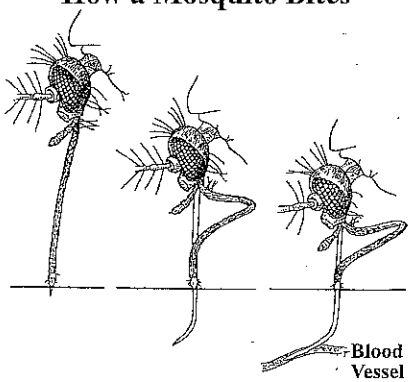
If two people are outside together, one will almost always get most of the mosquito bites.

How to Determine the Sex of Adult Mosquitoes



The Male mosquito may be distinquished from the female by the feather-like or plumose appearance of the antenna and palpus.

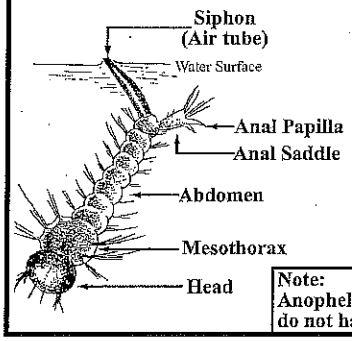
How a Mosquito Bites



The female mosquito probes the skin for an easy entry for her proboscis, then inserts the feeding stylets and searches for a capillary blood vessel. Once the stylets are in a capillary, the female will pump blood into her abdomen.

Blood is needed to provide protein for egg formation. Some species of mosquitoes can lay the first batch of eggs without a blood meal.

Mature Mosquito Larva



Note: Anopheles mosquitoes do not have a Siphon.

Do All Mosquitoes Suck Our Blood?

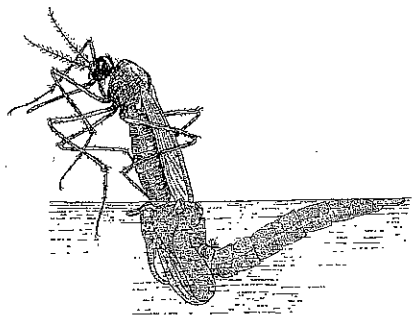
Only the female mosquitoes feed on blood, male mosquitoes feed on plant nectar and juices.

Some species only feed on the blood of amphibians (frogs). Mosquitoes have been observed feeding on other insects, even other mosquitoes.

Male and female mosquitoes in the genus Toxorhynchites feed on plant nectar.

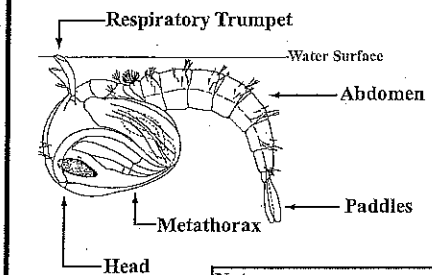
The minute mosquitoes in the genus *Malaya* wait for ants then thrust their proboscis between the mandibles (jaws) of the ant. The ant then feeds the mosquito.

Emergence of an Adult Mosquito



When a pupa is ready to become an adult mosquito, the pupa case splits open and an adult mosquito emerges from the pupa case. The adult mosquito then balances on the pupa case and the surface of the water until its wings are dry and hard. It can then fly away. During this transition, the mosquito is very vulnerable to wing, predators (such as water striders).

Mosquito Pupa



Note: Anopheles mosquitoes do not have respiratory trumpets

What Do Mosquito Larvae and Pupae Eat?

Mosquito larvae eat organic material, bacteria and microscopic plants and animals found in water. Pupae do not feed.

Some Interesting Mosquito Facts

With as many species of mosquitoes as there are in the world there are many different variations from the "normal" mosquito biology. Mosquito larvae and pupae in the genus *Coquillettidia* do not breath at the surface of the water, their siphon tubes are formed to puncture the hollow stems of aquatic plants for air. Some African *Anopheles* mosquito larvae pull themselves out of the water onto plant stems to avoid predators. Mosquito larvae in the genus *Toxorhynchites* eat other mosquito larvae and the adults of this genus have a curved proboscis to feed on nectar. Many mosquito species are adapted to use very specialized water sources such as the inside of pitcher plants, leave axels, abandoned snail shells, holes dug by crabs, cut bambo or rot cavities of plants. There is plenty more to be studied and discovered.

Alameda County Mosquito Abatement District
2000

Water Quality
The Purdue Extension Water Quality Team

Management of Ponds, Wetlands, and Other Water Reservoirs to Minimize Mosquitoes

PURDUE UNIVERSITY

Brent Ladd
Jane Frankenberger

Agricultural & Biological Engineering Department

Introduction

The recent discovery of West Nile virus in Indiana has directed increased attention to mosquitoes (carriers and transmitters of the disease) and potential means of controlling mosquito populations. Because mosquitoes are known to breed in standing water, many people are raising questions about the role of natural and artificial ponds and wetlands in relation to mosquito populations.

In addition to beautifying the landscape, ponds and wetlands provide important ecosystem services in Indiana such as storm water management, habitat for aquatic life, and ecosystem health and stability. Ponds and wetlands reduce storm water runoff problems by catching and slowing the movement of storm water. They help filter and clean rainfall and runoff water, and increase ground water aquifer recharge. Ponds and wetlands in the landscape provide for diverse flora and fauna, including birds, bats, aquatic insects, fish, and amphibians; all of which feed on mosquitoes. In addition to these positive aspects, ponds and wetlands provide recreational opportunities for many Hoosiers, including fishing, swimming, boating, and hunting.

Although under some circumstances ponds and wetlands can increase mosquito populations, predators of mosquitoes such as fish and other aquatic organisms will usually control mosquito populations if the pond or wetland supports a well-balanced ecosystem. This publication describes problems that make ponds and wetlands especially inviting to mosquitoes and how to develop and promote an ecosystem in your pond or wetland that controls mosquito populations by natural predation.

Management of ponds to minimize mosquitoes

Large & Natural Ponds

A well-functioning pond is characterized by a living ecosystem that includes fish and other aquatic organisms, stable banks with good plant cover, and a diversity of insect and animal life. Such a pond will have water with adequate and stable levels of oxygen, some surface wave action, and possibly a slight greenish tint from the presence of phytoplankton. In balance, phytoplankton provide the base of the aquatic food chain and are essential to

Purdue Extension
Knowledge to Go
1-888-EXT-INFO

Key Factors in Ponds that Reduce and Destroy Mosquito Larvae

- Fish and aquatic insects
- Surface wave action
- Disturbance from rainfall

a pond ecosystem. Ecologically stable ponds normally do not produce problem mosquito populations because the natural factors of fish predation and surface wave action tend to kill mosquito larvae. Ponds stocked with fish, such as Large Mouth Bass and Blue Gill, will greatly reduce or eliminate mosquito larvae.

Bats and Purple Martins consume mosquitoes, although field research has shown that they do not have significant effects on mosquito populations.[1,2] However, these species should be encouraged as they help complete a diverse ecosystem. Other birds, aquatic insects, dragonflies, fish, and amphibians all consume mosquitoes and their larvae and together serve as natural mosquito control.

In addition to fish, wave action or water movement on the pond surface is an important factor in reducing mosquito larvae survival rates. Natural ponds and most Indiana farm ponds will have adequate surface water movement and do not require additional aeration. In the case of stagnant ponds lacking water movement, or ponds lacking enough oxygen for fish survival, mechanical aerators can help improve the pond condition.

Ponds receiving excess nutrients can favor algae blooms and submersed aquatic vegetation. This situation can lead to increased mosquito egg laying in these ponds and pools due to excess plant cover, providing the larvae with protection from predators, wave action, and rainfall.[3] Mosquito larvae also feed on organic debris in water. These problem ponds need to be addressed by restoring the ponds with aeration and stocking them with fish. For more information on pond aeration and restoring water movement, contact one of the resource people listed at the end of this publication, or view the following Web publication: http://agpublications.tamu.edu/pubs/efish/370fs.pdf. Avoid the use of fertilizer within at least a 50 foot radius of ponds since this will help prevent excess nutrients from entering the ponds.

Make sure that high quality vegetative buffers are in place around ponds. These will slow or trap sediment, pesticides, and nutrients. Encouraging natural vegetation on the banks and shoreline of larger ponds may provide some adult mosquito habitat, however it also has many benefits for pond quality. Tall vegetation surrounding a pond makes it less attractive to geese. Large numbers of geese can degrade pond water quality and have also been implicated as vectors of West Nile virus.[4] In addition, natural vegetation surrounding large ponds provides habitat for predators of adult mosquitoes and their larvae.

Mosquito Prevention Checklist for Pond Owners

- ☐ Maintain high quality vegetative buffers around the pond.
- ☐ Use top feeding minnows and other fish to reduce or eliminate mosquito larvae.
- ☐ Use aeration to improve stagnant ponds.
- ☐ Prevent excess nutrients and pollutants from entering the pond.
- ☐ Do not spray chemicals or apply fertilizer near, uphill, or upwind from the pond.
- ☐ Prevent livestock from entering the pond and degrading the banks of the pond.
- ☐ Prevent ruts when mowing.
- ☐ Keep grass clippings out of the pond.
- ☐ Encourage patches of natural vegetation at pond edges to provide beneficial wildlife and insect habitat.
- ☐ Avoid shallow ponds and basins without fish or aeration.
- ☐ Employ chemical controls by a certified pesticide applicator only as a last resort.

A balance must be struck between open water and aquatic vegetation. A good rule of thumb is to have 30 percent of the shallow area of the pond in rooted-floating and submersed aquatic vegetation. These aquatic plants provide necessary habitat for fish and other wildlife and should be protected. The side slope of ponds influences the presence of submersed and rooted-floating aquatic plants. For more information on pond side slope and construction see the contact list on page 7 under the section: “Assistance with pond and wetland restoration and management.”

Types of Aquatic Vegetation

Emergent

- Plants that are rooted in the silt and pond shoreline such as cattails.

Rooted-floating

- Plants that are rooted under water in shallow areas and have floating surface vegetation such as waterlily.

Submersed

- Plants that have their roots under water in bottom sediments and grow up through the water such as pondweed.

Free-floating

- Very small plants that float on the surface such as duckweed.

For information on controlling invasive aquatic plants refer to the following Purdue Extension publications:
Aquatic Plant Management, WS-21,
www.agcom.purdue.edu/AgCom/Pubs/WS/WS_21.pdf
Barley Straw for Algae Control, APM-1-W
www.btny.purdue.edu/Pubs/APM/APM-1-W.pdf
Control of Duckweed and Watermeal, APM-2-W
www.btny.purdue.edu/Pubs/APM/APM-2-W.pdf

Small Backyard Water Gardens and Shallow Ponds

Small or very shallow ponds are prone to mosquito problems if they lack fish, water movement, or have their edges or surfaces completely covered with aquatic plants. If a small pond becomes stagnant restore water movement with a fountain, waterfall, or other aerator and stock the pond with minnows. Top feeding minnows will provide effective mosquito control in small ponds. A small fish that has received a lot of media attention is the Mosquito fish (*Gambusia affinis*). They have been shown to be the most effective fish for mosquito control in ponds not connected to natural waterways.[5,6] However, Mosquito fish do eat and affect habitat resources at varying levels and should not be considered for ponds connected with natural waterways.[7]

As water temperature rises it holds less oxygen. This may have a deleterious effect on fish in small and shallow ponds during summer months. Providing afternoon shade from hot summer sun for small and shallow ponds can improve conditions for fish by helping to keep water temperature from rising beyond the capacity of fish to tolerate. Artificial aeration will also help improve oxygen levels in small ponds. If mosquitoes are a problem, mowing around small backyard or shallow ponds may be necessary in order to eliminate adult mosquito habitat. Clippings from mowed vegetation can cause problems if they end up in the pond since they add excess nutrients and provide additional food and protection for mosquito larvae.[8] Make sure that clippings are prevented from entering the pond. For more information on backyard water gardens view this Web publication http://wildlife.tamu.edu/publications/TAEXPonds/789a.pdf.

Storm Water Ponds and Infiltration Areas

Ponds that have been built specifically for catching and holding storm water have important environmental benefits. When properly designed and managed these storm water ponds and infiltration areas should not become problem mosquito breeding habitat.[8] However, there are conditions under which these areas can encourage mosquitoes. When storm water holding ponds become nearly dry, vector mosquitoes may invade the ponds. Large fluctuations in water levels of storm water ponds can make the system ideal for floodwater mosquitoes. Monitor for mosquito larvae during periods when water levels remain low, or when water levels fluctuate frequently.

Areas designed to infiltrate, rather than hold, storm water can also become potential mosquito breeding areas. If these infiltration areas remain wet for periods longer than 72 hours, floodwater mosquitoes

are often the first to invade.[8] If poor management has resulted in grass cuttings or polluted runoff accumulating in these wet areas, vector mosquitoes can be found later in the summer season. Avoid placement of infiltration systems in areas where they are likely to remain wet for longer than 72 hours (e.g. where the water table is close to the surface). Storm water infiltration areas should be free of isolated depressions that could allow water to accumulate for longer periods. Mowing near infiltration areas should be done without producing ruts where water can collect, and grass clippings and debris should be removed regularly.

Use of Chemical Products in Ponds to Control Mosquitoes

Questions arise about the use of chemicals and other products for mosquito control. Due to a higher level of environmental and human health risk compared with natural mosquito control methods, chemical controls should be seen as a last resort. Chemicals for mosquito control are best left to certified pesticide applicators.[9] Before applying chemical controls, you should verify that the mosquito population in question is at risk for transmitting disease. For more information see the Purdue Extension publication *E-52-W, Mosquito Control by Trained Personnel,* www.entm.purdue.edu/Entomology/ext/targets/e-series/EseriesPDF/E-52.pdf.

Wetlands and mosquitoes

Natural Wetlands

Management practices that ensure healthy, functioning aquatic ecosystems are proven long-term and cost-effective strategies for controlling mosquito populations. Contrary to popular belief, natural wetlands can reduce the population of mosquitoes compared with drained or degraded wetland areas. According to the Indiana Department of Natural Resources-Division of Fish & Wildlife, wetland restoration decreases mosquito populations in two ways: by providing healthy habitat for the natural enemies of mosquitoes, and by preventing or reducing flooding in non-wetland areas. The IDNR fact sheet, *Did you know? Healthy wetlands devour mosquitoes* <www.in.gov/dnr/fishwild/publications/inwetcon/hlywet.pdf>, provides an example of one mosquito control project that documented a reduction of 90 percent in the mosquito population after restoring a 1,500 acre wetland area.[10]

To be certain, all wetlands will have populations of mosquitoes varying with the degree of wetness and air temperature. During drought periods when water in some wetland areas may be reduced to small or shallow pools, mosquitoes can migrate and congregate in these smaller areas of wetness, though populations of flood water mosquitoes overall tend to decrease during drought periods.[11,12] However, in areas where wetlands have been drained, mosquito populations thrive when these former wetland areas become inundated after rain storms.[10] Following rain, intermittent moist muddy or shallow stagnant water combined with an absence of predators of mosquitoes can allow the mosquito population to explode.[10,11,12,13] including disease carrying mosquitoes that breed only in stagnant water.[11] This type of flooding in non-wetland areas occurs more frequently *after* wetlands are drained, and this creates the most serious nuisance mosquito problems in Indiana.[10] The Indiana Departement of Natural Resources recommends restoring these wetland ecosystems.[10] For additional information on wetlands see the Purdue Extension publication *Wetlands and Water Quality, WQ-10* persephone.agcom.purdue.edu/AgCom/Pubs/WQ/WQ-10.html.

Long-term commitment to wetland restoration also saves tax payers money on mosquito control. A study of a 548 acre marsh in 1969 on the U.S. east coast reported spending $16,000 to implement wetland restoration. Since that time the wetland has

not needed any maintenance, cleaning, pesticides, or other costs. It was estimated that in a 25 year period since 1969 traditional insecticide methods would have cost $685,000.[10,14,15]

Constructed Wetlands

"Artificial" wetlands are being constructed in Indiana to control and treat storm water and wastewater. Whenever possible, constructed wetlands that treat wastewater should be located away from residential areas and beyond the flight range of local disease carrying mosquitoes. Locating constructed wetlands in open areas where wind can produce waves in the wetland will disrupt mosquito development.

Pollutant traps and sedimentation zones within the wetland should be managed to prevent blockages and pollutant buildup, as blockage can promote stagnant water. Maintaining water movement through the wetland is important for reducing mosquito populations. Riffle zones provide turbulence detrimental to mosquito larvae and also raise oxygen levels in the water.

Aeration systems for large constructed wetlands reduce mosquito larvae by disturbing the water surface, and sprinkler systems can inhibit mosquito egg laying. If constructed wetlands become overvegetated they provide ideal habitat for mosquito larvae due to being protected from predators and from rainfall and wave action. Maintenance of vegetation by harvesting and culling of plants can provide for increased water movement and predator access to mosquito larvae.

Managing water other than ponds and wetlands near the home

Mosquitoes that tend to lay their eggs in human-made reservoirs near residential areas are the primary disease carrying species, and are often referred to as vector mosquitoes.[11,16,17,18,19] More information on vector mosquitoes can be read online at www.entm.purdue.edu/Entomology/ext/targets/e-series/EseriesPDF/E-204.pdf. If you have a mosquito problem around your home, chances are good that they are breeding in your yard.

The number one action that homeowners can take to reduce vector mosquitoes near the home is to eliminate the reservoirs where these mosquitoes often breed.[20] The checklist on page 6, "Water reservoirs other than ponds and wetlands where mosquitoes may breed," provides a general list of these breeding areas. Consider that just one inch of water in an ordinary coffee can may result in as many as 1,000 mosquitoes every seven days. For a photographic chart of the life cycle of a vector mosquito visit the *Mosquito Hygiene Web site* at www.cfe.cornell.edu/erap/WNV/WNVEducDocs/MosqHygienePoster6-02.pdf.

In many cases, simply altering the reservoir will prevent mosquito breeding. For example, turning a wheelbarrow upside down to prevent pooling of stagnant water. In other instances, the reservoir should be eliminated, as in the case of abandoned tires. Regular maintenance is required for some reservoirs, such as keeping rain gutters cleaned of debris, and changing water in bird baths and pet bowls once a week. There are additional problem areas that fall into the jurisdiction of county and city officials, such as storm water drains and ditches. Contact your local health department for information and assistance.

For more information on mosquitoes and their control around the home refer to Purdue Extension publication, *Mosquitoes In and Around the Home, E-26-W*, www.entm.purdue.edu/Entomology/ext/targets/e-series/EseriesPDF/E-26.pdf.

An issue that deserves further inquiry

Ponds, wetlands, and residential environments in relation to mosquitoes are complex issues. This publication presents available information and strategies for pond, wetland, and water reservoir management as a way of helping Indiana residents to minimize mosquito problems. Further studies focusing on the effects of protecting and encouraging natural predators of mosquitoes through ecosystem restoration would shed light on some of these complex issues. Currently, only four percent of natural wetland areas in Indiana remain. As wetland areas are restored, mosquito populations and predator/prey relationships can be monitored. This publication will be updated as knowledge on this issue evolves.

Water reservoirs other than ponds and wetlands where mosquitoes may breed

Check if present	Potential reservoirs	Date problem remedied
☐	Basements with standing water	
☐	Birdbaths	
☐	Boats that have not been drained or covered	
☐	Cans, jars, or other open containers	
☐	Clogged house roof gutters	
☐	Culverts with stagnant water	
☐	Ditches that hold stagnant water	
☐	Drain outlets from air-conditioners	
☐	Dripping outdoor faucets	
☐	Flower pots	
☐	Leaf-filled drains	
☐	Leaking pipe joints	
☐	Livestock water tanks	
☐	Manure treatment lagoons	
☐	Old cisterns	
☐	Ornamental ponds	
☐	Over-irrigated lawns and fields	
☐	Saucers under potted plants	
☐	Septic absorption fields (if soggy)	
☐	Sewage treatment ponds	
☐	Standing water in tire ruts and horse or livestock lots	
☐	Storm water drain systems	
☐	Street gutters, catch basins at road corners	
☐	Stumps and tree holes	
☐	Swimming pool covers	
☐	Tires (abandoned)	
☐	Unsealed barrels	
☐	Wading pools or kiddie pools	
☐	Water cans, buckets, troughs, pet bowls	
☐	Wheel barrows or tilt-up carts	
☐	Wells in old frost pits that flood	

Assistance with pond and wetland restoration and management

Technical assistance is available from the agencies listed below. Some cost-share funds, as well as payment programs on agricultural lands, may be available for pond and wetland restoration and protection.

- Indiana Department of Natural Resources, Division of Fish and Wildlife, 402 W. Washington St., Rm. W273, Indianapolis, Indiana 46204. Phone: 317-232-4080 www.IN.gov/dnr/fishwild
- Indiana Natural Resources Conservation Service. Call 317-290-3200 for information. www.in.nrcs.usda.gov/
- The Purdue Extension Water Quality Web Site provides information and recommendations on many water quality subjects. www.ces.purdue.edu/waterquality/index.htm.
- Contact Purdue Extension, 1-888-EXT-INFO, and ask for the Aquaculture Specialist's contact information for fish related questions and ask for the Entomology Department for mosquito related questions.
- Jonathon Ferris, Purdue Extension Educator, is an aquaculture expert and can be contacted at 765-529-5002 for pond management questions.

References:

[1]Corrigan, R. *Do Bats Control Mosquitoes?* Presentation given to Texas Mosquito Control Association.

[2]Crans, W.J. *Products and Promotions That Have Limited Value for Mosquito Control*. Rutgers Cooperative Extension publication FS-867.

[3]Beehler, J.W., and M.S. Mulla. 1995. Effects of organic enrichment on temporal distribution and abundance of culicine egg rafts. Journal of the American Mosquito Control Association 11(2): 167-171.

[4]Bin, H., Grossman, Z. Pokamunski, S., Malkinson, M., Weiss, L., Duvdevani, P., Banet, C., Weisman, Y., Annis, E., Gandaku, D., Yahalom, V., Hindyieh, M., Shulman, L., and Mendelson, E. 2001. *West Nile fever in Israel 1999-2000: From geese to humans*. Annals of the New York Academy of Sciences, 951: 127-142.

[5]Homski, D., M. Goren, and A. Gasith. 1994. Comparative evaluation of the larvivorous fish Gambusia affinis and Aphanius dispar as mosquito control agents. Hydrobiologia 284(2): 137-146.

[6]Offill, Y.A. and W.E. Walton. 1999. Comparative efficacy of the threespine stickleback (Gasterosteus aculeatus) and the mosquito fish (Gambusia affinis) for mosquito control. Journal of the American Mosquito Control Association 15(3): 380-390.

[7]Lawler, S.P., D. Dritz, T. Strange, and M. Holyoak. 1999. *Effects of introduced mosquitofish and bullfrogs on the threatened California Red-Legged Frog*. Conservation Biology 13(3): 613-622.

[8]*DH-74, Mosquitoes and Stormwater Management*. 1993. In, University of Florida Disaster Handbook Guide.

[9]Williams, R.E., Sinsko, M.J., and G.W. Bennett. 2002. *Mosquito Control by Trained Personnel*. Purdue Extension publication E-52-W.

[10]IDNR Fact Sheet: Indiana Wetlands Conservation Plan. *Did you know? Healthy wetlands devour mosquitoes*. IDNR-Division of Fish & Wildlife, Rm W273 I.G.C.S., 402 West Washington Street, Indianapolis, Indiana 46204.

[11]Shaman, J., Stieglitz, M., Stark, C., Le Blancq, S., Cane, M. 2002. *Using a Dynamic Hydrology Model to Predict Mosquito Abundances in Flood and Swamp Water*. Emerging Infectious Diseases, 8 (1): 6-14.

