

Invasive Species Prevention Protocol

Mid Klamath Watershed Council
Fisheries Program

May 2023

Mid Klamath Watershed Council
PO Box 409, Orleans, CA 95556
Tel:(530)-627-3202
Fax:(866)-323-5561
www.mkwc.org

Mid Klamath Watershed Council's Invasive Species Prevention Protocol

Table of Contents

Introduction.....	3
General Protocol to Prevent the Spread of Terrestrial and Aquatic Invasive Species.....	4
Watercraft Cleaning and Decontamination Protocol.....	5
Recommended Supply List.....	6
Invasive Species of Concern Decontamination Spreadsheet.....	7
Appendices	
Appendix A: California Department of Fish and Wildlife, Aquatic Invasive Species Decontamination	
Protocols (Northern Region).....	8-13
CDFW's Equipment Decontamination/Disinfection Methods.....	9-12
CDFW's Watercraft Contamination.....	13
Appendix B: New Zealand Mudsnail Reference Material and Known Locations on the Klamath.....	
CDFW's Attachment A New Zealand Mudsnail Information/Photos.....	15-16
New Zealand Mudsnail Information.....	17
Klamath River Known Locations Map:Shasta River	18
Klamath River Known Locations Map:Bogus Creek-Klamath River.....	19
Klamath River Known Locations Map:Bogus Creek-Brush Creek.....	20
Klamath River Known Locations Map:Turwar Creek.....	21
Appendix C: Aquatic Invasive Species of Concern Reference Material.....	
Didymosphenia geminata (Rock Snot, Didymo).....	22-28
Myriophyllum spicatum (Eurasian watermilfoil).....	23
CDFW's Attachment B Quagga and Zebra Mussels.....	24-25
CDFW's Aquatic Invasive Species Guide.....	26
CDFW's Attachment C Citric Fungus Information.....	27
Appendix D: Invasive Plant PathogensReference Material.....	
CDFW's Sudden Oak Death Syndrome Information.....	28
Sudden Oak Death Syndrome Guidelines for Forestry.....	29-36
Port Orford Cedar Root Disease.....	30
Appendix E: Relevant BMP Checklists from California Invasive Plants Council.....	
Reference Resources and Links.....	31-34
	35-36
	37-39
	40-41

Mid Klamath Watershed Council's Invasive Species Prevention Protocol

Introduction

The Mid Klamath Watershed Council is dedicated to the prevention of the spread of invasive species. Invasive species pose a serious threat to the waters of California, and preventing their introduction and spread is the most effective and economical means for protecting ecosystems(Guidance for Developing a Dreissenid Mussel Prevention Program-California Department of Fish and Wildlife-August 25, 2020).

The Mid Klamath Watershed Council will implement the following protocols to prevent and minimize the risk of spreading invasive species establishment or movement during field activities and project implementation.

The Mid Klamath Watershed Council uses the California Department of Fish and Wildlife's Aquatic Invasive Species Disinfection/Decontamination Protocols (2016) when our equipment and field gear are in contact with water.

In addition, the Mid Klamath Watershed Council follows protocols that are consistent with those specified in the Invasive Species Best Management Practices BMPs (USDA Six Rivers 2014), and the California Invasive Plant Council's BMPs, that aim to reduce the risk of introduction and spread of non native invasive plants as a result of project implementation and field activities.

Mid Klamath Watershed Council's Invasive Species Prevention Protocol

General Protocol to Prevent the Spread of Terrestrial and Aquatic Invasive Species:

To prevent the survival of invasive species on field equipment, clothing and boots, you will need to clean your field gear and treat it, using the physical or chemical methods listed below:

To Prevent the Spread of Aquatic Invasive Species Follow these Steps:

1. If possible, keep several changes of field gear for use in different bodies of water, particularly between the Klamath River and its tributaries. Store this equipment separately.
2. When practical, in flowing water begin work upstream and work downstream. This avoids transporting AIS to non-infested upstream areas.
3. If decontamination is not done on site, transport contaminated equipment in sealed plastic bags and keep separate from clean gear.
4. Clean all gear and equipment before leaving a site, scrubbing with a stiff-bristled scrub brush and rinsing with water. Thoroughly brush small crevices such as boot laces, seams, net corners, etc. This is often the simplest and most effective for prevention.

Listed below are three options for equipment decontamination. Use your judgment and field sampling needs to select the method(s) that are appropriate for your equipment and schedule:

5. Allow equipment to thoroughly dry (i.e., until there is complete absence of moisture), preferably in the sun. Keep dry for a minimum of 48 hours to ensure any organisms are desiccated.
6. Hot water soak- Scrub gear with a stiff-bristled brush to remove all organisms. Immerse equipment in 140° F or hotter water. If necessary, weigh it down to ensure it remains immersed. Soak in 140° F or hotter water for a minimum of five minutes.
7. Freeze- Place in a freezer 14°F / -10°C for a minimum of eight hours.

To Prevent the Spread of Terrestrial Invasive Species Follow these Steps:

1. Clothing, boots, and gear will be cleaned prior to leaving the work site.
2. Boot brushes can be used to remove dirt and seeds from boots and pants. It is strongly advised to wear clothing that does not pick up seeds readily.
3. Crews will check vehicle tires before leaving the work site, and if there is mud and/or seeds, the tires will be cleaned on site with a brush, so as not to spread invasive plant seeds.
4. If working at a site that is a known location of either *Port Orford Cedar Root Disease* (*Phytophthora lateralis*) or *Sudden Oak Death* (*Phytophthora ramorum*) sanitize equipment, gear, boots, etc. with Lysol.
5. If decontamination is not done on site, transport contaminated equipment in sealed plastic bags and keep separate from clean gear.

Mid Klamath Watershed Council's Invasive Species Prevention Protocol

General Protocol to Prevent the Spread of Terrestrial and Aquatic Invasive Species:

To Prevent the Spread of Aquatic Invasive Species from Watercraft Follow these Steps:

1. Inspect all watercraft and equipment.
2. **CLEAN:** When you get your boat, kayak, raft, paddleboard, or other watercraft out of the water, inspect it to make sure there are no plants, mud or debris. If you find anything, remove it and dispose of it in the trash or on dry land away from water before moving to a new location.
3. **DRAIN:** Make sure there is no standing water in your personal watercraft. In a motorboat, remove the drain plug to drain the bilge and inspect the engine area to make sure all the water is drained and make sure your internal compartments are clean and dry as well. If you are in a kayak, tip it upside down to make sure there isn't any water in the bottom of your boat.
4. **DRY:** Use a rag or towel to dry your vessel including all compartments, as well as your anchor (if applicable). Most aquatic invasive species can only survive in wet conditions, so this is one of the best ways to help prevent their spread.

If sufficient drying time is not available, decontaminate all surfaces using one or more of the cleaning methods described below.

5. Diluted household bleach solution provides an inexpensive, effective way to control invasive species. Soak or spray equipment for at least one minute with a two percent bleach solution (three ounces of household bleach mixed with one gallon of water). If invasive pathogens or diseases are suspected, a 10 percent solution should be used (13 ounces of household bleach mixed with one gallon of water). Bleach is an extremely effective disinfection agent, but it is a caustic substance that can be corrosive to aluminum and other sensitive boating equipment.
6. Household cleansers/disinfectants, such as Formula 409® and Fantastic® that contain the quaternary ammonium compound alkyl dimethyl benzyl ammonium chloride can be used to disinfect equipment. These solutions can be used full strength as a spray, or diluted for soaking with two parts water to one part disinfectant. For all materials, follow label instructions and be sure to soak equipment for a minimum of 10 minutes.
7. Other common chemical decontamination methods are:
 - Undiluted white vinegar for 20 minutes
 - 500 mg/L hydrogen peroxide for 60 minute
8. Pressure wash the watercraft and trailer at base facilities, with 140°F water, including all of the boat equipment (i.e. ropes, anchors, etc.) that had come into contact with the water.