[12]Shaman, J., Day, J. F., Stieglitz, M. 2002. *Drought-Induced Amplification of Saint Louis encephalitis*

virus, Florida. Emerging Infectious Diseases, 8 (6): 575-581.

[13]Jensen, T., D.A. Carlson, D.R. Barnard. 1999. Factor from swamp water induces hatching in eggs of Anopheles diluvailis (Diptera: Culicidae) mosquitoes. Environmental Entomology 28(4): 545-550.

[14]Hansen, J. The economics of mosquito control. www.umaa.org/ecomosco.htm

[15]Hansen, J.A., Lester, F.H., Lombard, R.W., Shisler, J.K. and Slavin, P. 1976. The economics of marsh water management – a New Jersey view. New Jersey Mosquito Extermination Association, 63: 77-81.

[16]Andreadis, T.G., Anderson, J.F., Vossbrinck, C. R. 2001. *Mosquito Surveillance for West Nile Virus in Connecticut, 2000: Isolation from Culex pipiens, Cx. restuans, Cx. salinarius and Culiseta melanura*. Emerging Infectious Diseases, 7 (4): 670-675.

[17]Kulasekera, V.L., Cherry, B., Glaser, C., Miller, J. R., Kramer, L., Nasci, R.S., Mostashari, F., Trock, S.C. 2001. *West Nile Virus Infection in Mosquitoes, Birds, Horses, and Humans, Staten Island, New York, 2000*. Emerging Infectious Diseases, 7 (4): 722-726.

[18]Ratcliffe, S.T. 2002. National Pest Alert: West Nile Virus in North America. USDA CSREES Regional Integrated Pest Management Program and Pest Management Centers.www.ncpmc.org/NewsAlerts/westnilevirus.html

[19]Turell, M.J., Sardelis, M.R., Dohm, D.J., and O'Guinn, M.L. 2001. *Potential North American Vectors of West Nile Virus*. Annals of the New York Academy of Sciences, 951: 317-324.

[20]Williams, R.E., and G.W. Bennett. 2002. *Mosquitoes in and around the home*. Purdue Extension publication E-26-W.

Reviewers include John MacDonald, Purdue Entomology; Carole Lembi, Purdue Botany & Plant Pathology; Bill Maudlin, Indiana DNR Wetlands Specialist; Steve Lovejoy, Purdue Agricultural Economics; Jonathon Ferris, Purdue Extension Educator, Bob McCormick, Purdue Extension and Illinois-Indiana Sea Grant; John Knipp, Purdue Extension Educator; Jon Cain, Purdue Extension Educator; and Don Jones, Purdue Agricultural & Biological Engineering.

This publication is dedicated in memory of Chris Bitler, former Newton County Educator and Purdue Extension Water Quality Team member.

Purdue Extension
Knowledge to Go
1-888-EXT-INFO

New 06/03

United States Environmental Protection Agency

Wetlands & West Nile Virus

West Nile Virus (WNV) first appeared in the United States in 1999. Since its inital outbreak in New York City, the virus has spread across the country from East to West. Female mosquitoes transmit the virus primarily by infecting birds. Occasionally, mosquitoes transfer the virus from birds to humans, most of whom experience no symptoms. One out of five infected people develop West Nile fever, characterized by mild, flu-like symptoms. Infection can sometimes, although rarely, be fatal for humans. Since West Nile is lethal in some bird species, unusual bird deaths may signal human outbreaks.

Protect Yourself

Wear long sleeves and pants, especially when near stagnant or polluted water.

Be mindful of mosquito activity, which peaks at dusk and dawn in summer months.

Consider using mosquito repellants, if necessary, that contain DEET.

Broadleaf arrowhead

Are Wetlands a Threat?

Healthy wetlands are not uncontrolled breeding grounds for mosquitoes. Healthy wetlands sustain numerous species of mosquito-eating fish, amphibians, insects and birds, all of which help limit mosquito populations.

The principal mosquito carrier of West Nile virus on the East coast, *Culex pipiens*, does not prefer to reproduce in most wetlands. These species reach greatest numbers in large urban centers, breeding easily in artificial containers—birdbaths, discarded tires, buckets—and in human-created environments, such as clogged gutters, animal waste lagoons and sewage effluent. Adapted to polluted habitats, these *Culex* species generally avoid swamps and salt marshes altogether.

Damaged or degraded wetlands can provide ideal habitat for some mosquito species that carry West Nile. Excess nutrients in contaminated waters can spur microbial growth and cause harmful algal blooms, which feed mosquito larvae. Filling or draining wetlands may also increase mosquito outbreaks, as an altered landscape with stagnant pools of water may no longer contain mosquito predators.

Sometimes, even healthy wetlands may harbor large numbers of mosquito species that carry WNV. Unlike *Culex pipiens*, *Culex tarsalis*, the major WNV vector in western states, prefers to breed in clean water. Therefore, it may be necessary to use appropriate mosquito control measures to prevent WNV disease transmission.

Disease Transmission

Mosquitoes are the primary vectors of West Nile, meaning they carry the virus from host to host. While nectar is their primary food source, females take blood in order to develop their eggs. Mosquito activity is reduced in colder months, but the virus may still persist in dormant mosquitoes and eggs that survive winter.

The Centers for Disease Control and Prevention (CDC) reports that 43 mosquito species in the United States have tested positive for West Nile virus. The most common carriers are the House mosquito (*Culex pipiens*) on the East coast and *Culex tarsalis* in the West. Because it readily feeds on humans, *Culex salinarius* is also an important vector.

Since mosquitoes primarily infect birds, unusual bird deaths may signal a WNV outbreak and should be reported to appropriate local, county or state agencies. Based on analysis of 2001 and 2002 data, the CDC reports that counties that report WNV-infected dead birds early in the transmission season are more likely to report subequent WNV disease cases in humans.

***Culex pipiens* (House mosquito)**
Culex pipiens is the primary West Nile vector in the eastern United States. It can be found in urban and suburban settings, has a flight range of 1/4 to 1 mile and prefers to breed in standing water, especially in water polluted with organic matter.

Culex salinarius
Found in fresh and saltwater marshes, lakes and ponds, *Culex salinarius* also prefers artificial containers around human residences and businesses. Because it readily feeds on humans, evidence indicates that it may be responsible for transmitting West Nile to people.

***Culex tarsalis* (Western Encephalitis mosquito)**
An abundant mosquito in Western States, it breeds primarily in irrigated agricultural areas and in temporary or seasonal depressions. It is most active at dusk and feeds on humans, domesticated animal and birds. It is the primary vector for West Nile in the midwestern and western states.

Protect Your Home & Community

1 Eliminate stagnant water
Limit the number of places available for mosquitoes to lay their eggs by eliminating standing water sources from around your home (e.g., tires, garden pots and bird baths).

2 Protect wetlands from pollution
Including runoff from farms, lawns and roads with buffers, since contaminated water attracts mosquitoes.

3 Check Stormwater Systems
Ensure that stormwater catchments and constructed wetlands are properly designed and maintained.

4 Install Screens
Install or repair screens on doors and windows so that mosquitoes cannot get indoors.

5 Consider Using Pesticides
If necessary, try larvicides before adulticides, since larvicides more effectively control mosquitoes. Carefully follow instructions on the pesticide's label.

Wetland Restoration
and Mosquito Reduction in New Hampshire

Prior to its restoration in 1999, the two-acre Edmond Avenue wetland was in critical condition. Residential development near Portsmouth, New Hampshire, had partially filled the wetland, and urban and stormwater runoff had contaminated the water. Increased sedimentation had reduced the extent of open water, and invasive plants choked out native species.

Degraded wetland - shallow, stagnant pools harbor many mosquitoes.

By 1996, the continued degradation of the Edmond Avenue wetland transformed the ecosystem into a major breeding site for mosquitoes, including the *Culex* species primarily responsible for West Nile transmission. During 1996-1999, the application of mosquito larvicides and sprays jumped to 4-5 times per year, a four-fold increase from the previous 15 years. Since its restoration in 1999, the Edmond Avenue wetland no longer requires mosquito control measures. The restored wetland lacks stagnant depressions and is deep enough in some areas to support fish that eat mosquitoes. Wave action also disrupts mosquito breeding. Results have been astonishing—a near 100% reduction in mosquito habitat and the virtual elimination of *Culex* species, not to mention improved water quality and bird habitat.

Restored wetland - carefully designed open water habitat supports ducks, as well as fish that eat mosquitoes.

EPA 843-F-04-010
Office of Water
August 2004

West Nile Resources

Centers for Disease Control and Prevention, West Nile Virus
http://www.cdc.gov/ncidod/dvbid/westnile/

Maps of West Nile Occurence in the United States
http://westnilemaps.usgs.gov

State and Regional Information
http://westnilevirus.nbii.gov/states/

Cornell University, Center for the Environment
http://environmentalrisk.cornell.edu/WNV

American Mosquito Control Association
htttp://www.mosquito.org

EPA's Wetlands Division
http://www.epa.gov/owow/wetlands

Frequently Asked Questions:

• *How many people have become infected with WNV?*

For 2003, the CDC recorded 9,858 human cases and attributed 262 deaths to WNV nationwide.

• *Will draining or filling a wetland prevent WNV?*

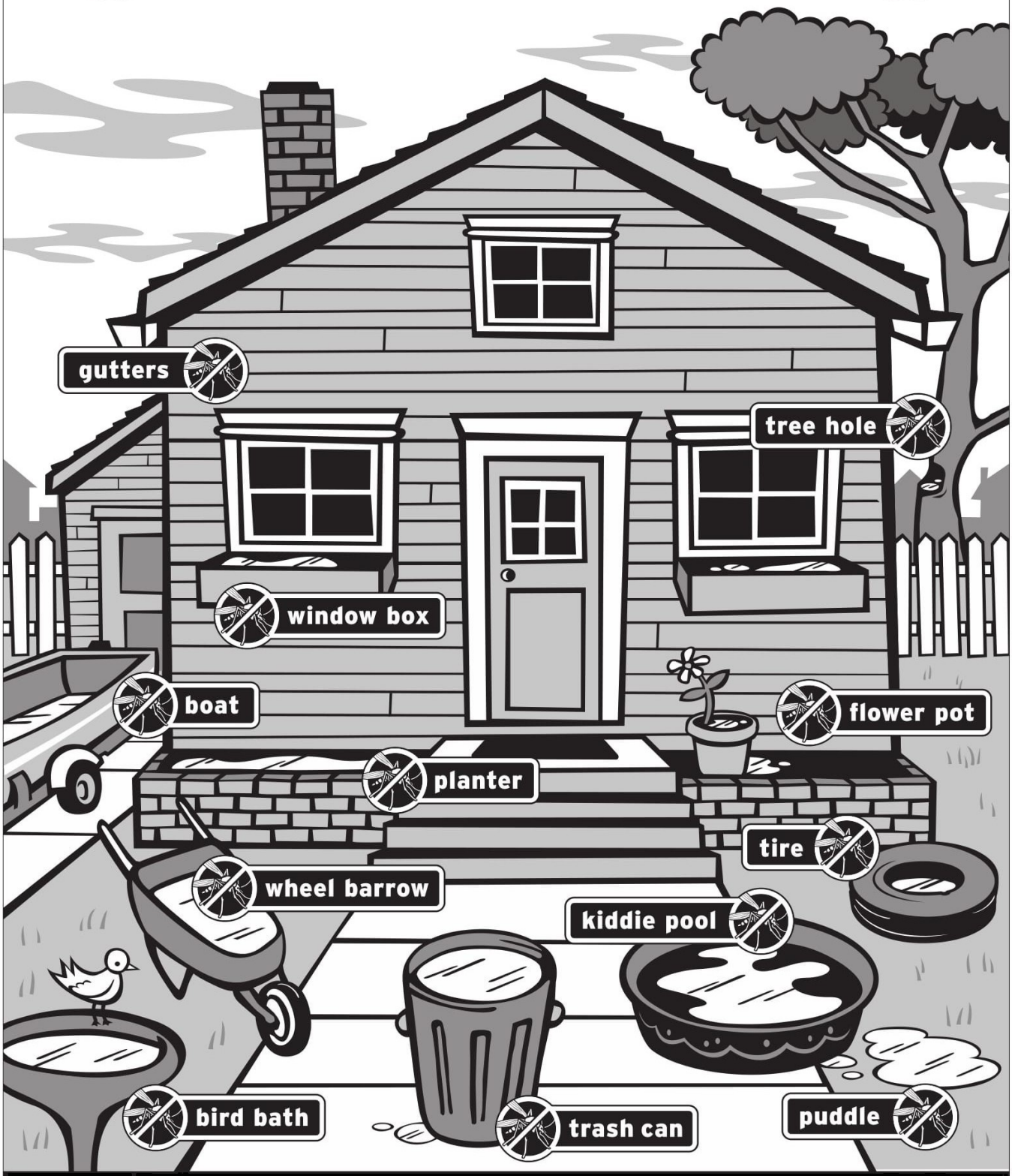
Draining or filling wetlands is not a necessary or appropriate way for controlling mosquitoes or WNV. Healthy, functioning wetlands typically have a balanced predator-prey relationship that provides natural mosquito control measures. Draining or filling a wetland may require a federal, state, tribal or local permit. Contact your regional Army Corps of Engineer's Office.

• *How far do mosquitoes travel?*

Many of the mosquitoes that transmit WNV have very short flight ranges. Therefore, eliminating backyard mosquito habitat, such as stagnant water or blocked roof gutters, can help control mosquito populations.

Fight the Bite

PROTECT YOURSELF AGAINST WEST NILE VIRUS.
EMPTY ALL WATER AROUND YOUR HOME
WHERE MOSQUITOS CAN BREED.



MULTNOMAH COUNTY

CALL 503-988-3464 FOR MORE INFORMATION

MULTNOMAH COUNTY VECTOR CONTROL AND CODE ENFORCEMENT

Health Department

Environmental Health Services
Vector Control and Code Enforcement

Dear Multonomah County Resident,

Multnomah County Vector control is tasked with the job of monitoring and controlling mosquitoes for the purpose of disease and nuisance prevention. We survey and control Mosquito habitats along public right of ways. We offer the following, but not limited, services to assist homeowners with mosquito problems:

- Assist property owners with identifying potential mosquito habitat on their property.
- Make recommendations to help minimize mosquito populations.
- Provide Mosquito fish (*Gambusia affinis*) to closed water systems that are not directly connected to natural waterways or at risk of flooding by natural water systems. i.e. pools, lined ponds, troughs, or rain barrels.
- Help with concerns of mosquito habitat on neighboring properties.
- Identify adult mosquito species for more targeted control.
- Answer any additional questions.

Multnomah County Vector Control agrees that healthy, balanced ponds, with many natural predators and native plants are self-limiting when it comes to mosquito populations.

However, Homeowners are responsible for eliminating sources of mosquito habitat on their property, including buckets, tarps, wheel barrows, bird bathes, boats, children's toys, rain barrels and other water holding containers. These unnatural water sources tend to produce the most mosquitoes, while also being the easiest to prevent.

To protect yourself from mosquito bites follow these simple guidelines:

5235 N Columbia Blvd. • Portland, Oregon 97203 • Phone: 503.988-3464 Fax: 503.988.5813

- Limit time outdoors when mosquitoes are most active at dusk and dawn

- Wear a mosquito repellent as according to its label.

- Wear lightweight long sleeve clothing.

- Install and repair window screens on your house.

- Eliminate standing water on your property.

If you have any additional questions, please feel free to contact us at 503.988.3464 Monday- Friday 8:00 am to 4:00 pm or check out or website for additional help.

Multnomah County Vector Control,

5235 N Columbia Blvd
Portland, Oregon 97203
503.988-3464
Fax: 503.988.5813
https://multco.us/health/staying-healthy/pest-prevention-and-control/vector-control-code-enforcement

5235 N Columbia Blvd. • Portland, Oregon 97203 • Phone: 503.988-3464 Fax: 503.988.5813
https://multco.us/health/staying-healthy/pest-prevention-and-control/vector-control-code-enforcement

PennState Extension

Barley Straw for Algae Control

In recent years, the use of barley straw has become more common as an alternative method for controlling excessive algae growth.

ARTICLES | **UPDATED: JANUARY 22, 2013**

A weighted onion bag with loose barley straw.

The problem

Excessive algae growth is one of the most common problems occurring in ponds in Pennsylvania. Traditional mechanical and chemical control methods are not always efficient or economical.

In recent years, the use of barley straw has become more common as an alternative method for controlling excessive algae growth. This method has been extensively studied by Dr. Jonathan Newman at the Centre for Aquatic Plant Management in Great Britain. This page summarizes the use of barley straw based on Dr. Newman's work and our experiences in Pennsylvania.

When applied at the proper time and rate, barley straw has been a very successful algae control technique in Pennsylvania ponds.

How does it work?

Barley straw does *not* kill existing algae, but it inhibits the new growth of algae. The exact mechanism is poorly understood, but it seems that barley straw, when exposed to sunlight and in the presence of oxygen, produces a chemical that inhibits algae growth.

Barley straw does *not* reduce the growth of other aquatic plants. In fact, in some cases aquatic plant growth has increased after barley straw applications because algae are no longer present to compete with the aquatic plants.

When should it be applied?

Barley straw is most effective when applied early in the year prior to the appearance of algae (fall through early spring). When applied to cold water (less than 50°F), it may take six to eight weeks for the straw to begin producing the active chemicals that inhibit algae growth.

If the straw is applied to warmer water (above 70°F), it may become effective in as little as one to two weeks. In any case, barley straw remains effective for approximately six months after application.

How much straw?

The most common application is about two to three bales per surface acre of pond (or about 10 to 25 grams of straw per square meter of pond area). The depth of water in the pond is not important. In ponds that are frequently muddy or those that have a history of heavy algae growth, two or three times this recommended dose may be required for the initial treatment.

However, overdosing the pond with barley straw may cause fish kills because the straw deoxygenates the water as it decays. This is especially a problem if the pond is overdosed with straw during a prolonged warm spell.

How to apply the straw?

The straw is most effective when applied loosely in cages or netting. It is best to anchor the straw packages to the bottom, but provide a float to keep the straw near the surface of the pond where sunlight and oxygen are more prevalent.

Apply the straw at several locations around the pond and especially near the water source if a spring or stream feeds the pond. In small garden ponds, small nets or nylon stockings can be used to hold the small amounts of straw needed.

Where can I get barley straw?

Finding a local supplier of barley straw can sometimes be difficult. You might consult with private and government agencies that work with local farmers, such as farm supply companies, extension offices, and Conservation District offices, to determine if barley straw is locally available.

In addition, several suppliers are available online (just type "barley straw" in your favorite search engine).

Oregon Department of Fish and Wildlife
3406 Cherry Ave NE
Salem, OR 97303
www.dfw.state.or.us

Living with Wildlife

OREGON DEPARTMENT OF FISH AND WILDLIFE

BATS

Bats are the only flying mammals, they use sound to locate their prey, and they live a very long time for such small animals. Oregon does not have spectacular congregations of thousands of bats like those found in Texas caves. The species found here are varied and interesting, but either solitary or found in small colonies.

While bats in other parts of the world feed on fruit, fish, nectar, or even blood, all Oregon bats dine on insects. They consume pests such as spruce budworm moths, tussock moths, mosquitoes, pine bark beetle moths and gypsy moths. A bat can catch up to 600 insects in an hour.

Photo: Bat Conservation International

Townsend's big-eared bat

People who mean no harm to bats often do not understand how vulnerable bats are to disturbance of their roosting sites. Thus these beneficial and harmless animals have been killed or have been unable to reproduce enough to maintain their numbers. While accurate counts of these small, nocturnal, and widely distributed animals are very difficult, there is evidence that some species are declining.

BAT FACTS

Bats are members of the order Chiroptera, meaning "hand-wing." Like all mammals, bats have warm blood and hair. They bear live young and nurse them with milk. Their wings are supported by long finger bones covered with two thin layers of skin, like the webbing between your thumb and first finger. This skin covering extends to the legs and, in some species, between the legs to the tail. Bats can use the wing and tail membranes to scoop insects. Bats have small, movable thumbs on the top of their wings for grasping and climbing. Their back feet are used for hanging.

Wings make bats look bigger than they really are. The biggest bat in Oregon is the Hoary bat, which weighs about an ounce, or about the same as five quarters.

(Continued on page 4)

ODFW: 12/00

Photo: Bat Conservation International

Hoary bat

What Bat is That?

Bats are easy to distinguish from other mammals simply because they have wings. In the field, their twisting flight pattern and nocturnal activity separate them from birds, although many people confuse bats with swifts. About 1,000 species are found throughout the world, 15 of them in Oregon.

Big brown bat *(Eptesicus fuscus)*. This is a relatively large bat, with a wingspan of 13 to 14 inches. The large size, dark color and slow flight help identify it. It is more likely to be active in cold weather than other bats. Ears are relatively short and black. It is common throughout the state and prefers human structures for roosting, so this bat is seen fairly often. It usually lives in colonies, often with other kinds of bats.

Myotis bat *(Myotis spp.)*. Seven species of the genus Myotis live in Oregon, all of them small brown bats with wingspans of 10 inches or less. Many are difficult to identify; most live in forests. The little brown bat is the most common and is frequently found in buildings. The fringed myotis and the western small-footed myotis are the least common. Myotis bats dwell in rock crevices, trees and human structures. As a group, myotis bats are the most abundant in Oregon, but several species are declining and/or are species of interest by the U.S. Fish and Wildlife Service.

Hoary bat *(Lasiurus cinereus)*. This is one of the most colorful bats in Oregon. It is also the biggest bat in Oregon, with a wingspan of nearly 16 inches. The body has dark fur tipped with white. The face has a dark mask, with a yellow-orange throat. The nearly round ears are edged in black. It is distinguished from the similar silver-haired bat by these markings and by patches of stiff, light tan hairs on its wrists. This impressive solitary bat roosts among the branches of both deciduous and coniferous trees throughout the state and likes to feed around permanent outdoor lights. They do not roost in buildings. This fast-flying bat migrates to southern California or perhaps beyond, returning to Oregon in the spring. It often bears twins.

Silver-haired bat *(Lasionycteris noctivagans)*. This solitary bat found in old growth forests has a wingspan of about 10 inches. The fur is glossy black, tipped with white. This bat looks somewhat similar to the hoary bat, but is smaller and lacks colorful markings. It is found throughout Oregon. This is usually the first bat out in the evening, emerging about 30 minutes after sunset. It often forages over woodland ponds, streams, meadows and roads, often flying very low. Like the hoary bat, it usually bears twins. It often roosts behind loose tree bark.

Pallid bat *(Antrozous pallidus)*. This is a large, pale bat with huge ears, large eyes and a dog-like face. Its wing beat is slower than most bats. It emerges late at night to feed primarily on the ground, eating large beetles, crickets and scorpions. It produces a musky odor when disturbed. The pallid bat is uncommon and is found mostly in arid regions in canyons.

Townsend's big-eared bat *(Plecotus townsendii)*. This is a medium-sized bat with enormous inch-plus long ears. It is gray, brown, or black and has a large lump on each side of its nose. It is generally active only after full darkness and sometimes collects insects from the air, as well as on plants. This is the bat most often found in caves; it usually hibernates instead of migrating. This species is very vulnerable to human disturbance and its numbers are declining sharply across its entire range, which includes most of the western United States. In Oregon, it is classified as a sensitive species in the "critical" category.