Developed from California Department of Fish and Wildlife, Aquatic Invasive Species Disinfection/Decontamination Protocols (Northern Region) <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=92821> ,

MKWC's Aikens Creek Revegetation Plan -FINAL-Updated 5.26.20

and NOAA Fisheries Service Preventing Invasive Species: Cleaning Watercraft and Equipment <https://invasivemusselcollaborative.net/wp-content/uploads/2018/11/NOAA-Decon-Watercraft.pdf>

Mid Klamath Watershed Council's Invasive Species Prevention Protocol

Recommended supplies to carry in vehicles to prevent the survival of invasive species on field equipment, rafts, clothing and boots:

1. Have separate equipment, waders, boots, etc. for different water bodies, especially between the Klamath River and its tributaries.
2. Gallon bottle of water and squirt bottle for rinsing gear
3. Five gallon bucket
4. Lysol or 409- for use in decontaminating gear that has been in a known location of either Port Orford Cedar Root Disease (*Phytophthora lateralis*) or Sudden Oak Death Syndrome (*Phytophthora ramorum*)
5. Large bags or sealed containers to isolate contaminated gear
6. Scrub brush/hoof pick (can be purchased at <https://naisma.org/play-clean-go-store/>)
7. Towels or rags for drying watercraft

Recommended supplies to have at the office to decontaminate gear and watercraft:

1. Hose with pressure nozzle for hosing off tires in a safe location from runoff
2. Hot plate to heat water to 140° or hotter
3. Large pot for soaking boots in 140° or hotter water > 5 mins.
4. A large freezer for freezing gear 8 hours or more
5. 409 or bleach solution(refer to page 5, number 6 for bleach ratio)
6. Undiluted white vinegar

Aquatic Invasive Species of Concern, and Current Disinfection Methods

Aquatic Invasive Species of Concern, and Current Methods for Disinfection of Gear and Equipment

(Adapted from USDA Forest Service Region 4 Guidelines for disinfecting fire equipment, summarized by Cynthia Tait:
http://www.fs.fed.us/r4/resources/aquatic/guidelines/aq_invasives_interim_fire_guidance08_final.pdf)

NOTE: A more complete—and continuously updated—table is available online at seagrant.oregonstate.edu/themes/invasives/

Decontam. Method	Whirling Disease	New Zealand Mudsnails	Chytrid Fungus	Zebra/Quagga Mussels	Didymo	Eurasian Watermilfoil
Hot water or freezing	90°C (195°F); 10 minutes	46°C (120°F); minimum of 5 minutes -3°C (27°F); > 4 hours	60°C (140°F); minimum of 5 minutes	≥ 60°C (140°F) water for minimum of 1 minute Freezing may be effective, but not tested	60°C (140°F); 1 minute	No data, but likely effective
Drying	Be dry for 24 hours, in sunlight best	Be dry for 48 hours, in sunlight best	Be dry for 3 hours, in sunlight best	3–5 days, in sunlight best	Be dry for 48 hours, in sunlight best	No data, but likely effective
Bleach (e.g., Clorox® or equivalent bleach product) 6% sodium hypochlorite (NaClO)	For 10 minutes: 1% bleach solution (500 ppm NaClO) • 1.1 liquid oz bleach per gallon water • 2.2 Tbsp liquid bleach per gallon water • 0.9 gallons each per 100 gallons water	Not effective at the necessary concentrations without risk of damaging gear and equipment	For 10 minutes: 7% bleach solution (0.4% NaClO) (>3,500 ppm NaClO) • 9 liquid oz bleach per gallon water • 7 gallons bleach per 100 gallons water	Gear rinsed with 0.5% bleach solution (250 ppm NaClO) • 0.6 liquid oz bleach per gallon water • 1.1 Tbsp liquid oz bleach per gallon water • 0.5 gallons bleach per 100 gallons water	For 1 minute: 2% bleach solution (800 ppm NaClO) • 1.8 liquid oz bleach per gallon water • 3.6 Tbsp liquid Clorox per gallon water • 1.4 gallons Clorox per 100 gallons water	No data, but likely effective
Quaternary ammonium compounds (QAC) (e.g., alkyl dimethyl benzylammonium chloride [ADBAC]; dicyl dimethyl ammonium chloride [DDAC])	15-minute exposure 4.4% Quat128® (1,500 ppm QAC active ingredient) • 6.1 liquid oz. Quat 128 per gallon of water OR 3.1% Sparquat 256® • 4.1 liquid oz. per gallon water	10-minute exposure 4.6% Quat 128 (1,570 ppm QAC active ingredient) • 6.4 liquid oz. Quat 128 per gallon of water OR 3.1% Sparquat 256 • 4.3 liquid oz. per gallon water OR Dilute 1 part Formula 409® Cleaner Degreaser Disinfectant to 1 part water	30-second exposure to 0.015% Quat 128 (5 ppm QAC active ingredient) • 1/8 tsp per gallon water	No published data, but likely effective	No published data, but likely effective	No data

Above Chart is an Excerpt from *How to Prevent the Spread of NZMS Through Field Gear (PDF)* Copyright 2010 by Oregon State University, Published by Oregon Sea Grant https://www.dfw.state.or.us/conservationstrategy/invasive_species/docs/NZ_Mudsnails_10-page.pdf

APPENDIX A

California Department of Fish and Wildlife, Aquatic Invasive Species Disinfection/Decontamination Protocols (Northern Region)

Mid Klamath Watershed Council's Invasive Species Prevention Protocol

Reference: California Department of Fish and Wildlife, Aquatic Invasive Species Disinfection/Decontamination Protocols (Northern Region) <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=92821>



California Department of Fish and Wildlife, Aquatic Invasive Species Disinfection/Decontamination Protocols (Northern Region)

The California Department of Fish and Wildlife (CDFW) is committed to protecting the state's diverse fish, wildlife, and plant resources, and the habitats upon which they depend. Preventing the spread of aquatic invasive species (AIS) in both CDFW's activities, as well as those activities CDFW permits others to conduct is important to achieving this goal. The protocols outlined below are a mandatory condition of your CDFW authorization to work in aquatic habitats intended to prevent the spread of AIS. This applies to CDFW personnel and as a condition for permitting work in aquatic environments in Region 1.

Information about New Zealand mudsnails (NZMS), quagga and zebra mussels, chytrid fungus and Sudden Oak Death Syndrome is summarized in Attachments A through D. For more complete information on the threats of AIS and aids to their identification, please visit the links provided in this document and the Department's Invasive Species Program webpage at:

<https://www.wildlife.ca.gov/Conservation/Invasives>

Many AIS are difficult, if not impossible, to see in the environment and can be unknowingly transported to new locations on equipment. Therefore, decontamination is necessary to prevent the spread of AIS between different waterbody locations. To achieve this, equipment should be decontaminated following the protocols outlined in this document. All equipment that comes into contact with water during field activities and watercraft should be decontaminated using one or more of the protocols listed below.

General procedures to prevent the spread of AIS:

- If decontamination is **not** done on site, transport contaminated equipment in sealed plastic bags and keep separate from clean gear.
- Gear may be dedicated for a specific field site but should be left on site and be cleaned when moved off site.
- Sets of field gear may be rotated in and out of field per cleaning cycle.
- When practical, begin work upstream and work downstream. This avoids transporting AIS to non-infested upstream areas.

Equipment Decontamination/Disinfection Methods

Option 1: Standard Decontamination (Office Method)

Freeze + Saltwater Immersion + Dry

This option consists of three parts, as freezing alone may not kill some organisms (e.g. chytrid fungus, Sudden Oak Death Syndrome, etc.).

- Scrub gear before leaving field with a stiff-bristled brush to remove all debris. Thoroughly brush small crevices such as boot laces, seams, net corners, etc.
- Bag gear for transport from field to office.
- Place gear and bag in a freezer below 32°F for a minimum of eight hours.
- Thaw gear and bag.
- Immerse gear and bag in 5-10% saltwater solution for 10 minutes (see Dilution Table on p. 4).
- Rinse gear.
- Hang gear to dry.

References

Johnson M.L., L. Berger, L. Philips, R. Speare. Fungicidal effects of chemical disinfectants, UV light, desiccation and heat on the amphibian chytrid *Batrachachytrium dendrobatitis* in DISEASES OF AQUATIC ORGANISMS. Vol. 57: 255-260, 2003

Richards, D.C., P. O'Connell, and D.C. Shinn. 2004. Simple control method to limit the spread of the New Zealand mudsnail, *Potamopyrgus antipodarum*. North American Journal of Fisheries Management 24(1):114-117.

USFS Intermountain Region Technical Guidance, For Resource Advisors, Preventing the Spread of Aquatic Invasive Organisms Common To The Intermountain Regions. 2014 Technical Guidelines for Fire Operations.

Mid Klamath Watershed Council's Invasive Species Prevention Protocol

Reference: California Department of Fish and Wildlife, Aquatic Invasive Species Disinfection/Decontamination Protocols (Northern Region) <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=92821>

Option 2: Chemical Treatment (Field Method)

In general, **chemical** decontamination/disinfection should only be used when Option 1 cannot be performed and clean gear is not available. This would be the case when conducting activities at more than one watershed or between long distances with one set of gear before returning back to the base office where a freezer, salt water immersion and drying rack are located.

- Prepare disinfection solution by diluting concentrate containing GS HD 256 (quat) in a well-ventilated space using gloves, eye protection and a NIOSH approved N95 filter mask. See Dilution Table on page 4 for dilution factors. Pour decontamination solution into a suitable holding container and submerge gear for at least 10 minutes. Gear may need to be weighed-down and/or rotated for complete and sustained immersion.
- Check field gear immersed in disinfection solution and inspect it to make sure all surfaces have been wetted for the required time.
- After treatment, rinse field gear with *fresh water (not water from previous waterbody--to avoid further contamination)*. Dispose of *rinse water* at least 100 feet from any surface water.
- Make up fresh solution as needed and discard after it becomes heavily soiled with organic matter. Check with quat test strips: readings should be above 500 ppm for adequate disinfection.
- Disinfection solution should be saved to be disposed of in a wastewater sewer facility (not in a septic system) **or** it can be neutralized on site. For onsite neutralization of quat solution, mix the remaining working solution with bentonite clay as directed in the Dilution Table, below. Mix the bentonite/quat. decon. solution slurry a couple of times before pouring it out on the ground at least 100 ft. away from surface water. This method will neutralize quaternary ammonium in 3-5 hours.

Mid Klamath Watershed Council's Invasive Species Prevention Protocol

Reference: California Department of Fish and Wildlife, Aquatic Invasive Species Disinfection/Decontamination Protocols (Northern Region) <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=92821>

4

Dilution Table

Concentrate	to 1 gal. water	to 5 gal. water
NaCl ¹ (rock salt)	1.5 cups (9% salt)	7.5 cups (9% salt)
GS HD 256 ²	2.5 oz. (1.8% solution)	12.5 oz. (1.8% solution)
bentonite clay ^{3,4}	12 tbs.	3.75 cups

References

1. Johnson M.L, L. Berger, L. Philips, R. Speare. Fungicidal effects of chemical disinfectants, UV light, desiccation and heat on the amphibian chytrid *Batrachochytrium dendrobatitis* in DISEASES OF AQUATIC ORGANISMS. Vol. 57: 255-260, 2003

2. USFS Intermountain Region Technical Guidance, For Resource Advisors, Preventing the Spread of Aquatic Invasive Organisms Common To The Intermountain Regions. 2014 Technical Guidelines for Fire Operations

3. United States Patent, Petrille, III et al. Methods of Detoxifying Quaternary Ammonium Compounds Toward Aquatic Organisms. Patent# 5518636. May 21, 1996

4. CDFW Northern Region unpublished data.2016

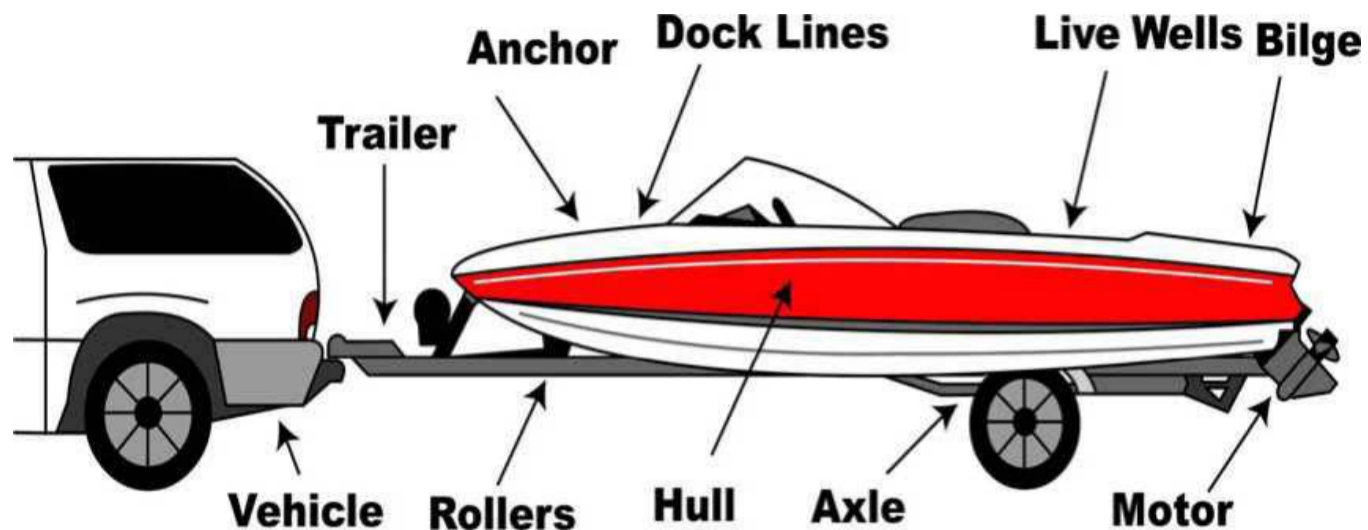
Safety Data Sheets

GS HD 256: http://www.spartanchemical.com/msds_sds/downloads/AGHS/EN/3508.pdf

Mid Klamath Watershed Council's Invasive Species Prevention Protocol

Reference: California Department of Fish and Wildlife, Aquatic Invasive Species Disinfection/Decontamination Protocols (Northern Region) <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=92821>

Watercraft Decontamination



- Prior to leaving the launch area, remove all debris from your watercraft, trailer, and equipment. Dispose of all material in the trash, on site if possible.
- Prior to leaving the launch area drain all water from your watercraft and dry all areas, including motor, motor cooling system, live wells, bilges, and lower end unit. Before leaving water body area, run motor dry for 5-10 seconds to flush water from engine.
- After leaving a **known or suspected invasive mussel infested water** pressure wash the watercraft and trailer at base facilities, with 140°F water¹, including all of the boat equipment (i.e. ropes, anchors, etc.) that had come into contact with the water.
- Flush the engine, live wells, bilges, and all other areas that could contain water with hot water that is at least 140°F. Make sure that water is contained sufficiently so that it doesn't run into storm drains or surface waters.

¹To ensure 100% mortality the water needs to be 140° F or greater at the point of contact.

APPENDIX B

New Zealand Mudsnail Reference Material and Known Locations in the Klamath River

Mid Klamath Watershed Council's Invasive Species Prevention Protocol

Reference: California Department of Fish and Wildlife, Aquatic Invasive Species Disinfection/Decontamination Protocols (Northern Region) <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=92821>

Attachment A

New Zealand Mudsnail (*Potamopyrgus antipodaru*):

- NZMS reproduce asexually therefore it only takes a single NZMS to colonize a new location.
- NZMS are prolific, and a single NZMS can give rise to 40 million snails in one year.
- Densities of over 750,000 NZMS per square meter have been documented.
- NZMS out-compete and replace native invertebrates that are the preferred foods of many fish species and alter the food web of streams and lakes.

Identifying NZMS:

- NZMS average 1/8 inch in length, but young snails may be as small as a grain of sand. Adults bear live young.
- See the photos, below, for assistance identifying NZMS. Expert identification will be necessary to confirm identification.

NZMS Habitat:

- NZMS can live in most aquatic habitats, including silted river bottoms, clear mountain streams, reservoirs, lakes and estuaries.
- NZMS have a temperature tolerance of 32-77° F.
- NZMS can survive out of water for more than 25 days in cool, moist environments, and have been found alive over 40 feet from water. *Known* locations can be found and new records should be reported to the USGS at: <http://nas.er.usgs.gov/taxgroup/mollusks/default.aspx>

Mid Klamath Watershed Council's Invasive Species Prevention Protocol

Reference: California Department of Fish and Wildlife, Aquatic Invasive Species Disinfection/Decontamination Protocols (Northern Region) <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=92821>

Descriptive features of the New Zealand Mudsnail (*Potamopyrgus antipodaru*)

IDENTIFYING THE NEW ZEALAND MUDSNAIL



Size: A mature snail is usually less than 5 mm (.2 in) long. (Photo by Jane and Michael Liu.)



Shape: Shell is elongated and dextral (its whorls or spirals lean toward the right). Snail typically has between 5 to 6 whorls on its shell. (Photo by D. L. Gustafson, <http://www.esg.montana.edu/aim/mollusca/nzms/>.)



1 whorl

Color: Most snails have a light- to dark-brown shell that may appear to be black when wet. (Photo by Jane and Michael Liu.)



Embryos: Upon dissection, mature snails will have brooded embryos. (Photo by D. L. Gustafson, <http://www.esg.montana.edu/aim/mollusca/nzms/>.)



Operculum: The mudsnail operculum (a rounded plate that seals the mouth of the shell when the animal's body is inside) can be seen on live snails but is not easily visible on dead or preserved snails. (Photo by D. L. Gustafson, <http://www.esg.montana.edu/aim/mollusca/nzms/>.)



New Zealand Mudsail (*Potamopyrgus antipodaru*)



COOL FACTS

New Zealand mudsnails can pass through a fish digestive tract unharmed and produce viable offspring within several hours. New Zealand mudsnails have an unusual form of reproduction called parthenogenesis. This means that females reproduce by cloning themselves. It is believed that most of the Western populations of New Zealand mudsnail all came from two females, resulting in only two genetic forms in the west. In fact, males of the species are extremely rare in western North America.