Western pipistrelle *(Pipistrellus hesperus)*. The smallest bat in the United States, this species weighs less than one-quarter ounce (5 grams). The fur is pale yellow or brownish gray. The ears are relatively short and it has a dark face mask. This bat is common only in the Owyhee uplands in extreme southeastern Oregon. It flies early in the evening, well before dusk, and has a characteristic fluttering flight.

Spotted bat *(Euderma maculatum)*. Spotted bats are rare in Oregon and seen only on the east side of the state. This is a medium-large bat with ears longer than those of any other bat in the U.S. It has dark fur with three large white spots—two on the shoulders and one on the rump.

Brazilian *(Mexican)* **Free-tailed bat** *(Tadarida brasiliensis)*. Roseburg, Oregon may be the most northern part of this bat's wide range. This is a fast-flying, medium-small bat with long narrow wings and a tail that extends beyond the membranes. This is the bat found in huge colonies in Texas. It appears to survive the cold winters in Oregon by staying in heated buildings instead of hibernating or migrating, often sharing these quarters with other bat species.

Keeping Our Bat Populations Healthy

Bats have lost many of their natural roosting sites in old trees, snags and caves as a result of human activity. Some species can roost in man-made structures. Conservation includes protecting natural sites and encouraging bats to use bridges, culverts and mines where their activity does not interfere with human use of these structures.

Photo: Bat Conservation International

Big brown bats

The Oregon Department of Fish and Wildlife is protecting old mines used by bats from human disturbance, advising people who have bats in their buildings, working with consultants on designing bridges so that bats can use them as roosts, and surveying the state's population of Townsend's big-eared bats. Many of these activities are in cooperation with the U.S. Forest Service, Bureau of Land Management, Bat Conservation International, The Forest Industry, U.S. Fish and Wildlife Service, Oregon Department of Transportation, Oregon Department of Forestry, other agencies and private landowners.

Rabies

Less than 1/10 of 1 percent of all bats are believed to carry rabies. Infected bats are rarely aggressive and soon die of the disease. Nonetheless, always avoid contact with any bat. If you are bitten or scratched by a bat, or any other wild animal, or have any contact with the animal's saliva, report it to your doctor and local health authority immediately. Capture the bat, if possible.

More Information

General:

America's Neighborhood Bats by Merlin D. Tuttle

Web sites:

http://www.torstar.com/rom
Tour a bat cave in Jamaica.

http://www.batcon.org
Visit Bat Conservation International. See their Bat Links page for many other sites.

Getting Along with Bats

Here are some tips for peaceful coexistence with your bat neighbors.

- In winter, avoid places where bats hibernate, because awakening a bat depletes energy reserves. A bat can lose 10 to 30 days worth of fat reserves from being awakened and then is at risk of starvation before spring arrives. Support protecting caves from human use when bats are present.
- In summer, avoid disturbing nursery caves or roosts. Frightened mother bats may drop or abandon their babies.
- Bats need open water. Support efforts to preserve, create and enhance marshes and wetlands.
- Never touch or pick up a bat. It may bite in self-defense like any other wild animal. A bat you or your pet can catch outside is probably sick and should be left alone. Do not handle dead bats.
- If a bat flies into your house, remove pets and children and close the room and closet doors. Open the windows and quietly watch the bat until it leaves. The bat is most likely lost, young and eager to leave. Watch it to be sure it leaves.
- If bats are roosting in your attic, you may want to evict them. Keep in mind that a small colony may have lived peacefully with you for years before you noticed them—it's not an emergency. Watch the building at dusk to see where the animals are leaving. Then during the day, identify all possible entrances, including any more than 1/4 inch by 3/4 inch. Do not close up entrances in summer when baby bats are present, or the babies will die without their mothers. Wait until all bats have left, then cover holes with netting, place a one way valve to ensure bats can exit but not return, or fill all holes and cracks. Bats will not gnaw at barriers you install. You can also spray the roost (not the bats) with dog or cat repellant. Poisons are not recommended; they are a serious health hazard to humans living in the house. For more information about ways you can exclude bats from your home, contact your local ODFW office.
- Good roosts are hard to find. Consider providing a bat house. Instructions are available from Oregon Department of Fish and Wildlife, or houses can be purchased at nature stores.
- Keep your cat inside your house. Domestic cats eat thousands of birds and other wildlife annually.
- Do not use pesticides near bat roosts or open water.
- If you own or manage forested property, preserve snags and cavity nesting trees for birds, bats and mammals that call these trees home.

BAT FACTS (continued from page 1)

Bats are competent fliers, although generally not as fast as birds. While they can fly 20 to 30 miles per hour, their average hunting speed is about 10 miles per hour. Bats can maneuver better than most birds—they can hover over one spot and can dodge obstacles easily. They actually chase insects in the air, not just bump into them.

Bats can see, but insect-eating bats rely on echolocation to capture their food in darkness. Bats emit high-pitched (ultrasonic) sounds through their mouth or nose (depending on species) and listen for the returning echo. This is a fast, efficient and very detailed source of information for them. Some moths emit their own blips to scramble the bat's sonar. People usually can't hear bat vocalizations, even if they are very "loud," because they are pitched above our range of hearing. Many bats have big ears and elaborate flaps and folds around their nostrils to enhance echolocation, making their faces look odd. Echolocation is very different from our ways of perceiving the world, but bats have perfected it and can easily catch a tiny gnat on a dark night while dodging through branches.

Bats sleep during the day and rest during the night in roosts. Day roosts are often crevices or cavities in rocky cliffs or trees, especially large snags. Night roosts are more exposed than day roosts and may be trees or buildings, bridges, carports or eves.

Mother bats congregate in small maternity colonies. Female bats will return year after year to the same safe, warm nursery roost. The males do not participate in raising the young and usually roost elsewhere. Baby bats are born in June or July. A female bat usually has just one baby at a time, although twins are normal in some species. The babies are born hairless, but they have curved claws for clinging to their mothers. The mother can fly with the baby attached, but usually she leaves her young hanging at the roost site while she feeds. The babies are able to fly in three to five weeks.

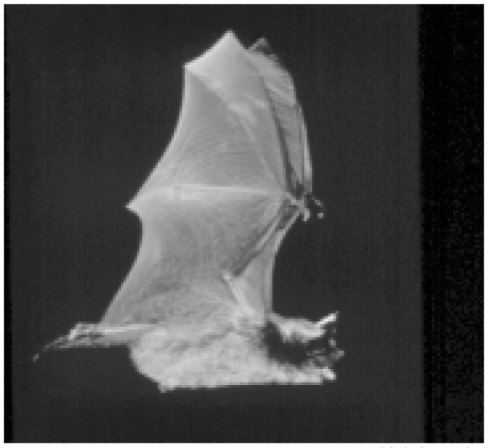


Photo: Bat Conservation International

Little brown bat

In late summer and early fall, bats build up fat reserves for hibernation or migration. They also breed in the fall, although the babies are not born until the following summer. Most of Oregon's bats hibernate during the winter in caves, abandoned mines, buildings and hollow trees. Hoary, silver-haired and Mexican free-tailed bats migrate south for the winter. When it's time to hibernate, a bat hangs in a roost site that combines safety with the right temperature and humidity. Its body temperature drops to the level of its surroundings and its metabolic rate slows considerably. The bat may spend several weeks or months in this torpid condition, living on stored fat.

Bats have few natural enemies (owls are one) and may live as long as 30 years. They are naturally abundant mammals, although we rarely see them. One or two babies per year per female is normally enough to maintain the population. However, if humans damage their habitat, it may take several years for the population to recover because of the low rate of reproduction. Bats are very susceptible to human activities, especially any disturbance of roost sites. Other activities such as logging, spraying pesticides and draining wetlands also affect bat populations.

DEPARTMENT OFFICES		
REGION	ADDRESS	TELEPHONE
Northwest	17330 SE Evelyn Street, Clackamas, OR 97015	503-657-2000
Southwest	4192 N Umpqua Hwy, Roseburg, OR 97470	541-440-3353
High Desert	61374 Parrell Road, Bend, OR 97702	541-388-6363
Northeast	107 20th Street, La Grande, OR 97850	541-963-2138
Salem HQ	3406 Cherry Ave NE, Salem, OR 97303	503-947-6000

ODFW Internet site address: www.dfw.state.or.us

ODFW: 12/00

Spotted Bat
Euderma maculatum

Spotted bats are rare in North America. They are white underneath with dark fur on their back and with large white spots. They live in dry climates and often roost on high cliffs.

Lives: Eastern Oregon.
Fun Fact: Bats hang upside down because it gives them an ideal position for take-off.

Townsend's Big-eared Bat
Corynorhinus townsendii

This is a medium-sized bat with large, long ears. It is gray, brown, or black. It is generally active only after full darkness. This species is very vulnerable to human disturbance and its numbers are declining. In Oregon, it is classified as a State Sensitive Species. Never disturb this bat if you are in a cave.

Lives: Throughout much of Oregon.
Fun Fact: In spring, mother bats look for warm, dark places to have their pups. A bat house at your place would be perfect!

Pallid Bat
Antrozous pallidus

This is a large, pale bat with huge ears, large eyes and a dog-like face. Its wing beat is slower than most bats. It emerges late at night to feed primarily on the ground, eating large beetles, crickets, and even scorpions. The pallid bat is uncommon and is found mostly in arid regions in canyons.

Lives: Southwestern and Eastern Oregon.
Fun Fact: Pallid bats can walk on the ground and are immune to a scorpion's sting.

Brazilian Free-tailed Bat
Tadarida brasiliensis

This is a fast-flying, medium-small bat with long narrow wings and a tail. It survives the cold winters in Oregon by staying in heated buildings instead of hibernating or migrating, often sharing these quarters with other bat species.

Lives: Roseburg, Oregon may be the most northern part of this bat's range.
Fun Fact: Myths: bats don't get tangled in your hair and they are not blind—they can see quite well.

What kids can do to help

1. Learn about bats.
2. Never disturb a bat colony.
3. Do not touch bats, alive or dead. They can have rabies, but very few do.
4. Put up a bat house on your property. Find building plans on ODFW's website.
5. Look for bats at dawn and dusk. Watch street lights that attract insects, bats may show up.
6. If you see a bat, stay calm.
7. Have bats in your house? Read the Living with Bats fact sheet in the Living with Wildlife section of ODFW's website.

Photo credits: Michael Durham Photography, www.durmphoto.com.

Oregon Department of Fish and Wildlife
3406 Cherry Ave N.E.
Salem, OR 97303
(503) 947-6000
www.dfw.state.or.us

Oregon Department of Fish and Wildlife

Facts for Kids

There are 15 species of bats in Oregon. Many of them are identified in the Oregon Conservation Strategy as species in need of help. Bats are the only flying mammal. A nocturnal species, they have a nifty ability called echolocation that allows them to make high-pitched sounds and then listen to the echo of those sounds to locate where objects are. Using echolocation or sound waves, they can find even the tiniest insect! Some of Oregon's bats migrate south in winter; some stay here and hibernate.

the OREGON CONSERVATION STRATEGY

Oregon's Fantastic Bats

California Myotis
Myotis californicus

California myotis is an acrobatic flyer. It is dark brown to blond with dark ears. It eats moths and flies. Early in the summer, a female joins a maternity or nursery colony where she gives birth to one offspring. In winter, these bats roost in mines, caves and buildings.

Lives: Throughout Oregon.
Fun Fact: Bats use echolocation to hunt, navigate and communicate.

Western Small-footed Myotis
Myotis ciliolabrum

This bat is brown to pale yellow with black ears and a black mask across its eyes and nose. It lives in dry climates, especially cliffs and rocks. It hibernates in caves and mines.

Lives: Eastern Oregon.
Fun Fact: Active at night, Oregon's bats rest during the day. They roost, that is, they hang upside down in out-of-the-way spots—caves, bridges, cliffs and trees.

Long-eared Myotis
Myotis evotis

The long-eared myotis is pale brown to strawberry. It is a slow flier and hovers around trees and rocks to catch flies, moths and wasps. It is usually found in forests and hibernates in winter.

Lives: Throughout Oregon.
Fun Fact: Oregon's bats eat only insects. An adult bat eats about 1,000 insects every hour!

Little Brown Myotis
Myotis lucifugus

This bat is commonly found in attics and buildings during summer months in maternity colonies. It weighs about half an ounce and has a wingspan of 9 to 11 inches. It prefers to live in forests near water. One baby is born in spring or summer. In winter, this bat hibernates in caves.

Lives: Throughout Oregon.
Fun Fact: Bats can live for 20 years, a long time for a small mammal.

Fringed Myotis
Myotis thysanodes

This bat is brown to reddish brown and has relatively long forearms. It gets its name from the fringe of hairs along the bottom of its tail. It roosts in trees, snags, buildings, caves, rocks, cliffs and bridges. It likes beetles and moths but will eat spiders and crickets.

Lives: Throughout Oregon.
Fun Fact: Bats lower their body temperature to near freezing when they hibernate. They don't eat all winter but live off stored fat.

Long-legged Myotis
Myotis volans

The long-legged bat lives in forests and comes out early in the evening to hunt. It is a fast flier and will chase insects for a long distance. One baby is born in the summer, and the species hibernates in winter.

Lives: Throughout Oregon.
Fun Fact: Bats can fly 20 to 30 miles an hour and travel more than 100 miles a night.

Yuma Myotis
Myotis yumanensis

Yuma myotis emerges when it is almost dark and forages for insects over streams and ponds. This bat is gray, tan or brown; it lives in a variety of habitats. Large numbers of female bats gather together in May or June to have their young. In autumn, they migrate.

Lives: Throughout Oregon.
Fun Fact: A baby bat is called a pup. Young bats can fly between two and five weeks of age.

Hoary Bat
Lasiurus cinereus

The hoary bat has a wingspan of nearly 16 inches. It has dark fur tipped with white, a dark mask on its face, a yellow-orange throat and round ears edged in black. This bat roosts in branches of trees and likes to feed around outdoor lights. Hoary bats migrate south in winter, returning to Oregon in the spring.

Lives: Throughout Oregon.
Fun Fact: The hoary bat and the silver-haired bat usually bear twins.

Canyon Bat
Parastrellus hesperus

This species weighs less than one quarter of an ounce! Its fur is pale yellow to brownish gray with a dark face mask. It likes rocky canyons and outcrops and flies early in the evening when it feeds on swarms of flying insects.

Lives: Eastern Oregon.
Fun Fact: Bats are mammals: they have hair, are warm blooded and feed their babies milk.

Silver-haired Bat
Lasionycteris noctivagans

This bat, found in older forests, has a wingspan of about 10 inches. Its fur is glossy black, tipped with white. It forages over ponds, streams, meadows and roads, often flying very low and roosting behind loose tree bark.

Lives: Throughout Oregon.
Fun Fact: Maternity roosts of the silver-haired bat are found in trees.

Big Brown Bat
Eptesicus fuscus

This is a relatively large bat, with a wingspan of 13 to 14 inches. Its dark color and slow flight help with identification. It is more likely to be active in cold weather than other bats, and prefers human structures for roosting.

Lives: Throughout Oregon.
Fun Fact: Insects are hard to find during the cold winter months, so bats hibernate in Oregon or migrate to warmer climates. They return in spring when insects are plentiful.

Got turtles?

If you have turtles in your pond, wetland or other slow-moving water on your property, lucky you!

Both species of Oregon's native turtles are uncommon, and it's hard for them to find suitable habitat. You'll want to make sure the conditions you provide for them stay suitable or even improve.

We have resources to help you!

Western Pond Turtles, Photo by Simon Wray

What kind of turtles do you have?

In Oregon, we have two species of native turtles, the western painted turtle and the western pond turtle, and several species of non-native invasive turtles. Check out turtle identification information at https://www.oregonturtles.com/species.html

Don't have turtles, but want them?

It's illegal to capture/relocate or buy turtles and turn them loose in your pond. Focus instead on providing suitable habitat – the "build it and they will come" approach. Turtles are very capable of and are known to make long-distance treks to newly created and enhanced habitats. In any case, improving habitat in and around your pond will make it more attractive to songbirds, dragonflies, frogs and other awesome creatures.
You can't lose!

Habitat Occupied by Turtles, Photo by ODFW

See turtles? Report them.

Biologists are tracking locations of turtles (both native and non-native) in Oregon. Let us know if you spot turtles, whether they are on your property or somewhere else. You can report your turtle sighting at www.oregonturtles.com/report.html or www.inaturalist.org/projects/western-pond-turtles-in-oregon.
The first step in making sure turtle populations remain stable is knowing where they are!

Get more information.

An abundance of information on how to help Oregon's native turtles can be found in a free, downloadable publication: http://www.dfw.state.or.us/wildlife/living_with/docs/ODFW_Turtle_BMPs_March_2015.pdf

Ask for help.

If you have turtles on your property and want help improving conditions for them, email oregonturtles@gmail.com and someone will get in touch with you.

Turtles have fairly simple needs, which you can help provide:

1) **Basking areas**
   After spending the winter hibernating, turtles need to haul out of the water in spring and early summer to warm up in the sunshine. They often select downed trees or large tree branches that have fallen into the water. If there is no natural downed wood in your pond or wetland, consider adding some. Turtles like to bask on wood as they can quickly drop into the water to avoid predators.

2) **Nesting areas**
   When it's time to lay eggs, female turtles look for sparsely-vegetated areas that get plenty of afternoon sun, since the sun's rays incubate the eggs. Suitable turtle nesting habitat has compact soils, usually with a high clay content to help the nest keep its shape and make it harder for predators to dig up the eggs. You can enhance nesting areas by providing patches of sparsely vegetated or bare ground in sunny areas close to your pond.

3) **Food and hiding cover**
   Young turtles conceal themselves from predators in rushes, sedges, duck weed and other vegetation at the shallow edges of the pond. Turtles eat worms, aquatic bugs, fish and other high protein items that help them grow. All turtles snack on aquatic vegetation, so it's important to have a healthy plant community in your pond. Native plants attract a variety of invertebrates which in turn become food for turtles. Some shrubby/forested habitat nearby is ideal as some turtles over-winter on land.

4) **Minimal disturbance**
   Turtles, turtle nests and hatchlings, and even hibernating turtles, are sensitive to disturbances like pet dogs swimming in ponds occupied by turtles, kayakers getting too close to basking turtles, or mowing equipment coming too close to nesting turtles. Turtles will be more likely to use your pond if basking and nesting areas are a little more private and away from areas of regular disturbance.

Western Painted Turtle, Photo by Port of Portland

Oregon Native Turtle Working Group

The Oregon Native Turtle Working Group was formed to share expertise among various organizations and agencies involved in turtle conservation and to promote appreciation and conservation of native turtles by all Oregonians.
www.oregonturtles.com

OREGON Fish & Wildlife

Guidance for Conserving Oregon's Native Turtles including Best Management Practices

the OREGON CONSERVATION STRATEGY

THE INTENT OF THIS DOCUMENT IS TO FACILITATE BETTER PROTECTION AND CONSERVATION OF OREGON'S NATIVE TURTLES AND THEIR HABITATS.

This document includes recommended **Best Management Practices (BMPs)** for protecting and conserving Oregon's two native turtle species, the western painted turtle and the western pond turtle. While there are opportunities for all Oregonians to become more knowledgeable about and participate in turtle conservation efforts, this document is intended primarily for use by natural resource and land managers, land use planners, and project managers.

The document has been peer-reviewed and the BMPs are supported by scientifically sound information. The BMPs are intended to be practical and cost-effective so that they can be readily used. Adherence to these BMPs does not necessarily constitute compliance with all applicable federal, state, or local laws.

Acknowledgements

This document was produced by the Oregon Department of Fish and Wildlife (ODFW) with significant financial and design contributions from The Port of Portland. Input and technical review was provided by the Oregon Native Turtle Working Group which is comprised of representatives from a variety of natural resource agencies, organizations, and institutions. This document arose out of a recommendation from the 2009 Native Turtle Conservation Forum, organized by the Oregon Native Turtle Working Group and hosted by the Oregon Zoo. More information about the Oregon Native Turtle Working Group can be found at: www.oregonturtles.com/

Contributors:

City of Eugene, City of Gresham, City of Portland Environmental Services, Clean Water Services, Columbia Slough Watershed Council, Metro (Natural Areas Program and Oregon Zoo), Middle Fork Willamette Watershed Council, Multnomah County Drainage District, North Clackamas Parks and Recreation District, Northwest Ecological Research Institute, Oregon Department of Fish and Wildlife, Oregon Parks and Recreation Department, Oregon State University, Oregon Wildlife (Heritage Foundation), Oregon Wildlife Institute, Port of Portland, Tualatin Hills Park & Recreation District, University of Oregon, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey, and Weyerhaeuser.

A big thank you also to the many Oregonians who reported their turtle sightings and offered their awesome photos for use in this document!

Recommended Citation:

ODFW. 2015. Guidance for Conserving Oregon's Native Turtles including Best Management Practices. Oregon Dept. of Fish and Wildlife. 99 pp.