Reference: Oregon Sea Grant Aquatic Invasions! A Menace to the West • Species Guide
https://seagrant.oregonstate.edu/sites/seagrant.oregonstate.edu/files/invasive-species/toolkit/nz_mudsnail.pdf



New Zealand Look-Alikes

Reference: "How to Prevent the Spread of New Zealand Mudsnails through Field Gear at https://www.dfw.state.or.us/conservationstrategy/invasive_species/docs/NZ_Mudsnails_10-page.pdf

Known Klamath River Locations of New Zealand mudsnail (most current 4/1/2022)

Collection record: <https://nas.er.usgs.gov/queries/SpecimenViewer.aspx?SpecimenID=1657395>

NAS - Nonindigenous Aquatic Species

Specimen Information



Potamopyrgus antipodarum
(New Zealand mudsnail)
Mollusks-Gastropods
Exotic

Specimen ID	1657395
Group	Mollusks-Gastropods
Genus	Potamopyrgus
Species	antipodarum
Common Name	New Zealand mudsnail
State	CA
County	Siskiyou
Locality	Shasta River (mouth) at the Klamath River
Mapping Accuracy	Accurate
HUC8 Name	Shasta
HUC8 Number	18010207
HUC10 Name	Yreka Creek-Shasta River
HUC10 Number	1801020705
HUC12 Name	Bunton Hollow Creek-Shasta River
HUC12 Number	180102070503

Map	
------------	--

Collection Day	14
Collection Month	10
Collection Year	2020
Year Accuracy	Actual
Potential Pathway	dispersed current hitch hiker
Status	unknown
Comments	Fairly high densities at CDFW weir site above mouth of Shasta River at the Klamath River.
Record Type	NAS sighting report
Verifier	L. Breck McAlexander (CDFW)
Freshwater/Marine	Freshwater
Number Collected	200

Known Klamath River Locations of New Zealand mudsnail (most current 4/1/2022)

Collection record: <https://nas.er.usgs.gov/queries/SpecimenViewer.aspx?SpecimenID=1633066>

NAS - Nonindigenous Aquatic Species

Specimen Information



Potamopyrgus antipodarum
(New Zealand mudsnail)
Mollusks-Gastropods
Exotic

Specimen ID	1633066
Group	Mollusks-Gastropods
Genus	Potamopyrgus
Species	antipodarum
Common Name	New Zealand mudsnail
State	CA
County	Siskiyou
Locality	Bogus Creek, upstream of salmon weir, above Iron fish hatchery
Mapping Accuracy	Accurate
HUC8 Name	Upper Klamath
HUC8 Number	18010206
HUC10 Name	Bogus Creek-Klamath River
HUC10 Number	1801020607
HUC12 Name	Bogus Creek
HUC12 Number	180102060701

<p>Map</p> <p>NAS ARM</p>	
-----------------------------------------	--

Collection Day	10
Collection Month	10
Collection Year	2019
Year Accuracy	Actual
Potential Pathway	unknown
Status	established
Record Type	NAS sighting report
Verifier	California Dept. of Fish and Wildlife
Freshwater/Marine	Freshwater
Number Collected	50

Known Klamath River Locations of New Zealand mudsnail (most current 4/1/2022)

Collection record: <https://nas.er.usgs.gov/queries/SpecimenViewer.aspx?SpecimenID=1633142>

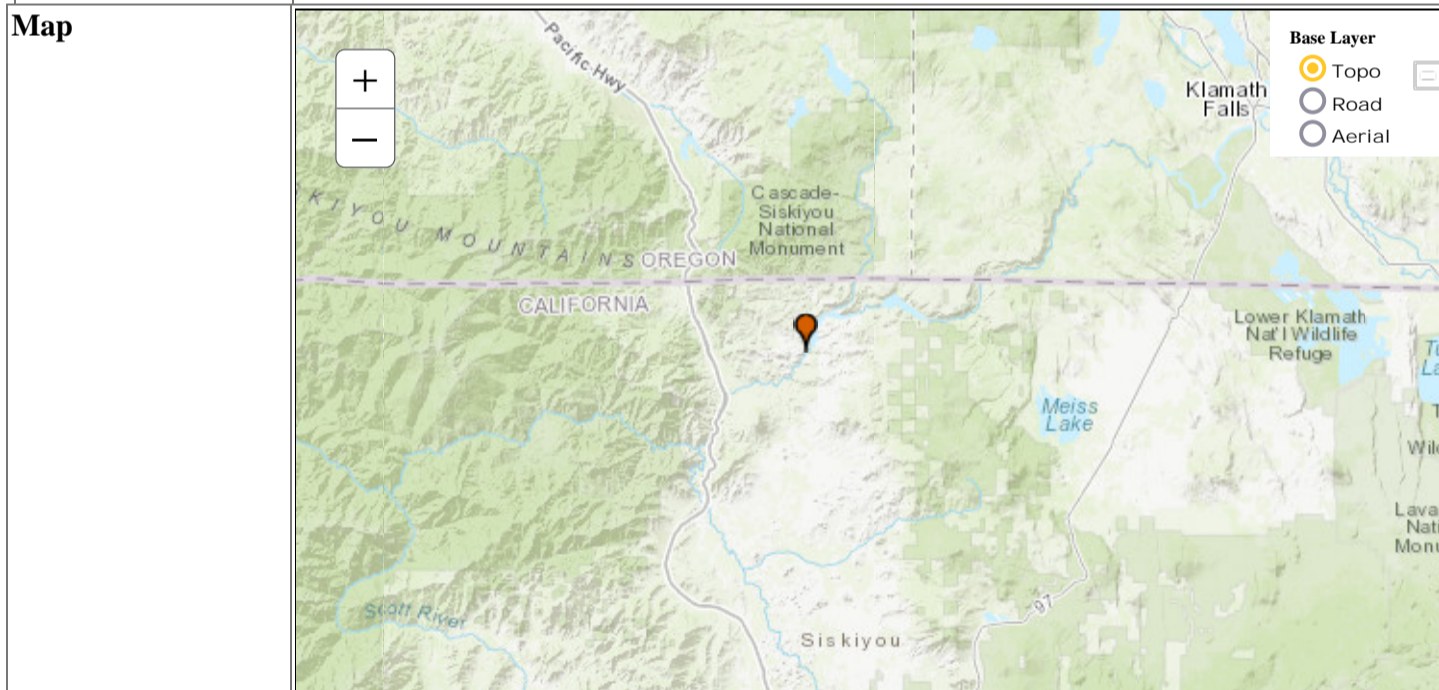
NAS - Nonindigenous Aquatic Species

Specimen Information



Potamopyrgus antipodarum
(New Zealand mudsnail)
Mollusks-Gastropods
Exotic

Specimen ID	1633142
Group	Mollusks-Gastropods
Genus	Potamopyrgus
Species	antipodarum
Common Name	New Zealand mudsnail
State	CA
County	Siskiyou
Locality	Klamath River
Mapping Accuracy	Accurate
HUC8 Name	Upper Klamath
HUC8 Number	18010206
HUC10 Name	Bogus Creek-Klamath River
HUC10 Number	1801020607
HUC12 Name	Brush Creek-Klamath River
HUC12 Number	180102060702



Collection Day	15
Collection Month	11
Collection Year	2019
Year Accuracy	Actual
Potential Pathway	unknown
Status	established
Comments	Low to medium density near river shore.
Record Type	NAS sighting report
Verifier	California Dept. of Fish and Wildlife
Freshwater/Marine	Freshwater
Number Collected	25

Known Klamath River Locations of New Zealand mudsnail (most current 4/1/2022)

Collection record: <https://nas.er.usgs.gov/queries/SpecimenViewer.aspx?SpecimenID=275371>

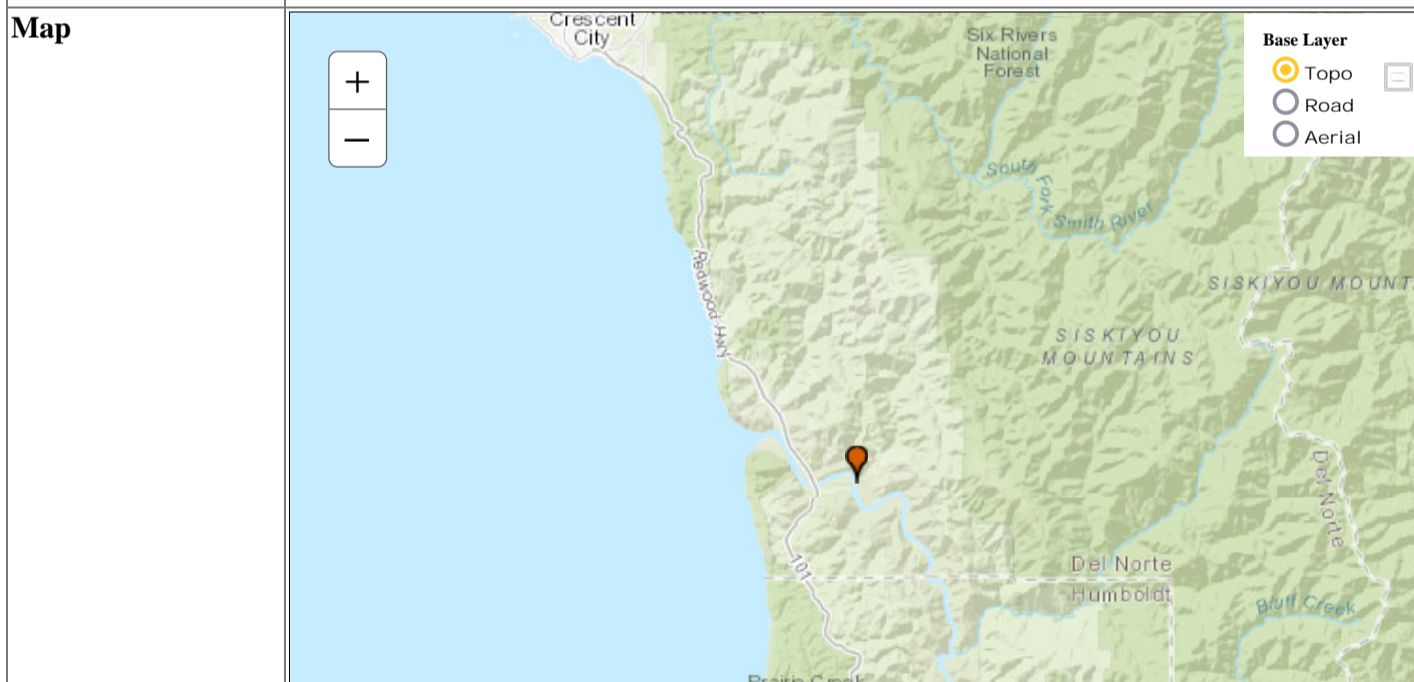
NAS - Nonindigenous Aquatic Species

Specimen Information



Potamopyrgus antipodarum
(New Zealand mudsnail)
Mollusks-Gastropods
Exotic

Specimen ID	275371
Group	Mollusks-Gastropods
Genus	Potamopyrgus
Species	antipodarum
Common Name	New Zealand mudsnail
State	CA
County	Del Norte
Locality	Klamath River, Klamath Glen boat ramp
Mapping Accuracy	Accurate
HUC8 Name	Lower Klamath
HUC8 Number	18010209
HUC10 Name	Turwar Creek-Klamath River
HUC10 Number	1801020911
HUC12 Name	McGarvey Creek-Klamath River
HUC12 Number	180102091103



Collection Day	3
Collection Month	10
Collection Year	2008
Year Accuracy	Actual
Potential Pathway	hitch hiker
Status	established
Reference 1	Ref. Number: 19769 Author: Montana State University. Date: 2011 Title: New Zealand mudsnails in the Western USA dataset (1995-2010).
Comments	Density = moderate.
Record Type	Literature
Freshwater/Marine	Freshwater

APPENDIX C

Aquatic Invasive Species of Concern Reference Material

Didymosphenia geminata (Rock Snot, Didymo)

Reference: Klamath National Forest, Erin Lonergan Forest Botanist-Klamath National Forest Aquatic Invasive Species Field Guide

Algae Family - Gomphonemataceae

Rock Snot - *Didymosphenia geminata*



Left: Kootenai River Network, Inc. Right and Inset: White River Partnership

7

Description: Microscopic diatom that can smother an entire stream bed with algal mats up to 8 inches thick

Appearance: Generally brown, tan or yellow in color. Looks similar to wet tissue and feels like wet cotton. Not slimy.

Habitat: Cold, freshwater streams with low nutrient levels

Reference: Klamath Network Featured Creature April 2014 <https://irma.nps.gov/DataStore/DownloadFile/495373>

Interesting Facts:

How does an algal bloom occur in nutrient poor streams? The didymo has a trick – the thick mat created by the stalks harbor bacteria that convert biologically unavailable phosphorous into biologically available phosphorous. Then didymo can adsorb the phosphorous.


Even though Rock Snot appears slimy underwater and are likened to toilet paper and insulation they are rough to the touch due to SiO₂ (silicon dioxide) in their cell walls.

Myriophyllum spicatum (Eurasian watermilfoil)

Reference: Klamath National Forest, Erin Lonergan Forest Botanist-Klamath National Forest Aquatic Invasive Species Field Guide

Water milfoil Family – Haloragaceae MYSP2

Eurasian water milfoil – *Myriophyllum spicatum* L.



Left and Inset: Leslie J. Mehrhoff, University of Connecticut **Right:** Barry Rice, sarracenia.com **Inset:** Graves Lovell, Alabama Department of Conservation and Natural Resources

11



Description: Submersed perennial with finely dissected whorled leaves
Roots: Creeping rhizomes with numerous fibrous roots at nodes
Stems: Typically submersed, becoming emerged only while flowering. Fragment easily and root at nodes.
Leaves: Submersed highly dissected leaves usually 4-whorled, glabrous pinnately divided into opposite leaves. Emerged leaves are bractlike.
Flowers: Flower spikes emerged and terminal. Flowers pinkish and whorled
Habitat: Ponds, lakes, streams, canals, ditches, usually in slow-moving water.



Ian Pfingsten - USGS, 2016

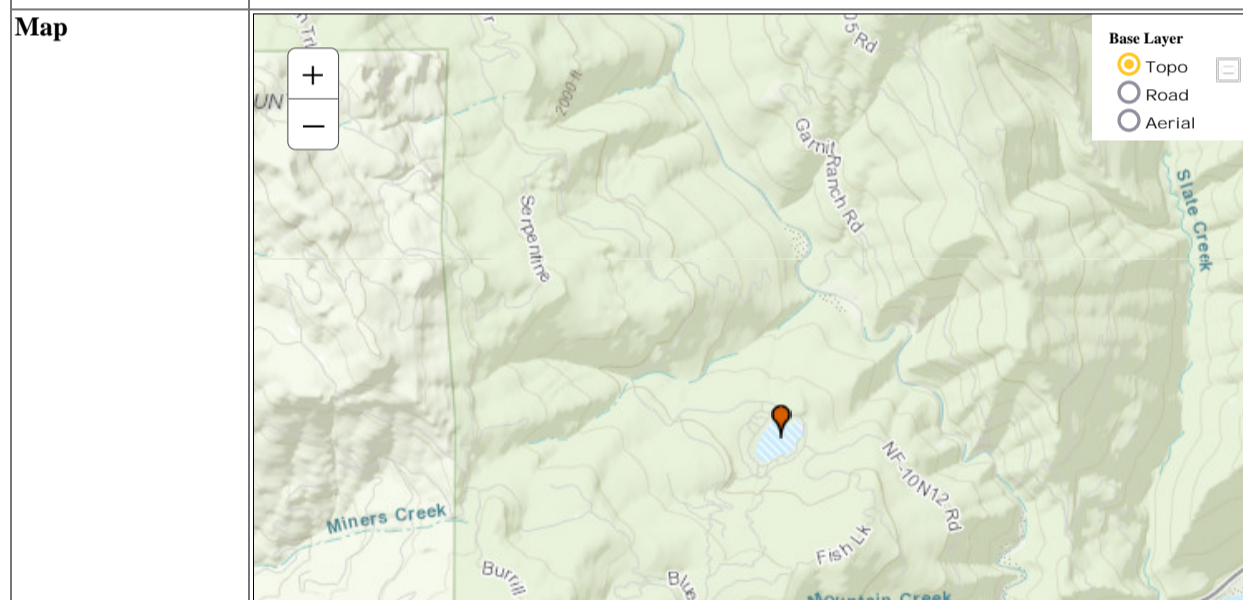
Known Klamath River Locations of *Myriophyllum spicatum* (Eurasian watermilfoil)

Collection record: <https://nas.er.usgs.gov/queries/SpecimenViewer.aspx?SpecimenID=1436213>



Myriophyllum spicatum
(Eurasian watermilfoil)
Plants
Exotic

Specimen ID	1436213
Group	Plants
Genus	Myriophyllum
Species	spicatum
Common Name	Eurasian watermilfoil
State	CA
County	Humboldt
Locality	Fish Lake
Mapping Accuracy	Accurate
HUC8 Name	Lower Klamath
HUC8 Number	18010209
HUC10 Name	Bluff Creek-Klamath River
HUC10 Number	1801020908
HUC12 Name	Bluff Creek
HUC12 Number	180102090804