Cover photos:

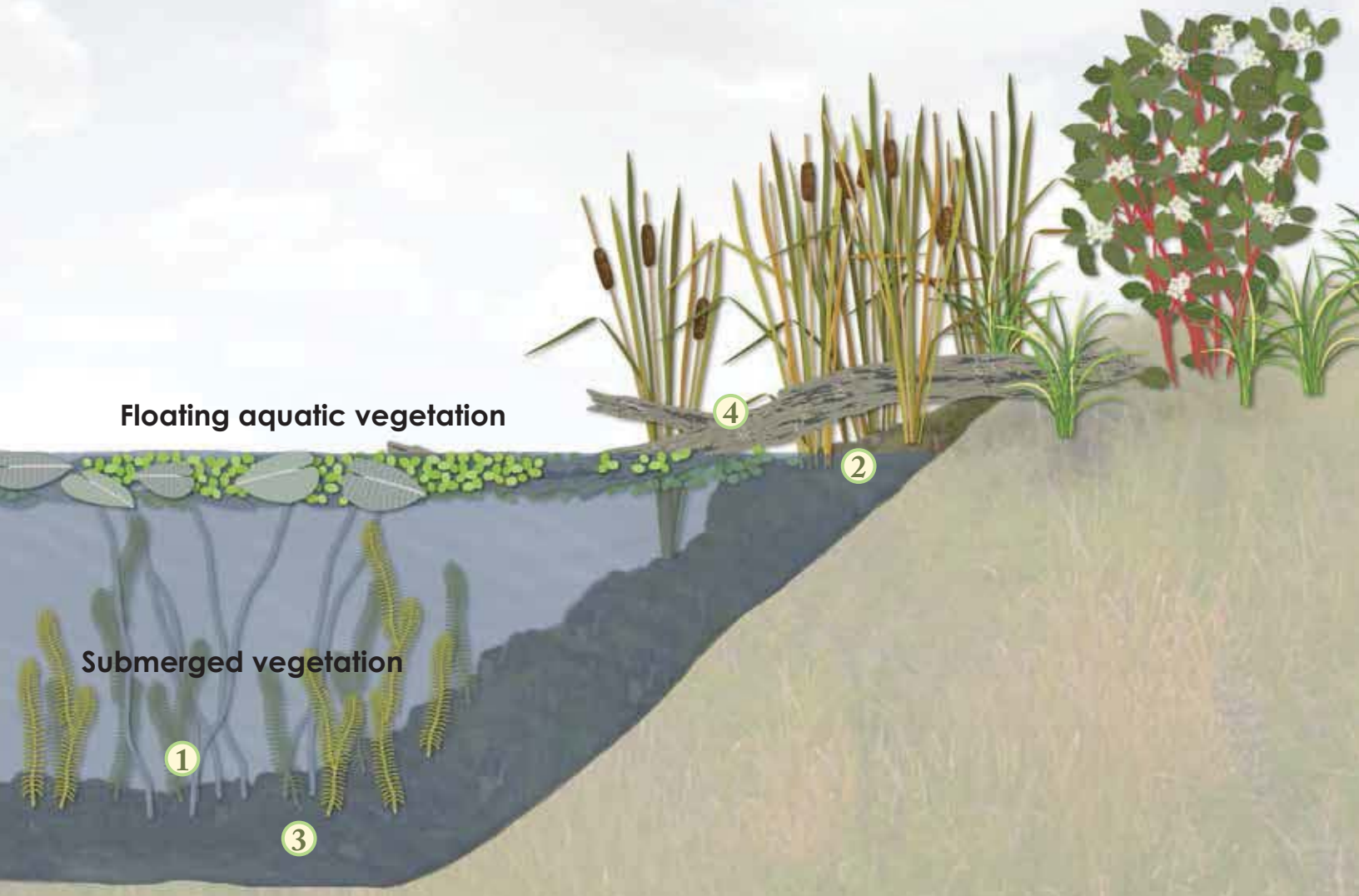
Western pond turtles basking
Photo Credit: Simon Wray

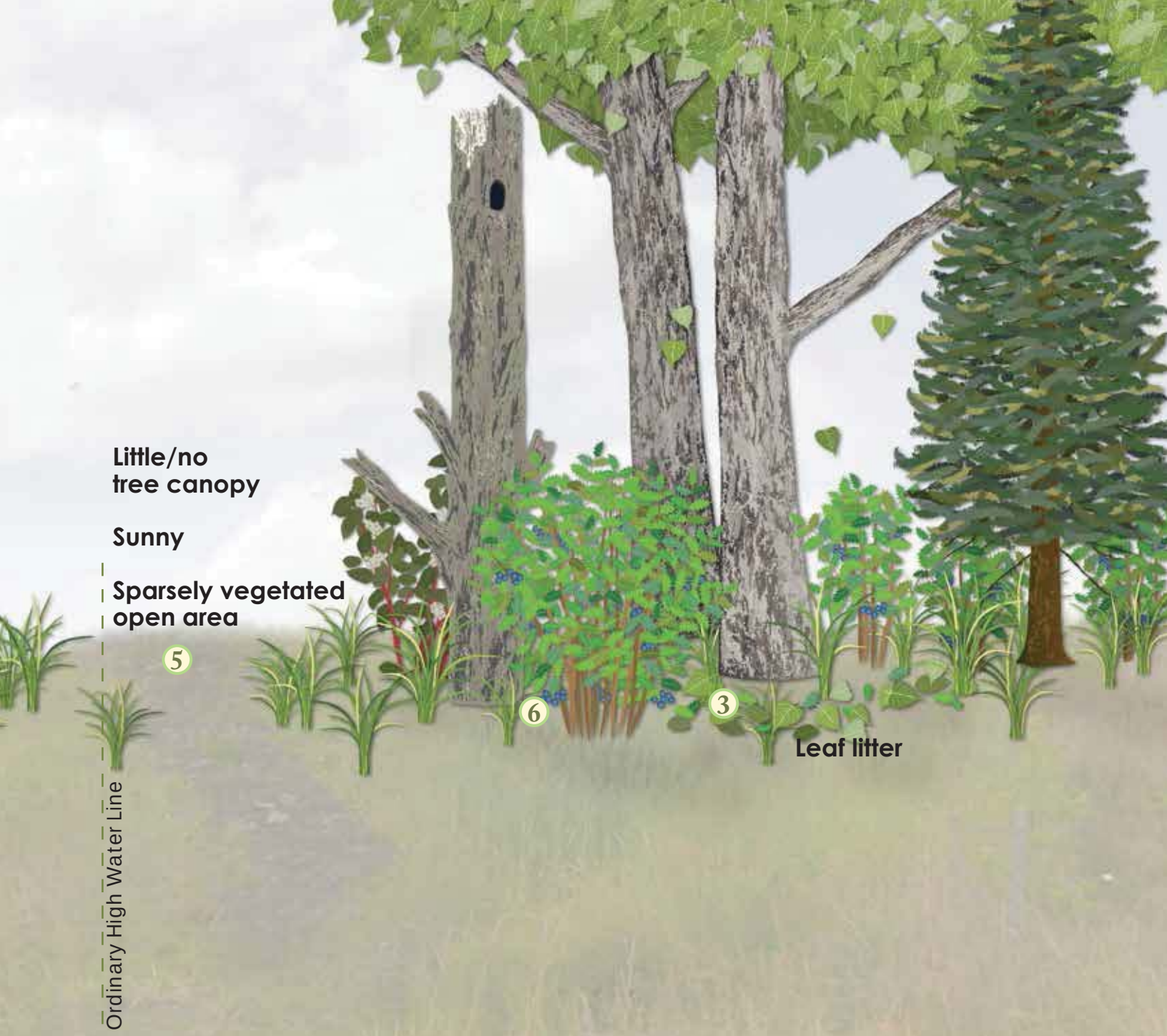
Western pond turtle
Photo Credit: ODFW

Western painted turtle
Photo Credit: Grace Alfieri

Figure 3.

Where Turtles are Found





1. **Foraging/hiding (adults)**
   Deep water with soft, muddy bottom
2. **Foraging/hiding (juveniles)**
   Shallow water bottom
3. **Overwintering**
   Bottom of pond or in forest
4. **Basking**
   Rock and downed wood
5. **Nesting**
   Bare ground, low vegetation, sunny
6. **Aestivating**
   Moist forest/shrubs, under wood/duff

Section 3: Species Status

Native Turtles

Both the western painted turtle and the western pond turtle are classified as "Sensitive-Critical" on Oregon's State Sensitive Species List. They are priority species in the Oregon Conservation Strategy (OCS), and are categorized as "Nongame Wildlife Protected" by Oregon Administrative Rule 635-044 (see Table 2). It is unlawful for any person to hunt, trap, pursue, kill, take, catch, angle for, or have in possession, either dead or alive, whole or in part, any "Protected" nongame species.

The western pond turtle (previously known as the northwestern pond turtle) is a U.S. Fish and Wildlife Service (USFWS) "Species of Concern" throughout its range and both turtle species are classified as "Sensitive Species" by the U.S. Forest Service (USFS) and by the U.S. Bureau of Land Management (BLM) in Oregon. The Oregon Natural Heritage Program (ORNHP) ranks both species as "S2" [imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction (extirpation), typically with 6-20 occurrences].

In 2013, the Center for Biological Diversity listed the western pond turtle as one of the 10 most vulnerable, least protected reptiles in the United States. See www.biologicaldiversity.org/news/press_releases/2013/amphibians-and-reptiles-09-18-2013.html

The concern over declining populations of pond turtles throughout their range motivated a listing petition under the federal Endangered Species Act (ESA) in 1992. The petition was denied primarily due to the species' broad distribution, occurrence in human-modified environments, and lack of evidence supporting allegations of specific threats such as a lack of juvenile recruitment (USFWS 1993). In July 2012, the Center for Biological Diversity filed a petition to list the pond turtle under the federal ESA based on the following threats: habitat alteration and destruction, overutilization, disease or predation, inadequacy of existing regulatory mechanisms, and other factors (i.e., non-native turtles, chemical contaminants, and population isolation). A USFWS decision on the petition is pending.

Table 2. Status of the Western Painted & Western Pond Turtle in Oregon (as of March 2015)

Species	ODFW	USFWS	USFS	BLM	Natural Heritage State Rank
Western Painted Turtle	Sensitive - Critical, OCS Strategy Species, Protected Nongame Wildlife	-	Sensitive	Sensitive	S2 (imperiled)
Western Pond Turtle	Sensitive - Critical, OCS Strategy Species, Protected Nongame Wildlife	Species of Concern	Sensitive	Sensitive	S2 (imperiled)

Non-Native Turtles

Unfortunately, a variety of non-native turtle species occur in the wild in Oregon. Box turtles, tortoises, softshell turtles, musk and mud turtles, map turtles, eastern and midland painted turtles, cooters, red-eared and yellow-bellied sliders, and common and alligator snapping turtles have all been observed in and/or removed from the wild. To date, only two non-native turtle species are known to successfully reproduce in the wild in Oregon: the red-eared slider *(Trachemys scripta elegans)* and the common (eastern) snapping turtle *(Chelydra serpentina)*. These species (see Figures 4 and 5) are considered invasive by the State of Oregon and are highlighted as such in the Oregon Conservation Strategy. Common traits of invasive species include the ability to survive and reproduce in the wild, and known or suspected harmful effects on native species and habitats.

Unfortunately, the red-eared slider appears to be already widely established in the wild throughout western Oregon waterways and nesting has been confirmed in numerous locations. The common snapping turtle is on the Oregon Invasive Species Council's "100 Worst" list of invasive species to be prevented from establishing in Oregon. Although snapping turtles have been documented in many waterbodies throughout western Oregon, nesting has only been verified at a few locations.

Figure 4. Identifying Features of the Red-eared Slider

Photo Credit: Myron Wells

Red stripe behind eye

Yellow stripes on head, neck and legs

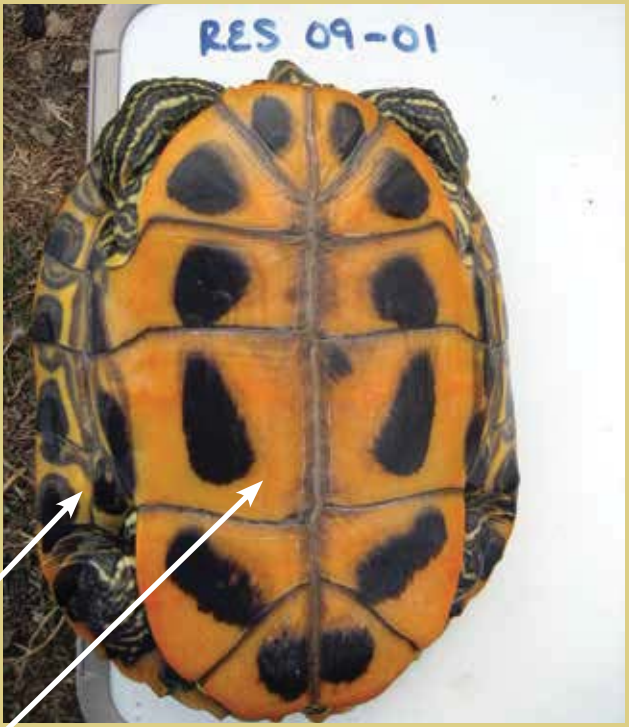


Photo Credit: Laura Guderyahn

Carpace dark brown with a serrated edge

Bridge yellow with dark blotches

Plastron yellow with dark blotches

It is illegal to release ANY non-native wildlife species into the wild. Many non-native species are invasive in nature. "Prohibited" non-native species are illegal to import, transport, buy, sell, give away, barter, or possess in Oregon without a permit from ODFW.

Non-native species deemed a threat to Oregon's native species, including the red-eared slider and the common snapping turtle, have been categorized as "Prohibited Nonnative Wildlife" (OAR 635-056) and are regulated by ODFW. It is unlawful to be in possession of (import, transport, buy, sell, give away, or barter) any live "Prohibited" non-native species, except as authorized by an ODFW Prohibited Species Permit.

Non-native species determined to pose no threat to any of Oregon's native fish and wildlife or their habitats are referred to as "Non-Controlled Nonnative Wildlife" and are legal to possess, import, transport, buy, sell, give away, or barter in Oregon. Some species of non-native wildlife have not yet been evaluated for their potential adverse effects on Oregon's native flora and fauna. Until a thorough review of a non-native species occurs by ODFW, the species is treated as a "Prohibited" species.

Non-native turtles have made their way to Oregon over the years primarily through the pet trade industry. Others entered the state as people moved to Oregon, bringing their pet turtle(s) with them. Non-native turtles have been released intentionally into local wetlands and streams while others have escaped accidentally from unsecured outdoor facilities.

Figure 5. Identifying Features of the Common Snapping Turtle

Photo Credit: ODFW

Long serrated tail

Carpace brown to black, serrated edge

Very large head and thick legs

Bumpy skin

Very small plastron compared to body size

Very large claws

Photo Credit: ODFW

If you see a turtle on your project site that may be a non-native species, call your local ODFW wildlife biologist (see Appendix A).

Oregon Native: Western Painted Turtle

(Chrysemys picta bellii)

Photo Credit: Grace Alfieri

Range in Oregon: Western painted turtles are narrowly distributed in the northern portion of the state. They are found in north-central and north-eastern Oregon, primarily in the Columbia River Basin, and in the northern portion of the Willamette River Basin. Though most known populations occur north of Salem, western painted turtles have been documented south of Eugene. Western painted turtles often co-occur with western pond turtles in aquatic habitats in northwestern Oregon.

Specific Habitat: Western painted turtles require both aquatic and terrestrial habitats. Selected aquatic habitat is typically slow-moving and shallow water, including streams, canals, sloughs, small lakes, and ponds with surface or emergent vegetation and a muddy substrate. Terrestrial habitat is used primarily for nest excavation and egg deposition. Nest sites are sparsely vegetated, often with a southern exposure and little or no overhead tree canopy, usually within 325 ft (100 m) of occupied aquatic habitat. A broad array of substrates is used for nesting. Soils are typically compact, but well-drained. Turtle nesting may occur in small open areas along trails, levees, roadbeds, fields, grasslands, stream banks, and within utility right-of-ways. Little is known of habitat use by hatchlings, but evidence suggests they use shallower aquatic habitats after spending time in and near the nest chamber. Painted turtles overwinter at the bottom of wetlands and other waterbodies, but they may also hibernate in terrestrial habitats (Gervais et al. 2009).

Threats: Factors limiting western painted turtle populations include loss of wetland and upland habitat, habitat degradation from invasive plants, and elevated predation of nests and hatchlings. Nest predation is believed to be elevated in urban environments due to greater abundance of mid-sized predators adapted to human disturbance such as raccoons, skunks, and coyotes, but there has been little quantification of these threats. Reduced nest site availability is a concern as well, particularly in urban environments. While it has been documented that introduced non-native fish species and bullfrogs eat hatchling turtles, the extent to which this occurs is unknown and the importance of this predation is not well understood. Adult turtles have few natural predators (e.g., river otter). Losses from road-kill, poaching, and other human-caused mortality are considered greater threats to adults than natural sources of mortality. With a large portion of Oregon's western painted turtle population occurring in or near urban areas, road mortality, limited connectivity between nesting, overwintering, aquatic, and dispersal habitats; competition from introduced turtle species, human disturbance from recreational uses of aquatic systems, and effects from chemicals are of particular concern. Although wetland systems are often partially protected by local, state, and/or federal land use and wetland laws, the adjacent upland areas that are crucial for reproduction are

Table 3. Recommended Turtle Nesting Soil / Substrate Mix	
Soil/Substrate Type*	**Percent of Total Mix**
Fine Clay	25 or less
Loam	25
Sand	25 - 50
Small Aggregate	25 or less

* Use of native (on-site) soils is preferable to prevent introduction of different weeds and soil microbes. Ideal aggregate (gravel) size is ¼ in (0.6 cm) minus (rounded if available), but expert recommendations range from ¾ in (2 cm) to 1/8 in (0.3 cm). The purpose of the aggregate is to aid in weed suppression.

Importing material to create nesting habitat.

Photo Credit: City of Portland Environmental Services

Inspecting the imported nesting material.

Photo Credit: City of Portland Environmental Services

Properly installed silt fencing can help prevent nesting material from accidentally entering adjacent wetlands during construction.

Photo Credit: City of Portland Environmental Services

Turtle nesting habitat one year post-construction shows minimal plant growth.

Photo Credit: ODFW

Soil Amendment Tips.

When importing fill, ideally deposit in mounds measuring at least 20 ft x 20 ft (6 m x 6 m) and ranging from 12 in (30 cm) to 36 in (91 cm) deep. A larger area of suitable nesting habitat is generally better than a single smaller one, but multiple nesting areas are better than a single area. Locate nest mounds on flat or gently sloped ground with no overhead tree cover in areas that receive full or nearly full sun.

An intact turtle nest.

Photo Credit: City of Portland Environmental Services

An excavator is used to move the nesting material into place.

Photo Credit: Calapooia Watershed Council

Before enhancement, this site was infested with invasive plants and lacked basking structures and nesting habitat.

Photo Credit: Calapooia Watershed Council

A close-up of imported nest material.

Photo Credit: ODFW

3. **If planting in turtle nesting areas,** only plant herbaceous species that reach less than 2 ft (0.5 m) in height, such as native bunchgrasses and wildflowers. These species naturally leave bare areas between plants. See Appendix C for a list of recommended plants. Aim for no more than 40 percent low-growing herbaceous plant cover. Ideally woody vegetation would not be planted at all on areas targeted for turtle nesting, but if required, plant only shrubs and plant sparsely, i.e., not more than 15-20 per acre (6-9 per hectare). A few shrubs may offer cover for gravid females and hatchlings that emerge from the nest. The ideal species mix will depend on site-specific conditions including soil type. Avoid species that spread quickly, especially those that have extensive root systems or are rhizomatous.

A female western pond turtle in suitable nesting habitat.

Photo Credit: Matthew Wolfe Greer

4. **Withhold irrigation on sites being managed for nesting habitat** to reduce and/or delay plant growth and keep plants sparse and lower in stature. Frequent irrigation could delay embryonic development and result in lowered egg hatch rates.

5. **Maintain nesting areas to retain suitability through time.** In the absence of natural disturbance regimes (flood or fire), turtle nesting habitat almost always requires some level of active maintenance to preserve ideal vegetation characteristics. Exceptions are sites considered highly disturbed already, for example gravel fill areas, dredge spoils sites, and road shoulders where soils tend to be amended, compacted and regularly disturbed. These types of sites are not prone to vegetative growth. Periodic (e.g., every 2-3 years) scraping, raking, spraying with herbicides, hand-pulling, mowing, or controlled grazing can be used to maintain patches of bare ground, keep vegetation height low, keep out reed canarygrass and other encroaching weeds, and remove shrubs and trees that will eventually shade the area. Maintain nesting habitat so that overall herbaceous cover is no more than 40 percent. Total shrub canopy cover should be no more than 20 percent and tree canopy cover no more than 10 percent. Smaller areas of turtle nesting habitat ideally would have no shrub or tree cover.

6. **Time creation, enhancement, and maintenance of nesting areas with turtles in mind.** New nesting areas in currently unsuitable habitat can be created at any time, but ideally would be completed by early May so the area is available to gravid females of the year for egg laying. Enhancement and maintenance of existing nesting areas or areas where nesting is suspected should

be timed to avoid impacts to already laid eggs, hatchlings overwintering in the nest, emerged hatchlings present near the nest, and nesting females. This timeframe is generally from April 1 through May 15. That said, turtles could be encountered even during this period so be on the lookout for turtles whenever working in suitable nesting habitat. Another option is to temporarily preclude females from nesting in the area scheduled to be enhanced. This can be achieved by using exclusion fencing such as silt fencing or by placing hardware cloth over the areas to discourage nesting attempts. The hardware cloth should be flush with the ground, firmly staked, and checked occasionally to prevent unintended entrapment of other wildlife. Ideally, nesting habitat would be monitored by a qualified wildlife biologist to try to determine turtle response (use) to creation, enhancement, and maintenance efforts. Coordinate with your local ODFW wildlife biologist. Consider also using remote wildlife cameras to detect turtle nesting activity.

Periodic scraping is one method to maintain nesting habitat suitability.

Photo Credit: Patrick Blanchard

How Much Nesting Habitat do Turtles Need?

There is no specific minimum amount of suitable nesting habitat required by an individual female western painted or western pond turtle. It only takes one small spot of suitable nesting habitat within the larger terrestrial habitat framework. That said, a larger area of suitable nesting habitat is considered better than a smaller area and multiple areas of suitable nesting habitat are better than a single area. More suitable habitat translates into more nesting opportunity for gravid females. More nesting habitat reduces nest density which likely dilutes nest predation. Nests spread out over a larger area also potentially increases the total number of hatchlings produced. Nesting habitat is considered one of the main limiting factors for Oregon's native turtles.

A predated turtle nest.

Photo Credit: ODFW

year-round. Suitable turtle aquatic habitats offer some areas of quieter, slowly flowing or static water.

Shallow water can provide young turtles with warmer water, ample hiding cover, and easier foraging opportunity.

Photo Credit: ODFW

3. **Improve aquatic vegetation conditions.** Promote and plant (if necessary) native floating, emergent, and submergent plant species to provide food and hiding cover for turtles and their prey. Small turtles will sometimes bask atop floating vegetation. Emergent vegetation provides hiding cover. Control non-native invasive plants and combat algal blooms by addressing the cause of the problem (see Invasive Species and Dredging, Filling and Pond Management in Section 12 for more information).

What do Turtles Eat?

Oregon's native turtles are omnivorous, eating a variety of plants and animals such as worms, aquatic invertebrates, tadpoles, fish, and submergent and emergent vegetation. They are also scavengers, eating carrion when it is available. Turtles tend to be more carnivorous in hatchling and juvenile stages of development.

A western painted turtle surface basking.

Photo Credit: Patrick Blanchard

4. **Consider removing pond liners, rip rap, and concrete to improve turtle access to bottoms of waterbodies and promote plant growth.** Turtles that do not overwinter in upland habitats bury themselves in soft, muddy bottoms of ponds and other waterbodies. A good layer of sediment, leaves, and other organic matter also provides rooting substrate for emergent and submergent plants and is important habitat for the suite of aquatic invertebrates that turtles prey upon. Many natural waterways have been altered as historic water conveyance methods included rip-rapping and lining streams with concrete. Many man-made ponds are lined with bentonite or thick plastic barriers to prevent water seepage. Ideally these artificial surfaces and bottoms would be eliminated to improve habitat suitability for turtles, though this may not be preferred if removal of the liner would result in loss of the aquatic habitat altogether.

Rising Waters – Turtles and High Water Events.

Water levels often rise during winter months. Prolonged high-water events in conjunction with high water velocities may dislodge turtles from underwater hibernation sites (muddy bottoms, overhanging banks), sweeping them downstream. Information is lacking on the short- and long-term effects of such events, though turtles are likely more subject to predation and increased energetic costs compared to being undisturbed. These events could cause turtles to emerge from hibernation in spring with lower-than-normal fat reserves.

Basking Structures

Basking is a critical life function of Oregon's turtles. Ideally there would be ample natural sources of various sized downed wood to provide needed habitat features for turtles, other wildlife, and fish. When lacking, wood can be brought in and placed strategically while still managing standing trees for future natural recruitment. Placed wood should be properly sized for a particular site to provide appropriate habitat and to maintain flood flow capacity. Secure installed wood where deemed necessary to protect downstream structures. Placement of some types of basking structures may be considered in-water work and should be done within ODFW in-water guidelines aimed at protecting native fish. Oregon Department of State Lands (DSL) and U.S. Army Corps of Engineer (ACOE) wetland rules may apply. Contact your local ODFW fish biologist for assistance in regards to in-water work and fish, and your local DSL coordinator for help determining if a DSL/ACOE permit is required. A permit is not required from DSL for the placement of large wood, boulders, and spawning gravels provided the material is placed consistent with the *"Guide to Placing Large Wood and Boulders"* (DSL/ODFW 2010). arcweb.sos.state.or.us/pages/rules/oars_100/oar_141/141_085.html

1. **Maintain existing basking structures whenever possible.** If the basking structure is a discarded vehicle tire or other trash item that turtles are known to use and that's all that is available to them, then leaving it in place is reasonable until it can be replaced with a natural basking structure.

Western pond turtles basking.