Collection Day	22
Collection Month	10
Collection Year	1978
Year Accuracy	Actual
Potential Pathway	hitch hiker on small watercraft
Status	established
Reference 1	<p>Ref. Number: 25610</p> <p>Author: Calflora</p> <p>Date: 2021</p> <p>Title: The Calflora Database: Information on California plants for education, research conservation</p>
Reference 2	<p>Ref. Number: 16045</p> <p>Author: Alexander, J., S. Markos, J. Yost, R.L. Moe, E. Dean, and M. Nazaire.</p> <p>Date: 2016</p> <p>Title: Consortium of California Herbaria (CCH)</p> <p>Publisher: Regents of the University of California</p>
Comments	Calflora observation ID: cch:HSC77911
Record Type	Literature
Disposal	HSC
Museum Cat Number	HSC77911
Freshwater/Marine	Freshwater-Brackish

Mid Klamath Watershed Council's Invasive Species Prevention Protocol

Reference: California Department of Fish and Wildlife, Aquatic Invasive Species Disinfection/Decontamination Protocols (Northern Region) <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=92821> Attachment B

Attachment B

Quagga and Zebra Mussels:

- Dreissenid mussels multiply quickly and out-compete other species for food and space.
- Their presence can alter food webs and environments, negatively affecting native and game fish species.
- Dreissenid mussels attach to hard and soft surfaces, and physically disrupt water delivery systems, hydroelectric facilities, agriculture, recreational boating and fishing.
- Adults can survive up to 30 days out of water in cool, humid conditions.
- They produce microscopic larvae that can be unknowingly transported in water, including live-wells, bilges, and motors.

Identifying Dreissenid mussels:

- Typically the same size as a fingernail but can grow up to about 2 inches long.
- Variable, usually dark and light alternating stripes. May also be solid cream, brown, or black.

Dreissenid mussel habitat:

- Variable, including both hard and soft surfaces in freshwater.
- From surface depth to more than 400 feet in depth.
Current known locations of Dreissenid mussels in California can be found at: <http://nas.er.usgs.gov/taxgroup/mollusks/zebramussel/>



California Fish and Wildlife Aquatic Invasive Species Guide

https://danapointboaters.org/documents/news/dfg/aquatic_invasive_species_guide.pdf



Aquatic Invasive Species

A Guide to Identifying Threats to California Freshwater Environments

Quagga and Zebra Mussels

Dreissena rostriformis bugensis and *D. polymorpha*



Quagga mussel showing 'threads.' Photo by Steve Wells, Portland State University



Zebra mussels attached to native mussel. Photo by USFWS

Shell – 2-shelled (bivalve), may have dark colored “threads” on one edge.

Size – From microscopic to up to 2” long. Free-floating (planktonic) larvae are microscopic and cannot be seen by the unaided eye.

Color – Usually alternating light and dark brown stripes, but can also be solid light brown to dark brown.

Didymo or “Rock Snot”

Didymosphenia geminata



Clumps (early stage) of colonized didymo. Photo by Department of Conservation, NZ



Thick mat (advanced stage) of didymo attached to rock. Photo by Tim Daley, PA Department of Environmental Protection

Algae – Appears slimy, but feels coarse, like damp wool. Can look like wet toilet paper in streams.

Size – Starts as small clumps and grows to form thick mats that can cover river and streambeds.

Color – Pale yellowish-brown to white.

New Zealand Mudsnail

Potamopyrgus antipodarum



Elongated shell with 5-6 whorls. Photo by Dan Gustafson



Dense colony of New Zealand mudsnails attached to the underside of a rock. Photo by Robyn Draheim

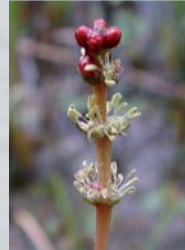
Shell – Single, elongated, right-handed coiling shell, usually consisting of 5-6 whorls, and an operculum (flap covering the shell opening).

Size – From microscopic up to 1/4” long.

Color – Variable, light to dark brown.

Eurasian Watermilfoil

Myriophyllum spicatum



Flower spike. Photo by John Somerville, UK



Stems are densely branched. Photo by Alison Fox, University of Florida, Bugwood.org



Stems and flower spikes. Photo by Idaho State Department of Agriculture

Stems – Branched and 20-30” long, reddish-brown or whitish-pink.

Leaves – Arranged circularly around the stem in groups of 3-6 (usually 4). Each leaf is less than 2” long, soft, and feather-like.

Flowers – Form spikes 2-4” long that are held above the water. Individual flowers are 1/8-1/4” long, reddish.

Roots – Fibrous, often develop from small pieces broken off larger plant.

Channeled Apple Snail

Pomacea canaliculata



Adult channeled apple snail shell. Photo by Georgia DNR, Wildlife Resources



Egg mass. Photo by Pete Corradino

Shell – Single shell with compact, deeply grooved whorls.

Size – Adult shells can reach up to 3” long.

Color – Yellowish to brown.

Eggs – Eggs laid in masses of 200-600, bright pink to reddish.

Hydrilla

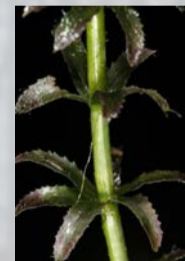
Hydrilla verticillata



Root tubers. Photo by Robert Vidéki, Doronicum Kft., Bugwood.org



Hydrilla stems. Photo by Vic Ramey, University of Florida/IFAS Center for Aquatic Invasive Plants



Saw toothed leaves. Photo by Robert Vidéki, Doronicum Kft., Bugwood.org

Stems – Slender, branched, up to 25' long, and green.

Leaves – Arranged in groups of 2-8 around the stem, spear-shaped, 1/2-3/4” long and 1/16” wide. Often 1-2 sharp teeth along the underside of the leaf rib.

Flowers – Grow on long stalks and float on the surface of the water. Individual flowers are 1/8-1/4”, white or reddish brown.

Roots – 1/2” long, white, and may have yellowish, potato-like structures, or tubers, on the ends.

To report invasive species, call 1-866-440-9530 or email Invasives@wildlife.ca.gov

Reference: California Department of Fish and Wildlife, Aquatic Invasive Species Disinfection/Decontamination Protocols (Northern Region) <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=92821> Attachment C

Attachment C


Chytrid Fungus

The disease has been linked to dramatic population declines and even extinctions of amphibians in several parts of the world including North America. Thirty percent of amphibian populations may have been affected by this disease, worldwide. Chytrid fungus or Bd (*Batrachochytrium dendrobatidis*) is invisible to the naked eye, but its effects can be seen in many amphibian populations that have been exposed to it. Certain animals/populations, however, seem to be immune and some may actually act as carriers of the disease. The fungus breaks down amphibians' keratinized tissue causing morbidity. This subsequently causes mortality.

For more information on chytrid fungus see:

http://cisr.ucr.edu/chytrid_fungus.html





APPENDIX D
Invasive Plant Pathogens Reference Material

Mid Klamath Watershed Council's Invasive Species Prevention Protocol

Reference: California Department of Fish and Wildlife, Aquatic Invasive Species Disinfection/Decontamination Protocols (Northern Region) <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=92821> Attachment D

Sudden Oak Death Syndrome (Phytophthora ramorum)

Sudden Oak Death Syndrome (SODS)

Since the mid-1990s Sudden Oak Death Syndrome, *Phytophthora ramorum*, has killed millions of tanoak trees and several oak (*Quercus*) tree species (coast live oak, California black oak, Shreve oak, and canyon live oak), and caused twig and foliar diseases in numerous other plant species, including California bay laurel, Douglas-fir, and coast redwood.

P. ramorum thrives in cool, wet climates. In California, coastal evergreen forests and tanoak/redwood forests within the fog belt are the primary habitat. For more information, visit www.suddenoakdeath.org

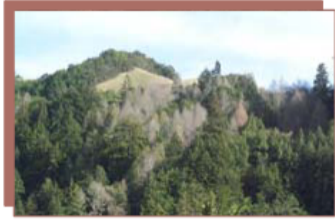
For questions on CDFW Northern Region Aquatic Invasive Species procedures contact:

L. Breck McAlexander, Region 1 Aquatic Invasive Species Coordinator LMCALEXANDER@dfg.ca.gov; off.: (530)

225-2317; mobile: (530) 440-0208. 0/



Reference: California Oak Mortality Task Force Sudden Oak Death Guidelines for Forestry-
<https://www.suddenoakdeath.org/wp-content/uploads/2014/12/forestry-08-10-with-new-2014-map.pdf>



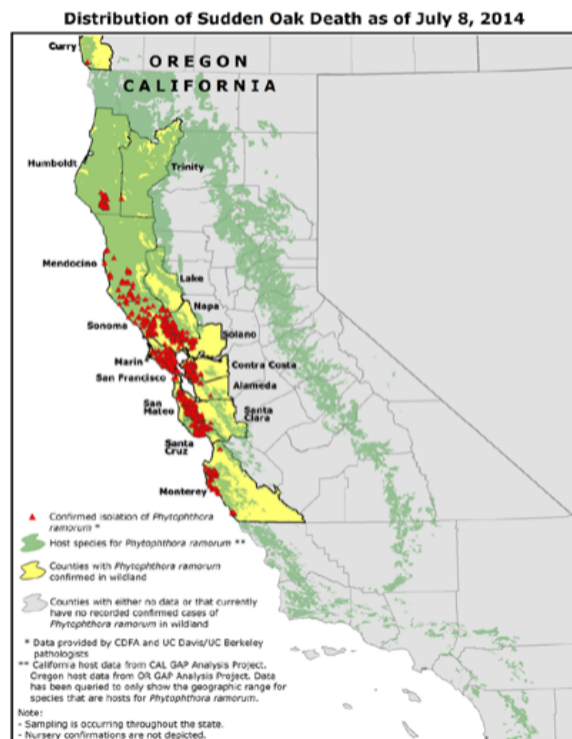
Sudden Oak Death Guidelines for Forestry

A plant disease known as Sudden Oak Death is threatening coastal forests in California and Oregon. Currently found in 15 coastal counties from Monterey to Humboldt, the disease is caused by the pathogen *Phytophthora ramorum*. To date, hundreds of thousands of tanoak and oak have been killed by this disease. In addition, more than 30 other native tree and shrub species are susceptible to the organism, yet most of these species suffer only minor damage, limited to leaf spots or twig dieback. *P. ramorum* may be transported to new areas when infected plants, infested soil, or contaminated water are moved. This guide provides simple, practical information on how to work in forests without unintentionally moving the pathogen from one area to another.

Regulations

The following California counties have confirmed *Phytophthora ramorum* findings and are under State and federal quarantine: Alameda, Contra Costa, Humboldt, Trinity, Lake, Marin, Mendocino, Monterey, Napa, San Francisco, San Mateo, Santa Clara, Santa Cruz, Solano, and Sonoma. The organism has also been found in Curry County, southwestern Oregon. These quarantined areas are subject to regulations regarding the movement and use of susceptible plants. County Agricultural Commissioners enforce both California and federal regulations.

The California State Board of Forestry and Fire Protection has approved the establishment of a Zone of Infestation (ZOI) for Sudden Oak Death (SOD) covering all portions of the 14 infested counties identified in the CDFA Section 3700 regulations. Pursuant to 14 CCR 917.9(a) [All Districts], the



RPF shall identify feasible measures to mitigate adverse infestation or infection impacts from timber operations (PCR 4527). Long-term plans such as NTMP's should re-assess Sudden Oak Death mitigations within each proposed Notice of Timber Operations (14 CCR 1090.7). Other CDF permitted projects, such as Exemptions, are required to follow all operational rules, and must therefore be conducted in a manner that minimizes the spread of SOD.

Before moving susceptible plant material outside the regulated area you must contact your local County Agricultural Commissioner for a permit, or have an active harvest plan that either includes SOD mitigations or has a currently valid, negative finding, "free-from" survey. USDA Forest Service and other agency firewood permits may serve as your permit or compliance agreement. Current California regulations require a permit for

movement of any regulated article from the 15 county regulated area to anywhere outside of those 15 counties. Current federal regulations require a permit (certificate) or treatment before moving any regulated plant material from the 15 infested counties to areas out of the state. Federal rules regulate soil movement from infested counties out of the state, but California does not currently regulate soil movement within the state. Currently there is no provision that allows moving any host material out-of-state under the federal regulations without removing all bark, or an approved treatment prior to shipment out-of-state. Even when bark is removed, a certificate must be obtained prior to shipment. State and Federal regulations apply when infected hosts are removed during timber operations. Regulated



Reference: California Oak Mortality Task Force Sudden Oak Death Guidelines for Forestry-
<https://www.suddenoakdeath.org/wp-content/uploads/2014/12/forestry-08-10-with-new-2014-map.pdf>

host material cannot not leave the ZOI except as authorized through an approved harvest document with either a valid "free-from" survey or where mitigations have been addressed minimizing the spread of the pathogen. Mitigation measures must be discussed in harvest documents due to the declarations of the 15-county area as a Zone of Infestation by the Board of Forestry and Fire Protection Regulations even when host logs are not being moved offsite. NOTE: a free-from survey is allowed only if the regulated articles are not moved interstate. The free-from survey is valid for a period of one year from the date of survey if no symptomatic hosts are found, or one year from the date of negative lab findings of symptomatic host samples.

Hosts, Symptoms, and Diagnosis

The symptoms of Sudden Oak Death can be dramatic (Photo 1), as with the mortality of large and small tanoaks, or fairly subtle (Photo 2), such as leaf spots on California bay laurel. The nature and progression of the infection varies in each host species, and even within a given species. *P. ramorum* symptoms are difficult to distinguish from a number of other common diseases. Foresters may be more confident in their preliminary diagnosis and the need for laboratory analysis if they observe multiple external and inner bark symptoms as well as symptoms on other hosts in the immediate area. If you see several symptomatic host plants (Photos 3 & 4) next to bleeding oaks and tanoaks (Photos 5 & 6) you may be in an infested area.

California bay laurel is a good indicator plant to check for symptoms. Although damage is limited to leaf spots, these trees are often the first plants to show symptoms in a newly infested area. Note that on California bay laurel, leaf spots are typically near the leaf tip, they are not on every leaf, and they may be hard to see from far away. While inspecting for leaf spots, focus on lower branches as this is where the disease is commonly found and leaves are more accessible.



Photo 3. Bay laurel leaf spots. (Photo by Matteo Garbelotto, University of California, Berkeley.)

Photo 4. Rhododendron leaf spots. (Photo by B. Moltzan, Missouri Department of Conservation.)

A more thorough guide to symptoms and list of susceptible species is available at www.suddenoakdeath.org. You can also find listings for upcoming diagnosis and treatment training sessions online.



Photo 5. Bleeding cankers on a coast live oak trunk. (Photo by Matteo Garbelotto, University of California, Berkeley.)



Photo 6. Bleeding cankers on a tanoak trunk. (Photo by Pavel Svihra, UC Cooperative Extension.)

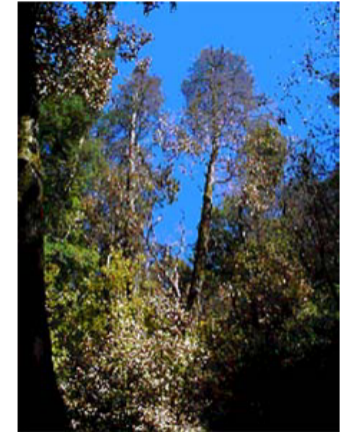


Photo 1. Forest in Marin County with tanoak trees killed by *Phytophthora ramorum*. (Photo by B. Tkacz, USDA Forest Service.)

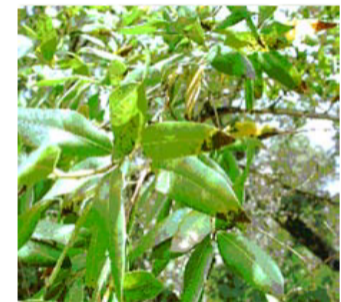


Photo 2. California bay laurel (also called pepperwood, or Oregon Myrtle) showing leaf spots typical of *Phytophthora ramorum*. (Photo by Bruce Moltzan, Missouri Department of Conservation.)



Photo 7. Canker under bark on coast live oak trunk. (Photo by Matteo Garbelotto, University of California, Berkeley.)

Reference: California Oak Mortality Task Force Sudden Oak Death Guidelines for Forestry-
<https://www.suddenoakdeath.org/wp-content/uploads/2014/12/forestry-08-10-with-new-2014-map.pdf>

Mitigation & Management Recommendations

Infested forests

If possible, avoid working in areas that are known or appear to be diseased. If you cannot avoid infested areas, follow the sanitation practices below when working in the known infested areas. If you don't know if the site is infested, play it safe and assume that it is. Maps of infested areas are available online (see Resources). These maps do not note every diseased area but can give you a general idea of the infested areas in California.

Pathogen biology and risk of spread

Phytophthora ramorum prefers moist environments and cool temperatures, and can be found in living, dying, or recently dead plants. During wet periods, the organism seems to be most active and therefore most likely to start new infections. Its spores can be found in soil, water, and plant material. The risk of movement and spread of the organism is greatest in muddy areas and during rainy weather. If possible do not work in infested forests during the wet, rainy and cool times of the year. Generally, avoid working in muddy conditions.