Photo Credit: Tom Ten Pas

2. **Place large wood in wetlands, stream channels, sloughs and other waterbodies** to serve as turtle basking structures. Place wood in locations that receive full to partial sun exposure. Wood with the root wad intact is preferred. Place logs and root wads at a variety of angles and water depths, with some parallel to the shoreline, but the majority perpendicular and extending from the bank out into the open water. Wood can be piled to create complexity, cover from predators, and varied basking opportunities at different water levels. Work with a qualified hydraulic engineer and stream restoration biologist to ensure proper placement of wood and protection of downstream resources and infrastructure, if any.

Basking structures being added to a habitat restoration project.

Photo Credit: ODFW

3. **Don't forget about smaller turtles.** Small turtles need small sized basking structures. Place smaller diameter logs and limbs and lower profile woody material in shallow water where there is ample hiding cover nearby. Fall trees crown-in to provide smaller diameter basking branches as well as complex cover for protection from predators. Consider solar exposure and location of nesting area(s).

Smaller pieces of wood with branches benefit small turtles.

Photo Credit: Multnomah County Drainage District

How Many Basking Structures Do Turtles Need?

There is no specific number of basking structures required by turtles. Generally, "more is better" and "some is better than none". Also, the bigger the structure, generally the better, though this may have diminishing returns on extraordinary sized structures. While some biologists have recommended spacing basking structures about 20 ft (6 m) apart, they can be installed closer together or farther apart. Site-specific characteristics of the waterbody should be considered. Ideally, imported structures should resemble naturally occurring sizes, shapes, and distributions. Increasing the number of basking structures available to turtles provides them with more basking opportunity and potentially less conflict over finding space, especially in areas that receive the most solar exposure.

4. **Float logs in ponds and other slow-moving waters.** Floating logs can also be placed in a sunny location in the center of a waterbody, close to the deepest part of the pond. Anchor logs to maintain their position in the center of the waterbody and away from the shoreline. Ideally, floated logs should be 8 to 20 in (20 to 50 cm) diameter and a minimum of 6 ft (2 m) long with bark and limbs attached. Root wads may or may not be attached.

A western pond turtle using a piece of floated wood anchored to the bottom of a pond.

Photo Credit: Douglas Grenz

5. **Place large wood in the floodplain and upland areas.** Pieces of wood and logs in the floodplain may enter stream systems during high-water events, providing habitat elements downstream in the future. Wood placed in upland areas will decay, enhancing soil conditions and building duff, the top layer of vegetation and soil which over time will benefit aestivating and overwintering turtles, plus many other species of wildlife and fish.

Wood of various sizes place in upland areas benefits a variety of wildlife including turtles.

Photo Credit: City of Portland Environmental Services

6. **Incorporate brush piles and rocks into aquatic habitat enhancement projects.** Place brush piles and rocks near shorelines and in shallow areas. Brush piles provide hiding cover for turtles and their prey, and rocks serve as basking sites for turtles. Though brush piles are typically short-term habitat structures, they can still provide important habitat functions for turtles and many other species of wildlife.

In addition to large wood, large rocks and rock piles serve as basking habitat.

Photo Credit: ODFW

Artificial Basking Structures.

Sometimes natural wood is not readily available, access to the waterbody is challenging, or it is cost prohibitive to place natural wood basking structures. In these situations, artificial structures can provide value to turtles. Artificial structures should be designed and deployed to prevent accidental drowning of turtles. Other considerations may apply and should be discussed with your local ODFW wildlife biologist. See Appendix D for photos and design specifications of example artificial basking structures.

Red-eared sliders using an artificial basking structure.

Photo Credit: Patrick Blanchard

7. **Use artificial or man-made basking structures if natural wood is not available.** See Appendix D for recommended designs for artificial basking platforms
8. **Last, but definitely not least … Promote (and then tolerate) beaver activity.** Beaver damming and foraging habits naturally provide turtles with an abundance of basking material. Trees and shrubs felled by beaver also provide turtles with important hiding cover. Ideally beaver presence and activity would be encouraged and managed with turtles in mind.

Beaver herbivory and damming activity naturally provides turtles of all sizes with an abundance of basking structures.

Photo Credit: ODFW

Aestivation Habitat

Some turtles enter a state of dormancy during periods of hot, dry weather. Some turtles burrow themselves into muddy bottoms or over-hanging banks of ponds while others seek refuge in upland habitats. Shrubby areas and forests with understory shrubs and ample leaf litter that are relatively close to aquatic habitats, provide cool, moist spots for turtles during periods of prolonged heat.

1. **Maintain and promote soft muddy areas in wetlands, ponds, and other waterbodies.** Turtles bury themselves into soft substrate to hide from potential predators and for aestivation.
2. **Protect and maintain existing vegetated areas near suitable aquatic turtle habitats.** Control non-native invasive vegetation as needed and plant native deciduous shrubs and trees to provide leaf litter. With the exception of invasive plant control, do not remove fallen leaves, tree branches, or other organic material near aquatic habitats.
3. **Maintain vegetated buffers around and adjacent to ponds, wetlands, and other waterbodies.** Promote a variety of native deciduous plant species near wetlands and other waterbodies as leaves create the conditions needed by turtles seeking to overwinter on land. Balance with provision of open, early successional habitats (nesting habitat).

Overwintering Habitat

Turtles hibernate during winter months. Some turtles bury themselves in the soft, muddy bottoms of ponds, wetlands, and other waterbodies while others overwinter in upland habitats. Hibernating turtles live off stored fat reserves and oxygen saturated in their blood. While some subspecies of painted turtles have been documented

overwintering on land it is thought that most of Oregon's western painted turtles use aquatic habitats for hibernation. There is indication that some western painted turtles in the Portland metro area overwinter on land (Guderyahn pers. comm. 2014). Western pond turtles have been documented overwintering in aquatic habitats as well as in upland habitats up to 1640 ft (500 m) from aquatic habitat. Turtles that overwinter on land take cover under shrub and leaf litter, sometimes digging down a few inches into the top layer of duff. They do not eat during hibernation. During hibernation, a turtle's core temperature becomes similar to the ambient (surrounding) temperature and their metabolic rate slows down. Emergence from hibernation is triggered by warmer temperatures, usually when air temperature is about 60° F (15.6° C) for at least three days in a row. Suggested methods to improve overwintering habitat for turtles are as follows:

1. **Maintain and promote soft muddy areas in ponds, wetlands, and other waterbodies** known to support turtles. Mud with ample leaf litter and other organic material insulates turtles against extreme temperatures.
2. **Maintain areas of permanent water that are 4 - 6 ft (1.2 -2 m) deep through turtle hibernation months.** Turtles overwintering in aquatic habitats need water that persists throughout the duration of hibernation, from about November through March. Water can fluctuate somewhat, but ideally would get no shallower than 4 ft (1.2 m).
3. **Maintain vegetated buffers around and adjacent to ponds, wetlands, and other waterbodies** known to support turtles. Promote a variety of deciduous native plants near wetlands and other waterbodies as leaves create the conditions needed by turtles seeking to overwinter on land.

A turtle (a red-slider turtle) observed basking on a sunny day in early March. Note the muddy carapace – a sign the turtle overwintered at the bottom of a wetland.

Photo Credit: Anonymous

This western pond turtle was observed crossing a road on October 10, 2012 heading from the South Umpqua River to a forested slope, likely to overwinter. Despite missing its right hind foot it moved quickly. A part of its tail was also missing and an old injury to its carapace was evident.

Photo Credit: Lloyd Stiewig

Habitat Proximity

Most turtles remain in relatively small areas known as a home range, yet they sometimes make long-distance movements to colonize suitable habitat or to find new mates (dispersal). Changes in water levels often trigger overland movements. Male turtles tend to move farther distances than female and juvenile turtles. Some juvenile turtles have been reported traveling back and forth frequently between low-flow portions of aquatic riverine habitats and adjacent ponds. Distribution and arrangement of suitable aquatic and terrestrial habitats are key to self-sustaining populations and the survival of Oregon's native turtles.

1. **Protect and maintain suitable aquatic and terrestrial turtle habitats where they exist near each other.** It is more ecologically and financially effective to protect suitable habitat that already exists rather than to attempt to re-create it.

An example of suitable aquatic and terrestrial habitat in close proximity.

Photo Credit: ODFW

What Should I Do if I Come Across an Aestivating or Hibernating Turtle?

Do not intentionally disturb aestivating or hibernating turtles. If you come across a turtle in this state, re-cover with leaf litter or other readily available organic material and leave the immediate area. Stay at least 25 ft [8 m] away from an aestivating or hibernating turtle. Call your local ODFW wildlife biologist for advice if this is not possible or if you have additional concerns. Note that most aestivating or hibernating turtles are very difficult to spot since they often completely cover themselves with mud, leaf litter, etc. and are likely to be discovered only if unearthed or if caught in the act of covering themselves. To prevent or minimize the chance of coming across an aestivating or hibernating turtle, avoid vegetation management or other potentially disturbing activities in turtle habitats when the temperature is more than 90° F (32° C) and during winter months.

This remnant wetland site is nestled between nearby residences and a pedestrian trail atop an old railroad grade/utility right-of-way. It provides all the habitat components needed by the reproducing population of western painted turtles present at the site.

Photo Credit: Patrick Blanchard

2. **When creating new turtle habitat, site aquatic and terrestrial habitats in close proximity,** ideally immediately adjacent to or within 500 ft (150 m) of one another. For example if constructing a wetland, site near existing suitable terrestrial habitat. Provide safe habitat connectors.
3. **Avoid constructing new barriers such as fences and public trails between aquatic and terrestrial habitats.** If fences must be installed between habitats, leave a gap of at least 4 in (10 cm) at the fence bottom to allow turtle movement between habitats.
4. **If trails are to be built near suitable turtle habitat, site and design as per the guidelines outlined in the Trail Construction and Maintenance section below (Section 12).** Avoid and minimize potential conflict between trails and turtles by implementing recommended BMPs.

Safe Movement Corridors

Turtles are instinctual animals known to use the same routes to get where they need to go. Turtles move easily through sparse grasses and wildflowers, though they can and will navigate through dense shrub and forest habitats with logs and other woody material. Shrubs, trees, and downed wood provide needed shade and moisture for turtles moving on hot summer days. As habitat has become more fragmented, movement has become more challenging for many wildlife species, including turtles. Culverts, roads, Jersey barriers, railroad tracks, and fences pose major challenges to turtles and can result in their injury or death. Adult female turtles are especially vulnerable as they often need to cross these hazards en route to suitable nesting habitat. Addressing barriers to fish and wildlife movement is a Key Conservation Issue in the Oregon Conservation Strategy (ODFW 2006) and a concern of many conservation partners.

1. **Identify and protect existing movement corridors that provide safe travel for turtles between aquatic and terrestrial habitats, especially nesting sites.** Contact your local ODFW wildlife biologist for assistance if necessary.

Safe movement corridors are especially important for vulnerable hatchlings like this western pond turtle observed moving from the nest habitat to aquatic habitat.

Photo Credit: Dan Rosenberg

2. **Incorporate habitat connectors / movement corridors into project designs.** Provide suitable landscape linkages to allow movements of turtles between important seasonal habitats. This may mean utilizing elevated board walks instead of traditional trail material, incorporating culvert underpasses at retaining walls, or avoiding an intact and natural connector between seasonal key habitat elements.

3. **Identify hazards to movement for example areas of turtle road mortality and implement actions to remove threat or prevent and minimize risk of injury and mortality.** For example, provide turtle underpasses; low, vegetated earthen berms that direct turtles to a safer route; or short buried fence to exclude turtles from dangerous areas.

This snapping turtle was killed while trying to cross I-84 in the Columbia River Gorge.

Photo Credit: ODFW

Section 9: Determining if Turtles are Present

Since turtles often aren't visible, particularly at certain times of the year, it is important to do the following if your planned project or activity is located within the range of the western painted or western pond turtle:

1. **Obtain existing data on turtle presence / sightings in *and near* the project area.** It is important to consider turtle occurrence information beyond the immediate project area since turtles may go unnoticed at a particular site and because they are quite mobile. Request occurrence information from the Oregon Biodiversity Information Center (ORBIC orbic.pdx.edu/) and contact ODFW for data on historic and recent turtle sightings within 2 mi (3.2 km) of the project area. Remember that lack of turtle presence / sighting data does not necessarily mean turtles are absent.
2. **Use an ODFW-recommended turtle habitat assessment tool** (see Appendix E for example tools) to identify suitable turtle habitats (foraging, basking, nesting, aestivating, and overwintering/ hibernating) at and near the project site. Look beyond the immediate project footprint as turtles are mobile and the project area may provide for only a portion of their habitat requirements.
3. **Conduct visual surveys for turtles in aquatic habitats,** if deemed necessary. See Appendix F for recommended survey protocols and data forms, and contact your local ODFW wildlife biologist for technical assistance.

Visual surveys for turtles are one of the best methods for determining if turtles are present at a site.

Photo Credit: Patrick Blanchard

This predated turtle nest was found during a search for turtle nests.

Photo Credit: ODFW

Section 10: Planning and Designing Projects with Turtles in Mind

Consideration of potential impacts to turtles and their habitats, particularly to known or suspected nesting sites, ideally would be deliberated early in the project planning and design phases. This way the project can avoid and minimize negative impacts to turtles during the implementation stage.

1. **If modification of known occupied or suitable turtle habitat is planned or may occur, contact your local ODFW wildlife biologist** to discuss options and recommended methods to avoid and minimize negative impacts to turtles, including avoidance of direct mortality of native turtles in compliance with OAR 635-044.
2. **Site new major infrastructure (e.g., paved roads) ideally at least 1,650 ft (500 m) away from a known turtle population and suitable turtle habitats.** It is generally recommended that minor infrastructure (e.g., picnic table) be sited at least 500 ft (150 m) from known turtle populations.
3. **For projects involving existing infrastructure located within 1,650 ft (500 m) of known turtle populations and suitable turtle habitats, provide and maintain buffers of native vegetation, ideally at least 500 ft (150 m) wide.** Incorporate partially vegetated buffers adjacent to turtle habitats to provide visual and auditory buffers, reducing disturbance to turtles. Vegetated buffers can also protect turtles by discouraging human access to these areas. Native rose, tall Oregon grape, stinging nettle, and Douglas hawthorn are particularly effective.
4. **Site and design projects to minimize habitat fragmentation and maintain connectivity** to nearby habitats. **Incorporate crossing structures** such as underpasses and fencing to minimize road mortality and barriers to turtle movement.
5. **Design projects to minimize the impacts of contaminants on turtles.** Consider potential sources of environmental pollutants and exposure pathways that might put turtles at risk. Develop contingency plans to prepare for the possibility of a chemical release and consider developing monitoring plans.
6. **Design projects to maintain and protect natural hydrologic regimes.** The productivity of waterways, wetlands, and associated upland habitats is dependent upon periodic water fluctuations such as flooding and seasonal drying.
7. **If fencing is part of the project design, select a fencing style with turtles in mind.** Use fencing that does not restrict turtle movement unless otherwise recommended by ODFW (i.e., it may be desirable to restrict turtle movements to and from an area). Fencing should provide at least a 4 in (10 cm) space from the ground to the bottom of the fence. If using a fence design that has periodic gaps at the bottom, gaps should be no less than 4 in (10 cm) high and 10 in (25 cm) wide, and not more than 82 ft (25 m) apart. Many other species of wildlife need wider, higher, and/or closer gaps to facilitate movement.

One type of turtle friendly fence.

Photo Credit: Port of Portland

8. **Consider human access and types of human activities** when siting and designing projects. Turtles and their habitats can be affected by the overuse of an area by people engaged in recreational activities. Easy access into an area can disturb turtles and damage habitat. Human access can also lead to introduction of non-native invasive species (plants and animals). Consider options to manage public access (land and water) to minimize negative affects to turtles.
9. **Consider project timing and turtle activity cycles.** Time and conduct project activities with turtles in mind and in a manner that will avoid and minimize disturbance, injury and/or mortality of turtles, particularly during nesting season.
10. **Identify suitable nesting habitat on and near the project site, including staging areas.** Evaluate potential impacts to nesting habitat from the planned action. If possible, modify the planned project to avoid and minimize impacts to suitable turtle nesting habitat.

When and Where Can Turtles Be Encountered?

Turtles may be encountered at any time of the year on land or in the water, moving or not moving (see Figure 6). Since turtles utilize different habitats at different times of the year, it is important to consider the timing of various project activities. While individual turtle activity can be variable and affected by environmental factors such as weather, there are known and predictable seasons of typical turtle behavior, habitat needs and usage, as well as activity and breeding patterns. Turtles are generally active from early April through late October. Both species typically hibernate from November through March. Under certain environmental conditions some western pond turtles hibernate and aestivate in upland habitats. Although western painted turtles are considered more aquatic in nature than pond turtles and overwintering and aestivation on land has not been confirmed in Oregon, it is suspected and a real possibility. Known overwintering and aestivation sites are usually within 500 ft (150 m) of aquatic foraging habitat. Eggs are buried in the ground on land, usually within 325 ft (100 m) of aquatic foraging habitats; pond turtle nests have been documented up to 1,318 ft (402 m) from water in the Willamette River Basin (Rosenberg et al. 2009). Research indicates western painted turtles tend to nest closer to water than western pond turtles, though they have been documented nesting 820 ft (250 m) away from water (Gervais et al. 2009). Hatchlings can be encountered on land or in the water.

Western painted turtles have been observed nesting in this mowed field situated between the Willamette River and several oxbow wetland ponds.

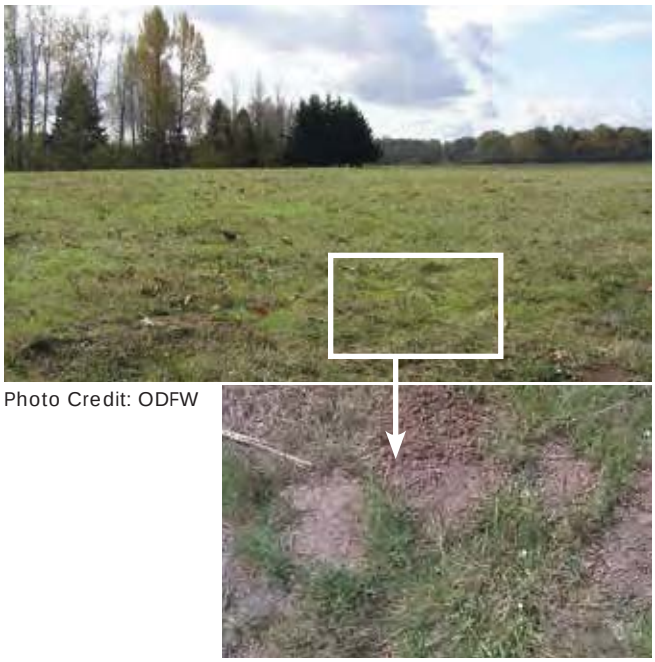


Photo Credit: ODFW

This female western painted turtle was observed nesting on the side of a gravel trail on June 11, 2014.

Photo Credit: Vaughn Roden

11. **Conduct visual turtle surveys and turtle nest searches to obtain more information about turtle presence, use, and needs/opportunities at your project site.** Attempt to locate obvious or suspected turtle nests (intact or predated). Incorporate information into project siting and design.

Turtle Nesting Habitat.

Suitable turtle nesting habitat is characterized by areas with low to sparse vegetation with compact soils and ample solar exposure (little to no overhead tree canopy). Proximity to aquatic habitats is an important factor. A broad range of substrates are used for nesting, from recent fill comprised of a gravel/sand mixture to loamy soils with a high clay component. Floodplains, roadsides, levees, pastures, backyard lawns, and landscaped areas are all known to be used by females for nesting. Turtles have even been documented successfully nesting in the middle of compact gravel roads and in the middle of wood-chipped recreation trails. Solar radiation is a key factor as embryo development is dependent on the amount of sunlight received. Medium to tall shrubs shade out otherwise suitable nesting habitat. Infestations of the non-native invasive reed canarygrass can also shade out nest sites and form thick mats that are impenetrable to even the strongest female turtles. Generally, turtle nesting habitat is located above the high water mark and in areas not prone to flooding. While flooding or inundation with water can cause nest failure and hatchling mortality, some periodically inundated turtle nests are still successful.

Searching for evidence of turtle nesting activity.

Photo Credit: ODFW

Guidance for Conserving Oregon's Native Turtles including Best Management Practices

the OREGON CONSERVATION STRATEGY

THE INTENT OF THIS DOCUMENT IS TO FACILITATE BETTER PROTECTION AND CONSERVATION OF OREGON'S NATIVE TURTLES AND THEIR HABITATS.

This document includes recommended **Best Management Practices (BMPs)** for protecting and conserving Oregon's two native turtle species, the western painted turtle and the western pond turtle. While there are opportunities for all Oregonians to become more knowledgeable about and participate in turtle conservation efforts, this document is intended primarily for use by natural resource and land managers, land use planners, and project managers.

The document has been peer-reviewed and the BMPs are supported by scientifically sound information. The BMPs are intended to be practical and cost-effective so that they can be readily used. Adherence to these BMPs does not necessarily constitute compliance with all applicable federal, state, or local laws.

Acknowledgements

This document was produced by the Oregon Department of Fish and Wildlife (ODFW) with significant financial and design contributions from The Port of Portland. Input and technical review was provided by the Oregon Native Turtle Working Group which is comprised of representatives from a variety of natural resource agencies, organizations, and institutions. This document arose out of a recommendation from the 2009 Native Turtle Conservation Forum, organized by the Oregon Native Turtle Working Group and hosted by the Oregon Zoo. More information about the Oregon Native Turtle Working Group can be found at: www.oregonturtles.com/

Contributors:

City of Eugene, City of Gresham, City of Portland Environmental Services, Clean Water Services, Columbia Slough Watershed Council, Metro (Natural Areas Program and Oregon Zoo), Middle Fork Willamette Watershed Council, Multnomah County Drainage District, North Clackamas Parks and Recreation District, Northwest Ecological Research Institute, Oregon Department of Fish and Wildlife, Oregon Parks and Recreation Department, Oregon State University, Oregon Wildlife (Heritage Foundation), Oregon Wildlife Institute, Port of Portland, Tualatin Hills Park & Recreation District, University of Oregon, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey, and Weyerhaeuser.

A big thank you also to the many Oregonians who reported their turtle sightings and offered their awesome photos for use in this document!

Recommended Citation:

ODFW. 2015. Guidance for Conserving Oregon's Native Turtles including Best Management Practices. Oregon Dept. of Fish and Wildlife. 99 pp.

Cover photos:

Western pond turtles basking
Photo Credit: Simon Wray

Western pond turtle
Photo Credit: ODFW

Western painted turtle
Photo Credit: Grace Alfieri

Section 2: Native Turtles in Trouble

Worldwide, about 50 percent of all freshwater turtle species are considered threatened, more than any other animal group (Turtle Taxonomy Working Group 2014). Oregon's two freshwater turtle species, the western painted turtle and the western pond turtle (Figures 1 and 2), are identified as priority at-risk species in the Oregon Conservation Strategy (OCS), Oregon's Wildlife Action Plan and statewide framework for conserving fish and wildlife species (ODFW 2006).

Many of the habitats that our turtles depend upon (e.g., freshwater riparian, wetland, and open water areas with associated upland habitats) are also identified in the OCS as priority at-risk habitats. Key turtle habitat elements include aquatic foraging areas, shallow water hatchling rearing areas, basking structures, sparsely vegetated upland areas for nesting, and semi- to heavily vegetated upland areas for overwintering and aestivation (Figure 3).

Figure 1. Identifying Features of the Western Painted Turtle

Photo Credit: ODFW

Photo Credit: Dan Lake

Figure 2. Identifying Features of the Western Pond Turtle.

Photo Credit: ODFW

Head, neck and leg color same as top shell with flecking pattern

Carpace dark brown to olive

Carapace has smooth edge

Plastron creamy yellow usually with dark staining

Photo Credit: Ben Power

Like so many native species across America and the globe, Oregon's turtles are threatened primarily by habitat loss and degradation. Population trends and large-scale patterns of abundance of western painted and western pond turtles in Oregon are difficult to measure, but declines in abundance of both species are believed to be significant given measurable losses in habitat availability (quantity) and habitat function (quality). Habitat loss is largely due to the conversion of land for human uses (e.g., urbanization and agriculture). Habitat degradation is due in part to non-native invasive species. These changes are particularly striking in the Willamette Valley, but have occurred throughout Oregon and within the ranges of both turtle species.

Turtles are Long-Lived. Oregon's native turtles are relatively long-lived, having the potential to live 50 years or more in the wild. Western painted and western pond turtles reach sexual maturity typically between 7 and 12 years of age. As with many other turtle species, they experience naturally high rates of nest failure and hatchling/juvenile mortality. Even small increases in mortality, especially of adult female turtles, can have significant negative impacts on future turtle populations. Although improving the survival of eggs and young is considered very important, reducing the loss of adult turtles is likely even more important for maintaining viable populations into the future.

Threats to Oregon's native turtles (in no particular order) are as follows:

- habitat loss and degradation
- non-native invasive species (plants and animals)
- declines in water quality
- changes in hydrology
- altered natural disturbance regimes (floods and wildfire)
- movement barriers
- population isolation and fragmentation
- predation by habitat generalists (e.g., raccoons, coyotes, corvids)
- mortality from vehicular traffic
- illegal collection and shooting
- release of pet turtles
- harassment, injury, and mortality from domestic pets
- chemical contaminants
- disease
- climate change

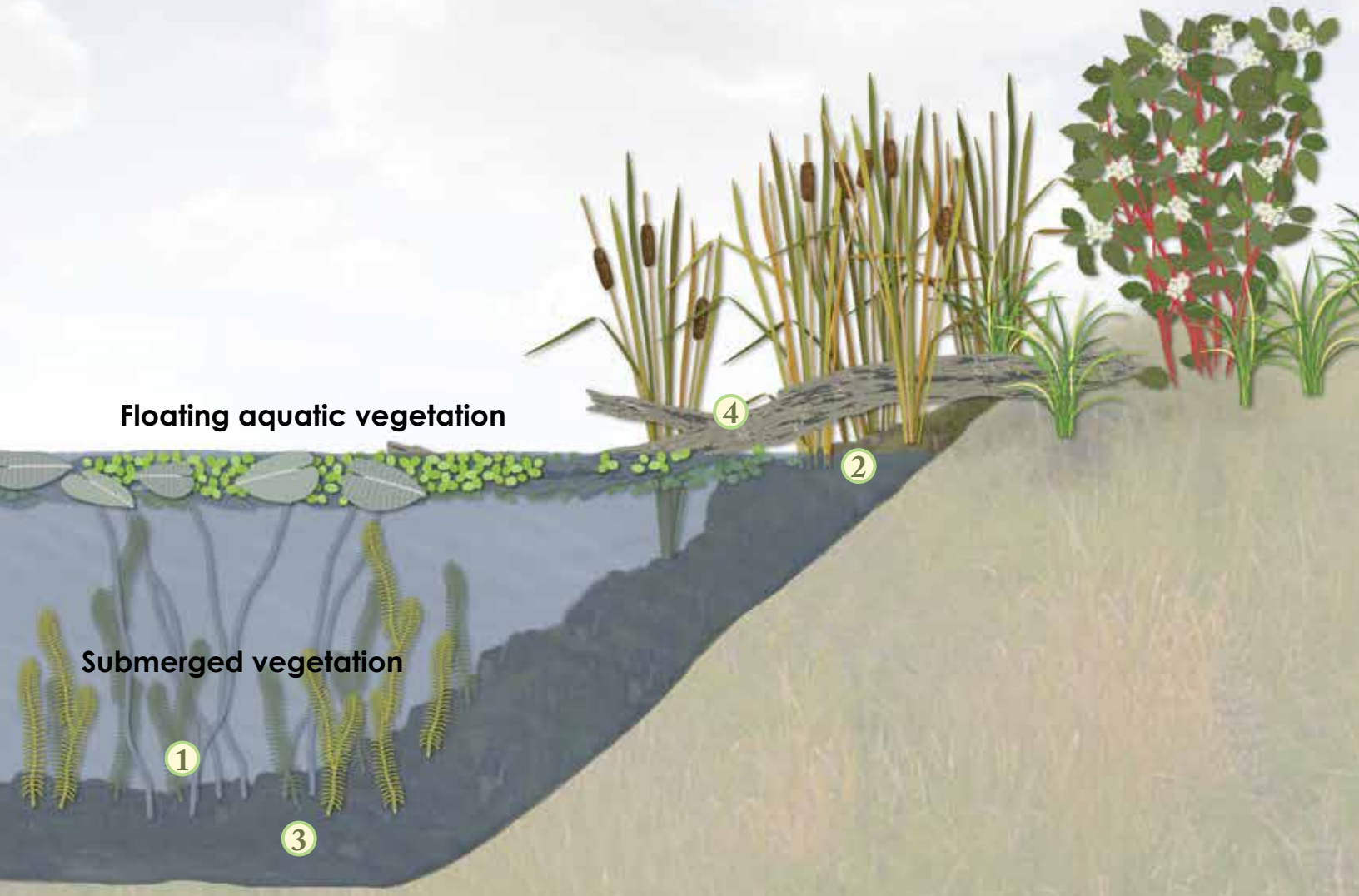
Turtles are important components of the food web. All life stages, including eggs, are important prey for a suite of natural predators (e.g., great blue heron, mink, and otter). Turtles are consumers of a variety of plant and animal material, and are beneficial scavengers. Turtles are also important culturally and are symbols of our natural heritage. Opportunities exist for all Oregonians to ensure our native turtles persist, as they are important ecologically to the overall health and biodiversity of our environment, and so they can be enjoyed by present and future generations.

If You Find A Turtle, Please Do The Following:

1. Make a written note of the exact location, date, and time of day found.
2. If possible, take a photograph of the turtle for species verification purposes.
3. As soon as possible, report this information to your local ODFW office and/or fill out the turtle sighting report form located at: www.oregonturtles.com/
4. If the turtle is in immediate danger (e.g., in the middle of a road), move it a short distance out of harm's way, pointing it in the same direction it was headed. It is not necessary to put a turtle in water as they are very terrestrial in nature.

Figure 3.

Where Turtles are Found



1. **Foraging/hiding (adults)**
   Deep water with soft, muddy bottom
2. **Foraging/hiding (juveniles)**
   Shallow water bottom
3. **Overwintering**
   Bottom of pond or in forest
4. **Basking**
   Rock and downed wood
5. **Nesting**
   Bare ground, low vegetation, sunny
6. **Aestivating**
   Moist forest/shrubs, under wood/duff

Section 8:
Creating and Enhancing Habitat for Turtles

Turtle habitat creation and enhancement efforts should focus on the following eight essential elements critical for turtle survival and success:

- sunlight
- nesting habitat
- aquatic habitat
- basking structures
- aestivation habitat
- overwintering habitat
- close proximity of aquatic and terrestrial habitat components
- safe movement corridors between aquatic and terrestrial habitats

Below is more specific information on the eight essential turtle habitat elements and BMPs when providing for each.

Sunlight

Because they are ectotherms, turtles need periods of direct sun exposure for proper digestion, to maintain shell health, and to regulate body temperature. Sun exposure is also critical to reproductive success and recruitment. Warmth from direct sunlight is needed for proper formation of eggs inside female turtles and for embryo development after eggs are laid. Warmth from direct sunlight triggers emergence of hatchlings from the nest chamber and movement to aquatic habitat. Warmth from sunlight also stimulates turtles to come out of hibernation in the springtime and begin foraging for food.

Aquatic and upland areas that are completely shaded are not likely to be used by turtles, except when hibernating or aestivating. Tree and shrub planting in riparian/wetland buffer zones to increase shade is often a tool used to meet water quality requirements and fish habitat restoration goals. Though there are many ecological benefits to heavily shaded, vegetated riparian areas, it is also beneficial to leave a portion of the riparian/wetland buffer area in a more open or early successional habitat condition, particularly on south- and southwest-facing aspects, for turtles and other species that require these open, sunny areas for part of their life cycle (e.g., pond-breeding amphibians, native bees). For more information on creating and enhancing nesting habitat for turtles, see the Nesting Habitat section below. General ideas and suggested techniques to create and maintain proper sunlight conditions for turtles are as follows:

1. **Create sunny areas along the edges of ponds and other waterbodies** where they are currently lacking by trimming vegetation or selectively removing trees and shrubs. Target northerly edges and other areas that have the potential to receive the most sunlight. Trees can be girdled to promote snag creation and eventual input of large wood.
2. **For projects involving re-vegetation of riparian areas, other aquatic habitats, and nearby upland slopes, allow some areas to remain completely to partly open and sunny** to provide basking and nesting opportunities for turtles.

Western painted turtles basking in the sun.

Photo Credit: Linda Vanoudehaegen

Western pond turtles basking in the sun.

Photo Credit: Keith Kohl

A western pond turtle basking.

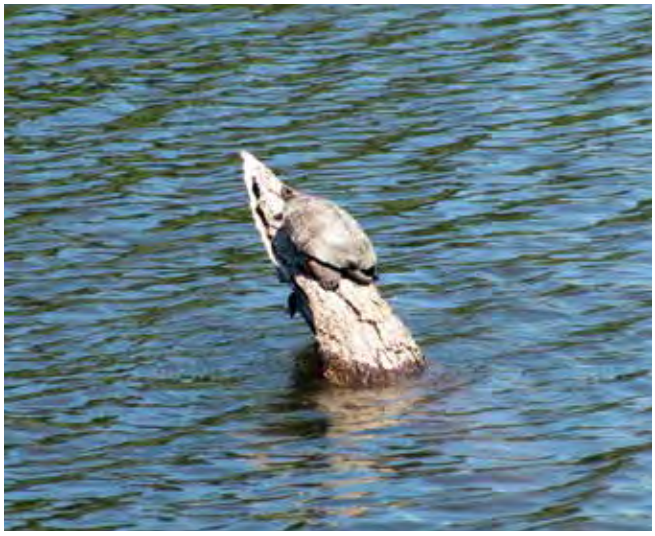


Photo Credit: USFWS

3. **Restore natural disturbance regimes (e.g., flooding, fire) to the extent practicable to create and maintain early successional habitat features.** Periodic disturbance from flooding and fire (wild or prescribed) creates and maintains bare ground and early successional vegetative conditions. Promoting and allowing herbivory and dam building activity by American beaver are an excellent means to this end. In the absence of periodic flooding and fire, disturbance regimes can be mimicked, though nothing can truly imitate natural disturbance processes.

Nesting Habitat

Suitable nesting habitat is essential for turtle reproduction and protection and maintenance of nesting habitat is critical to the survival of turtle populations (Bury et al. 2012). Turtles nest in areas with abundant sun exposure and little or no shrub or overhead tree canopy cover that would shade the nesting site. Nesting sites tend to have sparse, low-growing vegetation consisting of patchy grass and forbs, but bare soil is preferable. Turtles will nest wherever sufficient sun is perceived, but most turtles select south or southwest facing aspects. While turtles will nest on steep slopes, nests are usually located on slopes less than 15 percent. Soil types at known turtle nest sites vary, but typically include a high clay content, sandy loam, and gravelly cobble. Most nesting occurs within 325 ft (100 m) of occupied aquatic habitat. Although the majority of nest sites are within 164 ft (50 m), this may be a function of habitat encroachment by the built environment. Pond turtles have been documented nesting 1318 ft (402 m) from occupied aquatic habitat (Rosenberg et al. 2009) and painted turtles have been documented nesting 820 ft (250 m) from occupied aquatic habitat (Gervais et al. 2009). Some female turtles exhibit nest site fidelity, though this may correlate more to limited availability and accessibility of

suitable nesting habitat. Ideal suitable nesting habitat is in relatively close proximity to aquatic habitat, above the annual high water level. While turtle eggs and hatchlings can tolerate some degree of inundation during high-water events, hatching and post-hatching emergence survival rates are higher at sites that are inundated for a shorter period of time or not at all. Ideal nest sites are safely accessible by female turtles (e.g., no roads in between aquatic and nesting areas), provide some hiding cover from potential predators, and are subject to occasional, but not frequent and significant, ground and vegetation disturbance. Areas managed specifically for turtle nesting habitat ideally would have restricted public access at least during turtle nesting season.

Recommended BMPs for creating and enhancing nesting areas are:

1. **Protect and maintain known turtle nesting areas. Create new areas of nesting habitat.** Protecting and maintaining nesting areas is a top priority in turtle conservation efforts. Known turtle nesting areas should be protected from actions that would otherwise make the habitat unsuitable or subject nesting females, developing eggs, or emerging young to increased levels of predation, human related mortality, and illegal collection. Create and maintain areas of bare ground with low-growing sparse vegetation and little or no overhead tree canopy that receive full solar exposure, preferably south-facing. It is best to add to existing nesting habitat or to create nesting habitat near known nesting areas to increase the likelihood that females will use the nest site immediately.

Figure 7. Characteristics of Suitable Turtle Nesting Habitat.

Photo Credit: ODFW

Target areas that are flat or gently sloping within 325 ft (100 m) and no farther than 656 ft (200 m) from wetlands and other waterbodies occupied by turtles; targeted areas should rarely flood. Generally, the closer the nesting area is to turtle aquatic habitat the better. When managing a site for native turtles or multi-species benefits, certain areas ideally would be designated and managed specifically for turtle nesting and formalized in a site management plan.

To create new areas of turtle nesting habitat at this site, vegetation was removed and the ground scraped.

Photo Credit: ODFW

Creating New Nesting Habitat.

Creation of new nesting habitat typically involves removal of tree and/or shrub cover. Vegetation removal should be conducted in a manner that minimizes unintended harmful impacts to other protected species such as migratory birds and their active nests. After removal of vegetation, the ground will likely need to be disturbed through scarification methods (e.g., scraping with equipment or hand tools) to create areas of bare ground. Removal of the surface material from the site may help reduce the invasive plant seedbed.

2. **Consider bringing in soil to create or enhance nesting areas**. Depending on site-specific conditions, it may be helpful to import soil. Any imported material should be clean and weed-free. Ideally the material would be washed to minimize translocation of invasive pant species. Till / mix small gravels into the soil to loosen it up and help keep vegetation down. Adding a layer of fine gravels or clay soil can further suppress vegetation growth. Sandy soils, which do not promote the formation of nest chambers well, can be amended with native silt loam to improve substrate conditions. See Table 3 for recommended soil / substrate mix for turtle nesting areas.

3. **If planting in turtle nesting areas,** only plant herbaceous species that reach less than 2 ft (0.5 m) in height, such as native bunchgrasses and wildflowers. These species naturally leave bare areas between plants. See Appendix C for a list of recommended plants. Aim for no more than 40 percent low-growing herbaceous plant cover. Ideally woody vegetation would not be planted at all on areas targeted for turtle nesting, but if required, plant only shrubs and plant sparsely, i.e., not more than 15-20 per acre (6-9 per hectare). A few shrubs may offer cover for gravid females and hatchlings that emerge from the nest. The ideal species mix will depend on site-specific conditions including soil type. Avoid species that spread quickly, especially those that have extensive root systems or are rhizomatous.

A female western pond turtle in suitable nesting habitat.

Photo Credit: Matthew Wolfe Greer

4. **Withhold irrigation on sites being managed for nesting habitat** to reduce and/or delay plant growth and keep plants sparse and lower in stature. Frequent irrigation could delay embryonic development and result in lowered egg hatch rates.

5. **Maintain nesting areas to retain suitability through time.** In the absence of natural disturbance regimes (flood or fire), turtle nesting habitat almost always requires some level of active maintenance to preserve ideal vegetation characteristics. Exceptions are sites considered highly disturbed already, for example gravel fill areas, dredge spoils sites, and road shoulders where soils tend to be amended, compacted and regularly disturbed. These types of sites are not prone to vegetative growth. Periodic (e.g., every 2-3 years) scraping, raking, spraying with herbicides, hand-pulling, mowing, or controlled grazing can be used to maintain patches of bare ground, keep vegetation height low, keep out reed canarygrass and other encroaching weeds, and remove shrubs and trees that will eventually shade the area. Maintain nesting habitat so that overall herbaceous cover is no more than 40 percent. Total shrub canopy cover should be no more than 20 percent and tree canopy cover no more than 10 percent. Smaller areas of turtle nesting habitat ideally would have no shrub or tree cover.

6. **Time creation, enhancement, and maintenance of nesting areas with turtles in mind.** New nesting areas in currently unsuitable habitat can be created at any time, but ideally would be completed by early May so the area is available to gravid females of the year for egg laying. Enhancement and maintenance of existing nesting areas or areas where nesting is suspected should

be timed to avoid impacts to already laid eggs, hatchlings overwintering in the nest, emerged hatchlings present near the nest, and nesting females. This timeframe is generally from April 1 through May 15. That said, turtles could be encountered even during this period so be on the lookout for turtles whenever working in suitable nesting habitat. Another option is to temporarily preclude females from nesting in the area scheduled to be enhanced. This can be achieved by using exclusion fencing such as silt fencing or by placing hardware cloth over the areas to discourage nesting attempts. The hardware cloth should be flush with the ground, firmly staked, and checked occasionally to prevent unintended entrapment of other wildlife. Ideally, nesting habitat would be monitored by a qualified wildlife biologist to try to determine turtle response (use) to creation, enhancement, and maintenance efforts. Coordinate with your local ODFW wildlife biologist. Consider also using remote wildlife cameras to detect turtle nesting activity.

Periodic scraping is one method to maintain nesting habitat suitability.

Photo Credit: Patrick Blanchard

How Much Nesting Habitat do Turtles Need?

There is no specific minimum amount of suitable nesting habitat required by an individual female western painted or western pond turtle. It only takes one small spot of suitable nesting habitat within the larger terrestrial habitat framework. That said, a larger area of suitable nesting habitat is considered better than a smaller area and multiple areas of suitable nesting habitat are better than a single area. More suitable habitat translates into more nesting opportunity for gravid females. More nesting habitat reduces nest density which likely dilutes nest predation. Nests spread out over a larger area also potentially increases the total number of hatchlings produced. Nesting habitat is considered one of the main limiting factors for Oregon's native turtles.

A predated turtle nest.

Photo Credit: ODFW

Close-up of a turtle egg shall fragment.

Photo Credit: Metro

A female western painted turtle observed nesting on June 25, 2013 at 6 pm.

Photo Credit: Dan Lake

Aquatic Habitat

Oregon's native turtles will use a variety of different types of waterbodies, from natural wetlands and riverine off-channel areas to former gravel pits and sewage treatment ponds. However, there are known habitat features that need to be present in order for a particular aquatic area to be considered suitable for turtles. The key features that relate to suitability for turtles are waterbody size, water depth, substrate, food availability, and hiding cover. Partial to full exposure of the aquatic habitat to sunlight is another key feature; this is addressed above. Basking structures are also important and are addressed below.

This remnant permanent wetland is an example of suitable aquatic habitat occupied by turtles. It has ample food, hiding cover, and natural wood basking structures.

Photo Credit: NERI

This off-channel slough is occupied by native turtles.

Photo Credit: Metro

This emergent wetland has been affected by adjacent agricultural practices, but it is occupied by native turtles.

Photo Credit: NERI

Another example of a remnant permanent wetland occupied by turtles.

Photo Credit: ODFW

A western pond turtle in swift riverine habitat.

Photo Credit: Eric Olson

A western pond turtle in an oxbow pond.

Photo Credit: ODFW

1. **Focus habitat improvement efforts in small to medium-sized waterbodies.** Large bodies of water are generally not as suitable for turtles as smaller waterbodies. Large waterbodies tend to have lower mean water temperatures than smaller waterbodies and lack vegetative cover and basking habitat beyond the immediate shoreline. Waterbodies that tend to be relatively warm year-round or warm for part of the year generally provide higher quality turtle habitat.

2. **Provide a range of water depths and water temperatures.** Turtles need both shallow water and deeper water areas to meet requirements of various life stages. Shallow water areas (less than 6 in [15 cm]) that are sunny, sheltered from the wind, and have a mixture of submerged and emergent aquatic vegetation contribute to ideal habitat conditions for hatchling turtles. Deeper areas are needed by larger turtles. When designing new wetlands or restoring existing wetlands, include side slope ratios ranging from 5:1 to 10:1 and about 50% of the waterbody area has a maximum depth of 6.5 ft (2 m) during mean water flows and a minimum 3 to 4 ft. (1 to 1.2 m) during annual low water conditions. It is desirable to allow some wetland areas to dry completely during the low water season, but some permanent water at least 3 to 4 ft. (1 to 1.2 m) deep should be present

year-round. Suitable turtle aquatic habitats offer some areas of quieter, slowly flowing or static water.

Shallow water can provide young turtles with warmer water, ample hiding cover, and easier foraging opportunity.

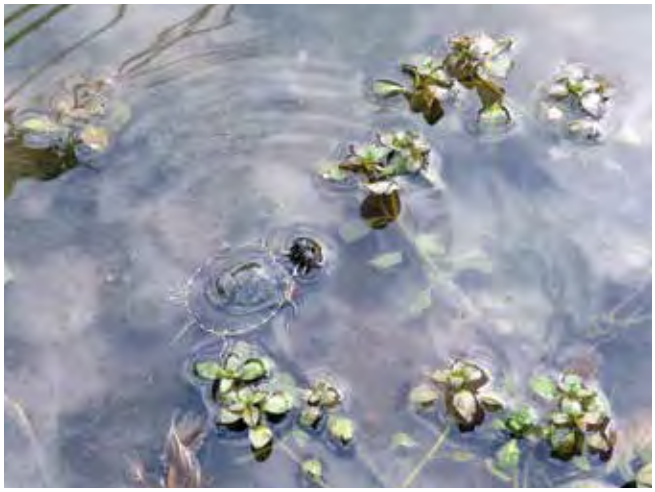


Photo Credit: ODFW

3. **Improve aquatic vegetation conditions.** Promote and plant (if necessary) native floating, emergent, and submergent plant species to provide food and hiding cover for turtles and their prey. Small turtles will sometimes bask atop floating vegetation. Emergent vegetation provides hiding cover. Control non-native invasive plants and combat algal blooms by addressing the cause of the problem (see Invasive Species and Dredging, Filling and Pond Management in Section 12 for more information).

What do Turtles Eat?

Oregon's native turtles are omnivorous, eating a variety of plants and animals such as worms, aquatic invertebrates, tadpoles, fish, and submergent and emergent vegetation. They are also scavengers, eating carrion when it is available. Turtles tend to be more carnivorous in hatchling and juvenile stages of development.

A western painted turtle surface basking.

Photo Credit: Patrick Blanchard

4. **Consider removing pond liners, rip rap, and concrete to improve turtle access to bottoms of waterbodies and promote plant growth.** Turtles that do not overwinter in upland habitats bury themselves in soft, muddy bottoms of ponds and other waterbodies. A good layer of sediment, leaves, and other organic matter also provides rooting substrate for emergent and submergent plants and is important habitat for the suite of aquatic invertebrates that turtles prey upon. Many natural waterways have been altered as historic water conveyance methods included rip-rapping and lining streams with concrete. Many man-made ponds are lined with bentonite or thick plastic barriers to prevent water seepage. Ideally these artificial surfaces and bottoms would be eliminated to improve habitat suitability for turtles, though this may not be preferred if removal of the liner would result in loss of the aquatic habitat altogether.

Rising Waters – Turtles and High Water Events.

Water levels often rise during winter months. Prolonged high-water events in conjunction with high water velocities may dislodge turtles from underwater hibernation sites (muddy bottoms, overhanging banks), sweeping them downstream. Information is lacking on the short- and long-term effects of such events, though turtles are likely more subject to predation and increased energetic costs compared to being undisturbed. These events could cause turtles to emerge from hibernation in spring with lower-than-normal fat reserves.

Basking Structures

Basking is a critical life function of Oregon's turtles. Ideally there would be ample natural sources of various sized downed wood to provide needed habitat features for turtles, other wildlife, and fish. When lacking, wood can be brought in and placed strategically while still managing standing trees for future natural recruitment. Placed wood should be properly sized for a particular site to provide appropriate habitat and to maintain flood flow capacity. Secure installed wood where deemed necessary to protect downstream structures. Placement of some types of basking structures may be considered in-water work and should be done within ODFW in-water guidelines aimed at protecting native fish. Oregon Department of State Lands (DSL) and U.S. Army Corps of Engineer (ACOE) wetland rules may apply. Contact your local ODFW fish biologist for assistance in regards to in-water work and fish, and your local DSL coordinator for help determining if a DSL/ACOE permit is required. A permit is not required from DSL for the placement of large wood, boulders, and spawning gravels provided the material is placed consistent with the *"Guide to Placing Large Wood and Boulders"* (DSL/ODFW 2010). arcweb.sos.state.or.us/pages/rules/oars_100/oar_141/141_085.html

1. **Maintain existing basking structures whenever possible.** If the basking structure is a discarded vehicle tire or other trash item that turtles are known to use and that's all that is available to them, then leaving it in place is reasonable until it can be replaced with a natural basking structure.

Western pond turtles basking.

Photo Credit: Tom Ten Pas

2. **Place large wood in wetlands, stream channels, sloughs and other waterbodies** to serve as turtle basking structures. Place wood in locations that receive full to partial sun exposure. Wood with the root wad intact is preferred. Place logs and root wads at a variety of angles and water depths, with some parallel to the shoreline, but the majority perpendicular and extending from the bank out into the open water. Wood can be piled to create complexity, cover from predators, and varied basking opportunities at different water levels. Work with a qualified hydraulic engineer and stream restoration biologist to ensure proper placement of wood and protection of downstream resources and infrastructure, if any.

Basking structures being added to a habitat restoration project.

Photo Credit: ODFW

3. **Don't forget about smaller turtles.** Small turtles need small sized basking structures. Place smaller diameter logs and limbs and lower profile woody material in shallow water where there is ample hiding cover nearby. Fall trees crown-in to provide smaller diameter basking branches as well as complex cover for protection from predators. Consider solar exposure and location of nesting area(s).

Smaller pieces of wood with branches benefit small turtles.

Photo Credit: Multnomah County Drainage District

How Many Basking Structures Do Turtles Need?

There is no specific number of basking structures required by turtles. Generally, "more is better" and "some is better than none". Also, the bigger the structure, generally the better, though this may have diminishing returns on extraordinary sized structures. While some biologists have recommended spacing basking structures about 20 ft (6 m) apart, they can be installed closer together or farther apart. Site-specific characteristics of the waterbody should be considered. Ideally, imported structures should resemble naturally occurring sizes, shapes, and distributions. Increasing the number of basking structures available to turtles provides them with more basking opportunity and potentially less conflict over finding space, especially in areas that receive the most solar exposure.

4. **Float logs in ponds and other slow-moving waters.** Floating logs can also be placed in a sunny location in the center of a waterbody, close to the deepest part of the pond. Anchor logs to maintain their position in the center of the waterbody and away from the shoreline. Ideally, floated logs should be 8 to 20 in (20 to 50 cm) diameter and a minimum of 6 ft (2 m) long with bark and limbs attached. Root wads may or may not be attached.

A western pond turtle using a piece of floated wood anchored to the bottom of a pond.

Photo Credit: Douglas Grenz

5. **Place large wood in the floodplain and upland areas.** Pieces of wood and logs in the floodplain may enter stream systems during high-water events, providing habitat elements downstream in the future. Wood placed in upland areas will decay, enhancing soil conditions and building duff, the top layer of vegetation and soil which over time will benefit aestivating and overwintering turtles, plus many other species of wildlife and fish.

Wood of various sizes place in upland areas benefits a variety of wildlife including turtles.

Photo Credit: City of Portland Environmental Services

6. **Incorporate brush piles and rocks into aquatic habitat enhancement projects.** Place brush piles and rocks near shorelines and in shallow areas. Brush piles provide hiding cover for turtles and their prey, and rocks serve as basking sites for turtles. Though brush piles are typically short-term habitat structures, they can still provide important habitat functions for turtles and many other species of wildlife.

In addition to large wood, large rocks and rock piles serve as basking habitat.

Photo Credit: ODFW

Artificial Basking Structures.

Sometimes natural wood is not readily available, access to the waterbody is challenging, or it is cost prohibitive to place natural wood basking structures. In these situations, artificial structures can provide value to turtles. Artificial structures should be designed and deployed to prevent accidental drowning of turtles. Other considerations may apply and should be discussed with your local ODFW wildlife biologist. See Appendix D for photos and design specifications of example artificial basking structures.

Red-eared sliders using an artificial basking structure.

Photo Credit: Patrick Blanchard

7. **Use artificial or man-made basking structures if natural wood is not available.** See Appendix D for recommended designs for artificial basking platforms
8. **Last, but definitely not least … Promote (and then tolerate) beaver activity.** Beaver damming and foraging habits naturally provide turtles with an abundance of basking material. Trees and shrubs felled by beaver also provide turtles with important hiding cover. Ideally beaver presence and activity would be encouraged and managed with turtles in mind.

Beaver herbivory and damming activity naturally provides turtles of all sizes with an abundance of basking structures.

Photo Credit: ODFW

Aestivation Habitat

Some turtles enter a state of dormancy during periods of hot, dry weather. Some turtles burrow themselves into muddy bottoms or over-hanging banks of ponds while others seek refuge in upland habitats. Shrubby areas and forests with understory shrubs and ample leaf litter that are relatively close to aquatic habitats, provide cool, moist spots for turtles during periods of prolonged heat.

1. **Maintain and promote soft muddy areas in wetlands, ponds, and other waterbodies.** Turtles bury themselves into soft substrate to hide from potential predators and for aestivation.
2. **Protect and maintain existing vegetated areas near suitable aquatic turtle habitats.** Control non-native invasive vegetation as needed and plant native deciduous shrubs and trees to provide leaf litter. With the exception of invasive plant control, do not remove fallen leaves, tree branches, or other organic material near aquatic habitats.
3. **Maintain vegetated buffers around and adjacent to ponds, wetlands, and other waterbodies.** Promote a variety of native deciduous plant species near wetlands and other waterbodies as leaves create the conditions needed by turtles seeking to overwinter on land. Balance with provision of open, early successional habitats (nesting habitat).

Overwintering Habitat

Turtles hibernate during winter months. Some turtles bury themselves in the soft, muddy bottoms of ponds, wetlands, and other waterbodies while others overwinter in upland habitats. Hibernating turtles live off stored fat reserves and oxygen saturated in their blood. While some subspecies of painted turtles have been documented

overwintering on land it is thought that most of Oregon's western painted turtles use aquatic habitats for hibernation. There is indication that some western painted turtles in the Portland metro area overwinter on land (Guderyahn pers. comm. 2014). Western pond turtles have been documented overwintering in aquatic habitats as well as in upland habitats up to 1640 ft (500 m) from aquatic habitat. Turtles that overwinter on land take cover under shrub and leaf litter, sometimes digging down a few inches into the top layer of duff. They do not eat during hibernation. During hibernation, a turtle's core temperature becomes similar to the ambient (surrounding) temperature and their metabolic rate slows down. Emergence from hibernation is triggered by warmer temperatures, usually when air temperature is about 60° F (15.6° C) for at least three days in a row. Suggested methods to improve overwintering habitat for turtles are as follows:

1. **Maintain and promote soft muddy areas in ponds, wetlands, and other waterbodies** known to support turtles. Mud with ample leaf litter and other organic material insulates turtles against extreme temperatures.
2. **Maintain areas of permanent water that are 4 - 6 ft (1.2 -2 m) deep through turtle hibernation months.** Turtles overwintering in aquatic habitats need water that persists throughout the duration of hibernation, from about November through March. Water can fluctuate somewhat, but ideally would get no shallower than 4 ft (1.2 m).
3. **Maintain vegetated buffers around and adjacent to ponds, wetlands, and other waterbodies** known to support turtles. Promote a variety of deciduous native plants near wetlands and other waterbodies as leaves create the conditions needed by turtles seeking to overwinter on land.

A turtle (a red-slider turtle) observed basking on a sunny day in early March. Note the muddy carapace – a sign the turtle overwintered at the bottom of a wetland.

Photo Credit: Anonymous

This western pond turtle was observed crossing a road on October 10, 2012 heading from the South Umpqua River to a forested slope, likely to overwinter. Despite missing its right hind foot it moved quickly. A part of its tail was also missing and an old injury to its carapace was evident.

Photo Credit: Lloyd Stiewig

OREGON DEPARTMENT OF FISH AND WILDLIFE

LIVING WITH WILDLIFE: AMERICAN BEAVER

Contents

FACTS ABOUT OREGON'S BEAVERS

The American Beaver (*Castor canadensis*) is the largest living rodent in North America. Adults average 40 pounds in weight and measure more than three feet in length, including the tail. They have a nose and ears that seal out water. These semi-aquatic mammals have webbed hind feet, large incisor teeth and a broad flat tail. They have poor eyesight, but excellent hearing and sense of smell. The beaver's sharp incisors, which are used to cut trees and peel bark while eating, are harder on the front surface than on the back so the back wears faster creating a sharp edge that enables a beaver to easily cut through wood. The incisors continually grow, but are worn down by grinding, tree cutting and feeding. Beavers are territorial and to mark their territory by creating small mounds of mud, leaves, and sticks, which they then cover with pungent oil called castoreum.

Once among the most widely distributed mammals in North America, beavers were trapped virtually to extinction in the 1800s to meet demand for beaver pelts. A subsequent decline in demand coupled with proper wildlife management allowed beavers to become reestablished in much of their former range and are now common in many areas, including urban settings.

Beavers are found where preferred foods are in good supply—along rivers and small streams, lakes, marshes and even roadside ditches that have adequate year-round water flow. In areas where deep, calm water is not available, beavers with enough building material available will create ponds by building dams across creeks or other watercourses to impound water.

Food and Feeding Habitats

- Beavers eat the leaves, inner bark, and twigs of aspen, alder, cottonwood, willow and other deciduous trees. They also eat shrubs, ferns, aquatic plants, grasses, blackberries and agricultural crops.
- Most foraging is done within 165 feet of the water's edge. In areas with few predators and a lean food supply, toppled trees and other signs of foraging may be found twice that distance from the den site.
- Foraging levels are most intense during late fall (earlier in cold winter areas of Oregon) as beavers prepare for winter.
- Fermentation by special intestinal microorganisms allows beavers to digest 30 percent of the cellulose they ingest from vegetation.
- When the surface of the water is frozen, beavers eat bark and stems from a food cache anchored to the bottom of the waterway for winter use. Food caches are seldom found where winters are comparatively mild, such as in the lowlands of western Oregon.

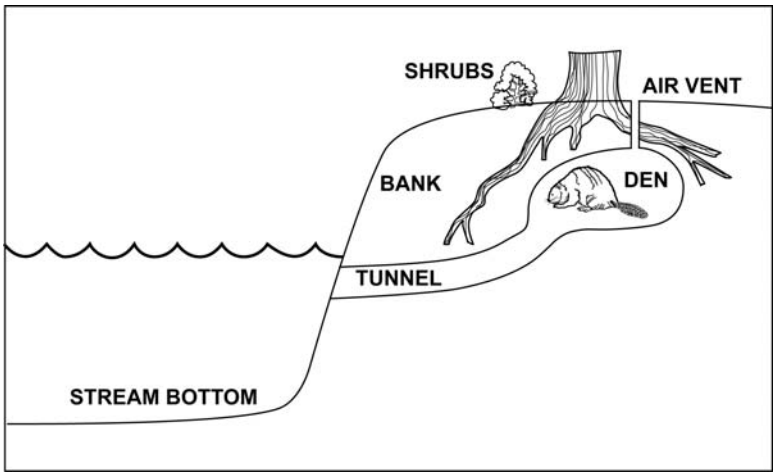


Figure 1. Like many rodents, beavers construct nesting dens for shelter and for protection against predators.

Beaver Dams

- Beavers build dams to create deep water for protection from predators, for access to their food supply and to provide underwater entrances to their den. Resultant moist soil promotes growth of favored foods.
- Beavers living on water bodies that maintain a constant level (lakes or large rivers) do not build dams.
- Dams are constructed and maintained with whatever materials are available—wood, stones, mud and plant parts. They vary in size from a small accumulation of woody material to structures 10 feet high and 165 feet wide.
- The sound of flowing water stimulates beavers to build dams; however, they routinely let a leak in a dam flow freely, especially during times of high waters.
- Beavers keep their dams in good repair and will constantly maintain the dams as the water level increases in their pond. A family of beavers may build and maintain one or several dams in their territory.
- In cold areas, dam maintenance is critical. Dams must be able to hold enough water so the pond won't freeze to the bottom, which would eliminate access to the winter food supply.

Lodges and Bank Dens

- Depending on the type of water body and the geographic area they occupy, beavers construct lodges or bank dens as a place to rest, stay warm, give birth and raise young. These may be burrows in a riverbank or the more familiar lodges in the water or on the shore. Both burrows and lodges consist of one or more underwater entrances, a feeding area, a dry nest den and a source of fresh air.
- Lodges consist of a mound of branches and logs plastered with mud. One or more underwater openings lead to tunnels that meet at the center of the mound where a single chamber is created.
- Bank dens are dug into the banks of streams and large ponds, and beavers may or may not build a lodge over them (Fig. 1). Bank dens may also be located under stumps, logs, or docks.
- All family members concentrate on repairing the family lodge or den in late fall (earlier in cold winter areas of Oregon) in preparation for winter.

Reproduction and Family Structure

- A mated pair of beaver will live together for many years, sometimes for life.
- Beavers breed between January and March, and litters of one to eight kits (average four) are produced between April and June. The number of kits born is closely related to the amount of food available (more food, more kits) and the female's age.
- The female nurses the kits until they are weaned at 10 to 12 weeks of age.
- Most kits remain with adults until they are about two years old although some leave as early as 11 months and a few females stay until they are three years old. The kits then go off on their own in search of mates and suitable spots to begin colonies, which may be several miles away.
- Beavers live in colonies that may contain two to 12 individuals. The colony is usually made up of an adult breeding pair, kits of the year, and kits of the previous year or years.
- Populations are limited by habitat availability; the density of beavers appears not to exceed one colony per one-half mile under the best of conditions.

Mortality and Longevity

- Because of their size, behavior and habitat, adult beavers have few natural enemies.
- When foraging on shore or migrating overland, beavers may be killed by bears, coyotes, bobcats, cougars or dogs.
- Other causes of death include severe winter weather, winter starvation, disease, water fluctuations and floods, falling trees and collisions with vehicles along roadways.
- Historically, beavers were one of the most commonly trapped furbearers.
- Beavers live five to 10 years in the wild.

VIEWING BEAVERS

Although beavers are nocturnal, they are occasionally active during the day. They do not hibernate but are less active during winter, spending most of their time in the lodge or den. Freshly cut trees and shrubs and prominent dams and lodges are sure indicators of beaver presence. Look for signs of beavers during the day; look for the animals themselves before

sunset or after sunrise. Look for a V-shaped series of ripples on the surface of calm water. A closer view with binoculars may reveal the nostrils, eyes and ears of a beaver swimming.

If you startle a beaver and it goes underwater, wait quietly in a secluded spot and chances are that it will reemerge within one or two minutes. However, beavers are able to remain underwater for at least 15 minutes by slowing their heart rate. In order to warn each other of danger, beavers slap their tails against the water, creating a loud splash. Sounds also include whining (noise made by kits), a breathy greeting noise and loud blowing when upset.

When seen in the water, beavers are often mistaken for muskrats or nutria. Try to get a look at the tail. Beavers have a broad, flat tail that doesn't show behind them when swimming, whereas muskrats and nutria have a thin tail that is either held out of the water or sways back and forth on the water's surface as the animal swims. When on land, beavers will generally stand their ground and should not be approached or cornered. They will face the aggressor, rear up on their hind legs and hiss or growl loudly before lunging forward to deliver extremely damaging bites.

Forage Sites
Beavers cut down trees, shrubs and other available vegetation for food and building materials. There will be a pile of wood chips on the ground around the base of recently felled trees. Limbs that are too large to be hauled off are typically stripped of bark over the course of several days. The cut on small wood usually involves a 45-degree cut typical of rodents, but at a larger scale. Branches and twigs under ¾ inch in diameter are usually eaten entirely.

Slides and Channels
Slides are the paths beavers make where they enter and leave the water. They are 15 to 20 inches wide, at right angles to the shoreline, and have a slicked down or muddy appearance. Beavers construct channels or canal systems leading to their ponds, using them to float food—such as small, trimmed trees—from cutting sites. With receding water levels during summer, beaver activity shifts toward building and maintaining channels to access new food supplies. Channels often look man-made, have soft, muddy bottoms and are filled with 15 to 25 inches of water.

Food Storage Sites
Beavers that live in cold climates store branches of food trees and shrubs for winter use by shoving them into the mud at the bottom of ponds or streams near the entrance to their bank den or lodge.

Droppings
Beaver droppings are seldom found on land—those that are will commonly be found in the early morning at the water's edge. Individual beaver droppings are usually cylindrical, up to 2½ inches long and look as if they were formed of compressed sawdust. The diameter is an indication of the animal's size—1 inch is average for adults. The color of fresh deposits is dark brown, with lighter-colored bits of undigested wood, all turning pale with age.

BEAVERS ON THE LANDSCAPE

Beaver ponds and dams benefit Oregon's native fish and other wildlife

- Beaver dams create ponds that provide fish protection from strong winter flows. They increase the storage of water resulting in a more stable water supply and maintenance of higher flows downstream for a longer period of time.
- By providing plenty of woody debris in which juvenile fish can hide from predators, beaver dams help young trout and salmon survive their first vulnerable year. They also provide winter pool habitat that is important for fish such as cutthroat trout and coho.
- Beaver ponds help store leaf litter in the water and in turn support aquatic insect production, an important food for fish, amphibians, waterfowl, bats and songbirds.
- Beaver dams contribute to improved nesting and brood rearing areas for waterfowl in ponds and surrounding areas. The increased growth of vegetation provides additional forage and cover for a variety of wildlife such as big game and songbirds.
- Beaver ponds attract and provide habitat for mink, river otter, muskrats, turtles, frogs and salamanders.
- The trees that die as a result of rising water levels behind beaver dams attract insects that are a food source for many wildlife species such as woodpeckers. The tree snags also provide homes for cavity-nesting birds.

Beavers can help private landowners

- Beaver dams create wetlands which help control downstream flooding by storing and slowly releasing water, reducing the severity of high stream flows particularly after winter storms and spring snow melt.
- Beaver created wetlands improve water quality by removing or transforming excess nutrients, trapping silt, binding and removing toxic chemicals and filtering out sediment.
- Beaver dams facilitate ground water recharge and help raise the ground water table. This promotes vegetative growth, which in turn helps stabilize stream banks and minimize erosion. In some areas, beaver dams have been a major factor in building up soil in meadows and reducing the impact of invasive vegetation.
- Beaver dams reduce water velocity, reducing channel scouring and streambank erosion.
- Wetlands created by beavers attract a variety of fish and wildlife that provides recreational and aesthetic values to landowners.

Beavers can cause damage on public and private lands

- Beavers can become a problem if their foraging habits or building activities cause flooding or damage property.
- Beaver activity may result in damage to timber, crops, ornamental or landscape plants.
- Beaver dams and subsequent increased water levels may jeopardize the integrity of septic systems, roads or other human structures.
- There are several options for landowners in dealing with problem beavers that are covered in the following sections: preventing conflicts and remedying existing problems; lethal control; and moving beaver.

PREVENTING CONFLICTS AND SOLVING PROBLEMS: PLANTS AND TREES, FLOODING

Knowing that beavers fulfill an important role in creating wetlands that provides multiple benefits to a variety of fish and wildlife as well as landowners, one approach to dealing with beavers is to learn to live with them.

Newly planted tree protected from beaver damage using rebar and fencing. Rebar stake is used to hold up protective cage. (Photo by Doug Ray.)

PROTECTING PLANTS AND TREES

Choose and place plants carefully

Plant areas with Sitka spruce, elderberry, cascara, osoberry (Indian plum), ninebark, and twinberry, because they are not the beavers' preferred food plants. Densely plant aspen, cottonwood, willow, spirea (hardhack), and red-twig dogwood because once their roots are well established the plants often resprout after being eaten. Planting preferred plants away from known beaver trails will limit losses. *Note:* Beavers do use plants as construction materials that they might not eat.

Install barriers around trees

Wire cages around trees can prevent beavers from chewing on them. The trunks of individual large trees can be loosely wrapped with galvanized welded wire fencing, hardware cloth, or multiple layers of chicken wire (Fig. 2). Metal flashing can also be used. Trunks should be wrapped to a height of at least four feet, or in areas where flooding is common, at least two feet above the high-water mark. A 6 to 12 inch space should be left between the wire cage and the tree trunk as beavers may try to chew between the wires. Some form of stake or support is needed to keep beavers from pushing fencing against tree trunk and chewing. Check wire barrier every year to make sure they do not inhibit tree growth. Barriers can be painted to make them less noticeable. Welded wire fencing coated with green vinyl that helps the fencing blend in is also available. Lengths of corrugated plastic drainpipe can be attached around the trunks of narrow-diameter trees. *Note:* Dark-colored pipe can burn trunks in full sun; wider diameter pipe or pipe with holes in it may prevent overheating problems.

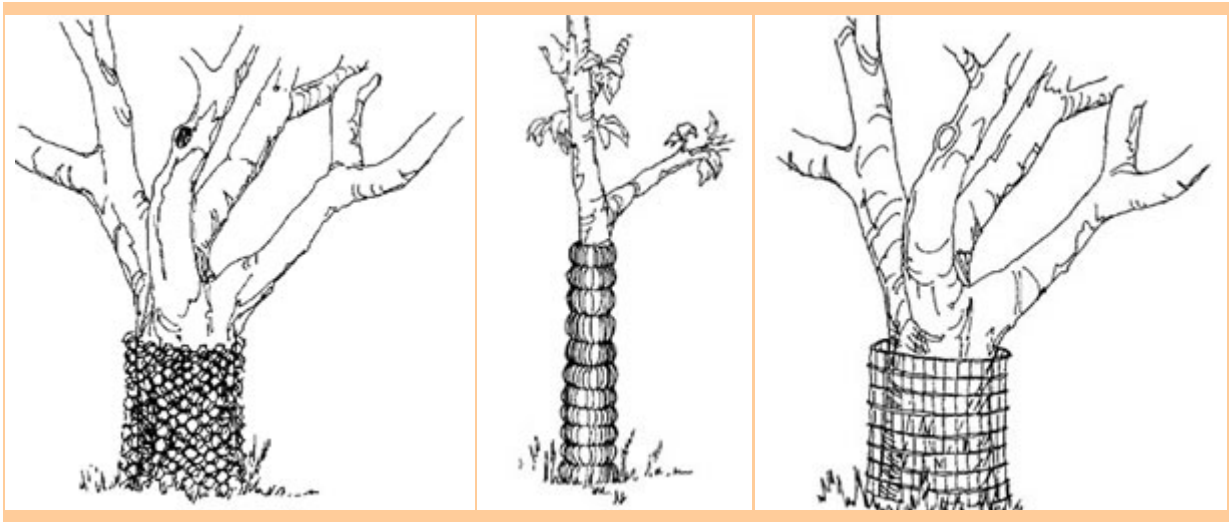


Figure 2. Various barriers can be used to protect plants from beaver damage. All plants should be protected to at least 4 feet above ground—or the snow line—and inspected regularly to ensure that wire does not become imbedded in the bark. (Drawing by Jenifer Rees.)

Surround groups of trees and shrubs with 4-foot high barriers made of galvanized, welded wire field fencing or other sturdy material (Fig. 3). A beaver's weight will pull down chicken wire and other lightweight material. Stake the barriers to prevent beavers from pushing them to the side or entering from underneath. An electric fence with two hot wires suspended 8 and 12 inches off the ground is also effective at protecting groups of plants. Consult local codes and experts before installing electrical fencing.

Figure 3. Groups of plants can be protected from beaver damage by surrounding them with wire fencing. (Photo by Russell Link)

Protect large areas that border beaver habitat by installing 4-foot high field fencing. Keep the bottom of the fence flush to the ground, or include an 18-inch wide skirt on the beaver side of the fence to prevent beavers from entering underneath. *Note:* Preventing access to food sources may force beavers to eat other nearby plants, including roses and other ornamentals.

Apply repellents on trees

Painting tree trunks with a sand and paint mix (2/3 cup masonry grade sand per quart of latex paint) has proven somewhat effective at protecting trees from beaver damage. The animals presumably don't like the gritty texture.

Commercial taste and odor repellents have provided mixed results, perhaps because they need to be reapplied often, particularly in moist weather. Taste and odor repellents are most effective when applied at the first sign of damage, when other food is available, and during the dry season. Two repellents that have had some success are Big Game Repellent® and Plantskydd®. Taste repellents are usually most effective when used at the first indication of beaver activity.

PREVENTING FLOODING

Before starting ***any*** of the following treatments or activities, landowner approval must be obtained. In addition, as these activities typically require some work in wetlands or streams, permits may be required from various local, state, and federal agencies before work is started. Please refer to the *State Water-Related Permits Users Guide* for more information or contact the Department of State Lands to determine if a removal-fill permit may be required.

Help maintain beaver dams and ponds with flow devices

It may be possible to make a change in the depth of a beaver pond to prevent flooding by installing a flow device at the intended depth that extends upstream and downstream of the dam. The flow device, a beaver deceiver or flexible leveler, keeps the rise in water level in the pond at a minimum by using one or more plastic pipes to continually drain the pond area. In general, at least three feet of water in the pond area will need to be maintained for the beavers to stay. See a diagram of a flexible leveler on page 11.

Installation of flow devices may require an approved fish passage plan to ensure that fish are able to navigate the flow control device. To learn more and to review the Oregon State fish passage laws, visit the fish passage section of the ODFW Web site. People may also contact their local ODFW office for more information.

Dam removal
Removing beaver dams may alleviate a damage situation temporarily, but generally dam removal is a futile effort because beaver will quickly rebuild the dam, sometimes overnight.

For information on beaver dams while conducting forest management activities on private land, contact the Oregon Department of Forestry. Except as needed for road maintenance, operators must submit a written plan to ODF prior to the removal of beaver dams and other natural obstructions from waters of the state during forest operations. In compliance with the Forest Practices rules, removal of any beaver dam that is within 25 feet of a culvert can be considered necessary for road maintenance. See Oregon Department of Forestry Forest Practices rules and (Oregon Administrative Rule 629-660-0050). Implemented by Oregon Department of Forestry.

See Department of State Lands sources list at the end of this document.

Removal of beaver lodges or dens
In western Oregon, most lodges are bank dens, not in-water structures. ODFW does not generally recommend that lodges or dens be removed, but removal does not require a permit from ODFW. Check with your local ODFW office for more information. *Note:* Muskrat lodge removal is prohibited.

Blocked culverts
To a beaver, a culvert probably looks like a hole in an otherwise fine dam, and when they plug the hole, a flooded road can result. One option to keep beavers from plugging a culvert is to create an alternative location for the dam. In overview, a series of 3 to 5 inch diameter non-treated lumber posts or live willow posts spaced 18 to 24 inches apart can serve as a foundation for the beavers to build a new dam. If you place the woody material from the removed dam upstream from the posts, beavers will use it to start the new dam. See diagram on page 12.

Other options to prevent beavers from plugging a culvert are available but some may prevent fish passage so you are encouraged to contact your local ODFW biologist for the best option for the property in question.

MOVING BEAVERS

It is illegal for anyone to ***move*** beaver in Oregon without a permit from ODFW. Contact your local ODFW biologist to request a permit.

ODFW is currently developing guidelines for live-trapping and relocating beaver. The intent of the guidelines is to maximize the ecological benefits provided by beaver while

minimizing potential conflicts (e.g., damage to private property) where beaver relocation is deemed appropriate and is authorized by ODFW.

LETHAL CONTROL

After assessing beaver activity, determine if beavers are causing damage or creating a hardship that requires lethal control. Sometimes, the very presence of beavers is seen as a problem when, in fact, the beavers are causing no harm.

Private landowners or their agents may lethally remove beaver without a permit from ODFW. Beavers are defined in state statues as a predatory animal on private land. See section below on Species Status.

Once lethal control is decided upon, the landowners can trap the beaver themselves, hire an ODFW-permitted Wildlife Control Operator who works directly with property owners to resolve problem beaver situations on a fee basis, or allow an ODFW-licensed regulated trapper to remove beaver during the established trapping season. Call your local ODFW office or visit the ODFW Web site for a current list of Wildlife Control Operators.

Note: Removing beavers is often a short-term solution as other beavers will move into the area if suitable habitat is present.

SPECIES STATUS

Beavers on Public land: Beavers are classified as Protected Furbearers by Oregon Revised Statute (ORS) 496.004 and Oregon Administrative Rule (OAR) 635-050-0050 on public land. Statute implemented by ODFW.

Beavers on Private land: Beaver are defined as a Predatory Animal by Oregon Revised Statute (ORS) 610.002 on private land. Statute implemented by Oregon Department of Agriculture.

Explanation of terms

- "Predatory animals" means coyotes, rabbits, rodents, and feral swine which are or may be destructive to agricultural crops, products and activities. This definition is applicable where wildlife is taken under the authority of one who owns leases, occupies, possesses or has charge or dominion over the land. On public land this typically includes one who has a grazing lease. Refer to ORS 610.105.

- “Take” means to kill, attempt to kill or obtain possession or control of any wildlife (ORS 496.004).

REGULATED TRAPPING

Trapping, like most technologies, has changed dramatically during the last two hundred years. Traps and trapping systems have made tremendous advances since the 1800s when beaver were nearly eliminated. Today, all regulated trappers in Oregon must first complete a study course and successfully pass a written test showing an acceptable level of

knowledge of animal behavior, current laws and regulations and trapping skills. Modern science based information is used to establish strict laws, enforced by Oregon State Police, which allows regulated trappers to harvest beaver during authorized seasons using state-of-the-art traps and techniques. Such trapping systems are a benefit by removing damage-causing beaver while maintaining healthy and abundant beaver population. The vast majority of beaver trapped today fall into this damage category. ODFW Furbearer Regulations can be found on the ODFW Web site.

PUBLIC HEALTH CONCERNS

There are few public health concerns to the general public in regard to beaver. Trappers and biologists should follow safety rules when dealing with beaver. Beavers can be infected with the bacterial disease tularemia, which is fatal to animals and is transmitted to them by ticks, biting flies and via contaminated water. Animals with this disease may be sluggish, unable to run when disturbed or appear tame. Tularemia may be transmitted to humans if they drink contaminated water, eat undercooked, infected meat, or allow an open cut to contact an infected animal. The most common source of tularemia for humans is to be cut or nicked by a knife when skinning an infected animal. A human who contracts tularemia commonly has a high temperature, headache, body ache, nausea, and sweats. A mild case may be confused with the flu and ignored. Humans can be easily treated with antibiotics. Contact your family doctor immediately if you believe that you have contracted tularemia.

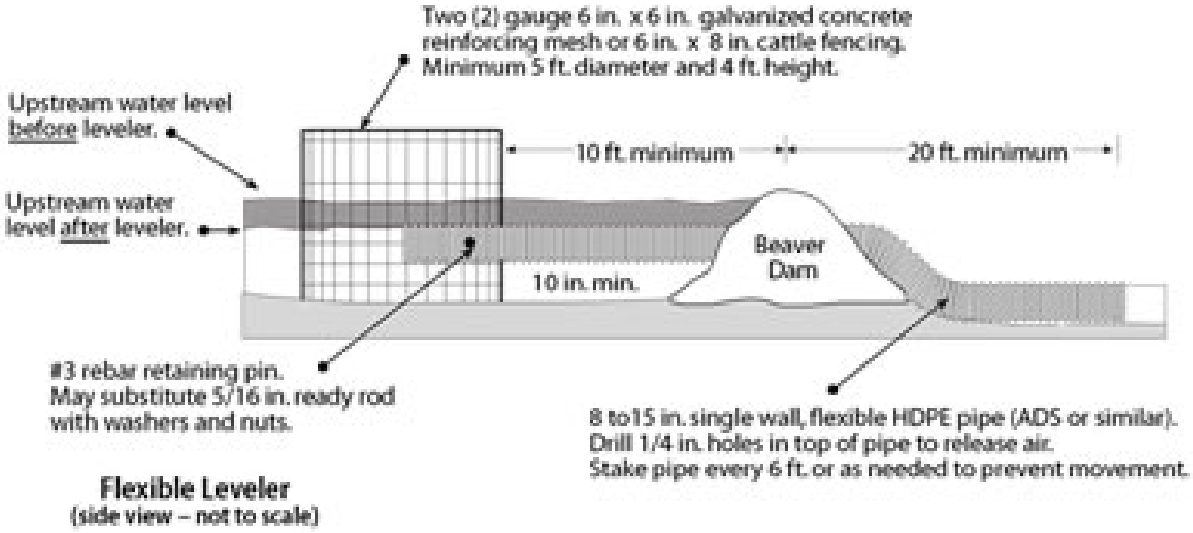
OTHER INFORMATION

Oregon Department of State Lands
Oregon Department of State Lands Removal-Fill Guidelines
ODFW Furbearer Regulations
ODFW Web Site
ODOT Beaver Bafflers (pdf)
State Water-Related Permits Users Guide
USDA Extension Service: Beaver (pdf)
USDA Living with Wildlife: Beaver, suitable for children (pdf)

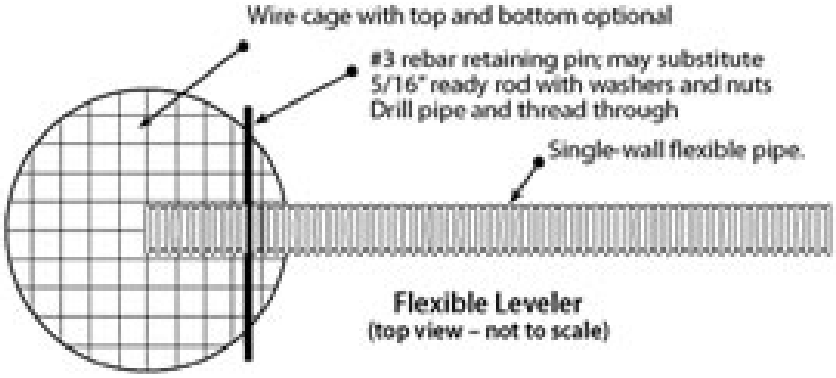
Oregon Department of Fish and Wildlife
3406 Cherry Ave. NE
Salem, OR 97303
www.dfw.state.or.us
(503) 947-6000

See diagrams on pages 11 and 12.

Note: The use of trade, firm, or corporation names and links in this publication is for the information of the reader. Such use does not constitute an official endorsement or approval by the Oregon Department of Fish and Wildlife.



Flexible Leveler
(side view – not to scale)

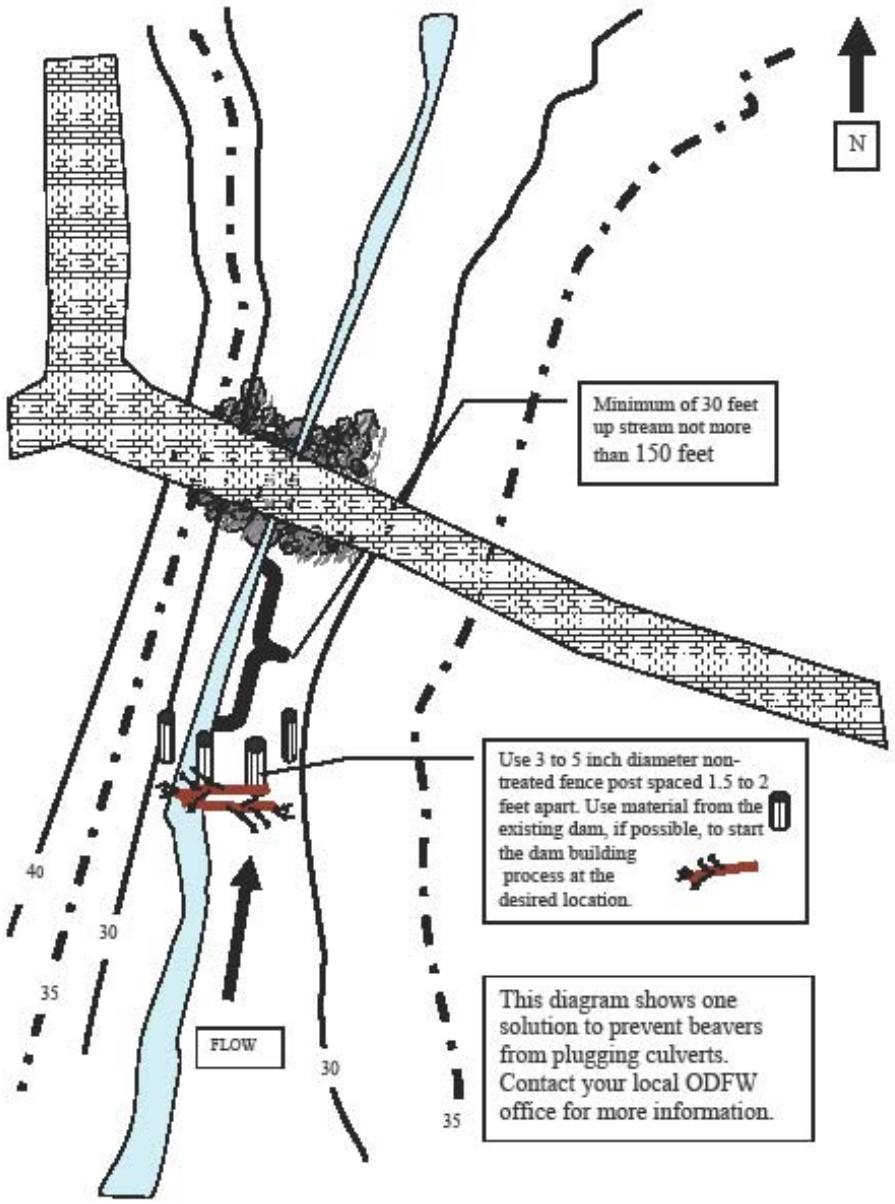


Flexible Leveler
(top view – not to scale)

Construction notes:

1. Construct wire cage using hog rings or similar devices for fasteners. Overlap one section for cage wall.
2. Cut out hole for flexible pipe in cage wall.
3. Remove dam as needed to place flexible pipe. Replace dam after leveler is installed.
4. Stake single-wall HDPE pipe every 6 ft. To prevent it from floating or beavers from moving it, use two T-posts and wire between them and over the top of the pipe to secure the pipe.
5. Drill 3/8th in. hole in culvert for rebar to allow for friction fit. If ready rod is used, place washers next to pipe and secure with double nuts.
6. One (1) 16 foot section of fencing will construct a cage wall approximately 5 feet in diameter. An additional section is needed to construct the top and bottom of each cage.
7. Pipe diameter should be sized to pass the stream base flow.
8. Final layout of the pipe should allow for a shallow gradient to facilitate fish passage.

Prevent beavers from plugging culverts



Oregon Department of Fish and Wildlife

Invasive Species Fact Sheet

Common Name: Red-eared slider
Family: *Emydidae*
Order: Testudines
Class: *Reptilia*
Species: *Trachemys scripta elegans*
Other names: Red-eared turtle, dime-store turtle
Origin: Eastern United States
Size: Max. carapace length 11 in.

Description:

- Head is greenish-gray with a red patch behind each eye and yellowish-white line across the head
- Carapace (upper shell) is smooth, slightly domed and greenish-gray to brown in color with weak serrate edges on the rear marginals.
- May be ornate with yellowish-white colored lines on scutes and ocellis. Young are bright green.
- Plastron (lower shell) is bright yellow with a single dark smudge on each scute. Sometime stains to a brownish-orange color.
- Legs are greenish-gray to black in color with yellow to white colored lines.

Ecology:

- Found in ponds, lakes and slow moving or still backwaters of rivers
- Diet consists of plants, insects, snails, tadpoles, crayfish, worms and fish

Status: Prohibited in Oregon. Large populations are found throughout the Willamette Valley and in other areas of the state. Most are illegally released pets.

Interesting facts: Red-eared slider lay their eggs about a month earlier than native turtles and may lay more than once a year. This can tip off predators so by the time native turtles lay their eggs, predators are keyed into nest sites.

Impact: Competes with native turtles for food and nesting, basking and cover habitat. Red-eared sliders can transmit parasites and diseases to which our native turtles have no immunity.

In addition to being a threat to native species, small turtles can be threat to human health. Since 1975, it has been illegal in the United States to sell or distribute turtles with shells that measure less than 4 inches in length. See the Centers for Disease Control and Prevention Web site for more information.

Action: Think twice before you buy a turtle as a pet. Turtles can live a long time—sometimes more than 20 years—and those cute little turtles can grow to the size of a dinner plate,

the OREGON CONSERVATION STRATEGY

Oregon Department of Fish and Wildlife

requiring large aquariums and regular maintenance.

If you have a pet red-eared slider, DO NOT release it into the wild. Call your local ODFW office for advice.

To report locations of red-eared sliders in the wild, call 1-800-INVADER. In the Willamette Valley, report sightings online on the Native Turtles of Oregon Web site.

More information: See Oregon Administrative Rules, Division 56, IMPORTATION, POSSESSION, CONFINEMENT, TRANSPORTATION AND SALE OF NONNATIVE WILDLIFE

Oregon Department of Fish and Wildlife
4034 Fairview Industrial Dr Se
Salem, Or 97302
Phone (503) 947-6000
www.odfw.com
www.odfw.com/conservationstrategy

the OREGON CONSERVATION STRATEGY

Oregon Department of Fish and Wildlife

Invasive Species Fact Sheet

Common Name: Bullfrog
Family: *Ranidae*
Order: *Anura*
Class: *Amphiba*
Species: *Lithobates catesbeianus*
(formerly Rana catesbeiana)
Origin: Eastern United States
Size: Adults: 3.5 – 8 inches (9cm -20.3 cm)
Tadpoles: 4 - 6 inches (10.2cm -15.3 cm)

Description:

- Tadpoles are dark green with black spots, orange or bronze eyes and yellowish underbellies.
- Metamorphosis of tadpoles can take up to two years. (The process of change from tadpole to frog).
- Juveniles are green to brown with tiny black spots, and orange- or bronze-colored eyes.
- Adult females are larger than the males, ranging in color from green to dark brown with dark spots on top and a cream or white colored throat. Both sexes have a large tympanum (eardrum) located just behind the eye.
- The females' tympanum is about the same size as its eye.
- Adult males range in color from green to dark brown with dark sports on top and a yellow throat. The males' tympanum is about the twice the size as its eye.
- Adults have golden colored eyes.
- The male emits a loud mating call.

Ecology:

- Thrives in the warm water of ponds, lakes, marshes, sloughs, irrigation ditches and streams.
- Diet of adult consists of about anything it can fit down its throat including fish, reptiles, small mammals, birds, amphibians and insects.
- Tolerates a wide range of water temperatures.

Status: Controlled species in Oregon. Can be legally harvested year-round; no angling license required.

the Oregon Conservation Strategy

Oregon Department of Fish and Wildlife

Interesting facts: Introduced into Oregon as a food item (frog legs) in the early 1900s. Bullfrogs lay up 20,000 eggs each season while native species such as red-legged frogs lay up to 5,000 eggs.

Impact: Devour native turtles and frogs, adversely affecting native populations; transmit disease to native species; aggressively compete for food and habitat; out produce reproductively, overwhelming native populations.

Action: Don't release bullfrogs–pets or science projects– into the wild. If you see adults or tadpoles for sale in stores or online in Oregon, please report them to ODFW.

If you see bullfrogs in the wild, remove them to eat or kill them. One accepted method is stunning the frog with a sharp blow to the head, followed by decapitation. Make sure you have first identified the frog as a bullfrog; most native frogs are protected and cannot be removed from the wild or killed.

Bullfrogs are most accurately identified by: golden eyes and a large tympanum (eardrum) located just behind the eye. Bullfrogs often have black polka dots on the top of the head and body, blotchy striping on the legs, and a whitish underside with gray mottling. The upper lip is bright green; on males the lower lip is yellowish in color.

Oregon Department of Fish and Wildlife
4034 Fairview Industrial Dr Se
Salem, Or 97302
Phone (503) 947-6000
www.odfw.com
www.odfw.com/conservationstrategy

the OREGON CONSERVATION STRATEGY

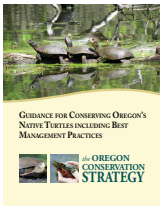
Pond Resources

ONLINE:

Aquatic Plant Identification Manual for Washington's Freshwater Plants:
https://fortress.wa.gov/ecy/gisresources/lakes/AquaticPlantGuide/index.html

Aquatic Plants and Weed Control

https://www.clemson.edu/extension/water/stormwater-ponds/problem-solving/aquatic-weeds/index.html



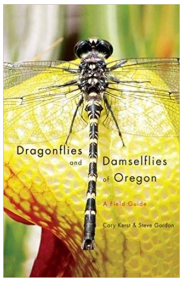
Guidance for Conserving Oregon's Native Turtles, Including Best Management Practices, Oregon Native Turtle Working Group
https://www.dfw.state.or.us/wildlife/living_with/docs/ODFW_Turtle_BMPs_March_2015.pdf

Backyard Ponds: Guidelines for Creating & ManagingHabitat for Dragonflies &Damselflies

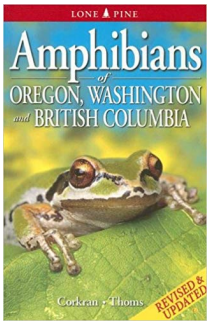
Celeste Mazzacano

https://xerces.org/wpcontent/uploads/2014/07/Pond_Habitat_Guidelines_Odonates_Final_Websec.pdf

IN PRINT



Dragonflies and damselflies of Oregon: A Field Guide, Cary Kerst & Steve Gordon, Oregon State Univerity Press



Amphibians of Oregon, Washington, and British Columbia (Lone Pine Field Guides) 2nd Edition by Chris Thoms and Charlotte Corkran