Sanitation and Recommendations

Timber operations which minimize or avoid the introduction, build-up, or spread of SOD are considered Best Management Practices (BMPs). Specific state and federal regulations must be followed, but BMPs should be incorporated, and could act as timber harvest plan mitigations. Infected host material (especially foliage) can be carried on logging equipment and vehicles, and transferred to other sites. Mitigation measures to minimize the unintended movement of host material are recommended. The following (or similar) mitigation measures should be implemented to the extent practical and may be required for timber operations regulated by the State. Even if regulated articles do not move from the ZOI and are therefore not subject to state or federal regulations, CCR 919.9(a) still requires mitigation in timber harvest plans on state or private property for a pest covered by a ZOI.

- RPF (or LTO for most Exemptions) should inform personnel that they are working in an area with Sudden Oak Death disease, unauthorized movement of plant material is prohibited, and the intent of mitigation measures is to prevent disease spread (14 CCR 1035.2). If some sites in the general operating area are found to be disease-free or have a low incidence of disease, consider initiating operations on these sites before moving to more heavily infested sites.
- To the extent practical and feasible, route equipment away from host plants and trees, especially in areas with disease symptoms.. Locate landings, log decks, logging roads, tractor roads, and other sites of equipment activity away from host plants, especially areas with disease symptoms.
- Each time equipment or vehicles leave the site, the equipment or vehicles should be inspected by operations personnel for host plant debris (leaves, twigs, and branches). Host plant debris should be removed from equipment and vehicles prior to their departure. This applies to all equipment and vehicles associated with the operation, including logging equipment, log-hauling trucks, pick-up trucks, employee's personal vehicles, etc. An exception will be granted for equipment or vehicles that leave the site temporarily and will be not be traveling to uninfested areas prior to their return.
- Conduct operations during the dry season. Utilize paved and rocked roads and landings to the extent possible.
- After working in an infested area, remove or wash off accumulations of soil, mud, and organic debris from shoes, boots, vehicles and heavy equipment, etc. before traveling to an area that is not infested with Sudden Oak Death. Lysol® or a bleach solution can be used to disinfect shoes and boots after cleaning.
- Inspect loads of logs and equipment leaving the site to ensure that no host material is being transported without a permit. This may require cleaning mud from vehicle to remove host plant material imbedded in mud depending on conditions when the timber harvest is conducted. Consider establishing an equipment power wash

Reference: California Oak Mortality Task Force Sudden Oak Death Guidelines for Forestry-
<https://www.suddenoakdeath.org/wp-content/uploads/2014/12/forestry-08-10-with-new-2014-map.pdf>

station. The station should be: located within the generally infested area; paved or rocked; well-drained so that vehicles exiting the station do not become contaminated by the wash water; located where wash water and displaced soil does not have the potential to carry fines to a watercourse (see "Saturated Soil Conditions" in 14 CCR 895.1); pay particular attention to sites where soil and organic debris may accumulate.

Firewood

If firewood from host material is being removed from the regulated area for commercial or private use, a compliance agreement must be in place. The information as to where and what is being removed, how it will be transported, specifically where it will be moved to, and during what time period should be included in the harvest document if the document will act as the compliance agreement. If this information is not included in the plan, a separate compliance agreement may be necessary. Contact your local County Agricultural Commissioner to obtain any necessary compliance agreements not covered by the plan. Always secure loads completely when transporting firewood or other materials.

Treatments

There are treatments or processing protocols that can be done to minimize the risk of spread. Removing the bark allows the wood to dry and permits movement within the state and out of state with a certificate. If bark is removed or other parts are not used, burn the excess materials if possible. If burning is done, make sure it is done in a safe and approved manner. Burning poses no risk of spread since the organism is killed in the fire. When storing material, keep it dry and out of any standing water. Kiln drying also will kill the organism.

Drafted water

Infested water has not been proven to be a pathway for *P. ramorum* to cause new infections in forested areas, but has been shown to cause new infections in nurseries. Hence, drafted water has the potential to spread spores of the pathogen onto roadside hosts during dust abatement operations. Spores of the pathogen have been recovered from water collected beneath infected hosts, as well as from creeks and streams in infested areas.

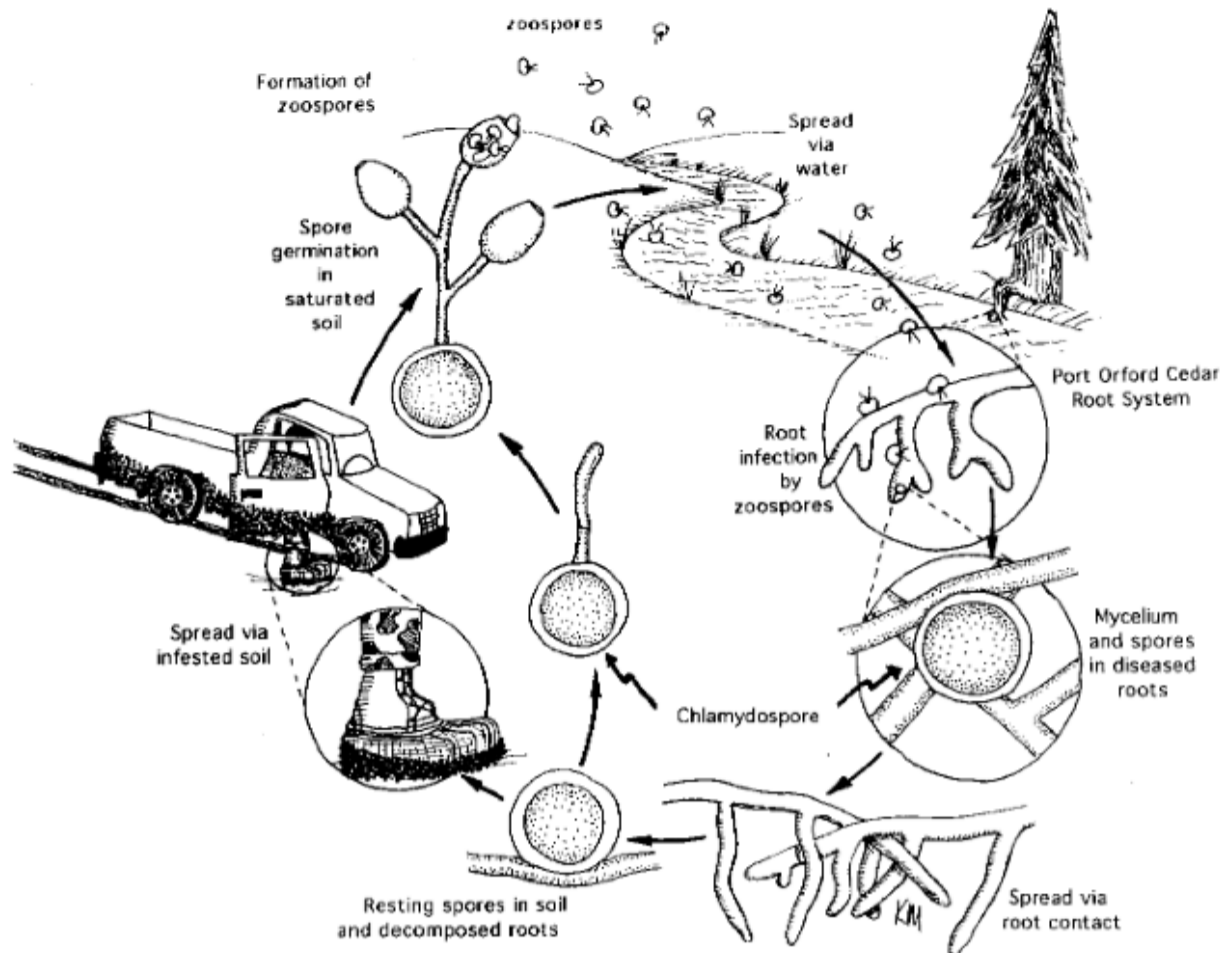
Water is not regulated under either state or federal quarantine regulations. However, the following practices may minimize the unintentional introduction of the pathogen:

- If water is drafted and used for dust control, draft water from areas upstream of known infestations or from uninfested drainages.
- If drafting from known infested watercourses, do not water roads with that source in areas that are not known to be infested.
- If water is being drafted under a 1600 Series agreement with the California Department of Fish and Game and or used in both infested and non-infested areas, they may require treatment with Ultra Clorox, similar to the recommended water treatment for *P. lateralis*, which causes Port-Orford Cedar Root Disease. The registration rate is 1 gallon of Ultra Clorox Bleach per 1,000 gallons of drafted water.
- Do not use untreated water from infested areas for irrigation of host species nursery stock. Off-road approaches to drafting sites should be sufficiently rocked to minimize accumulating infested soil on drafting vehicles.

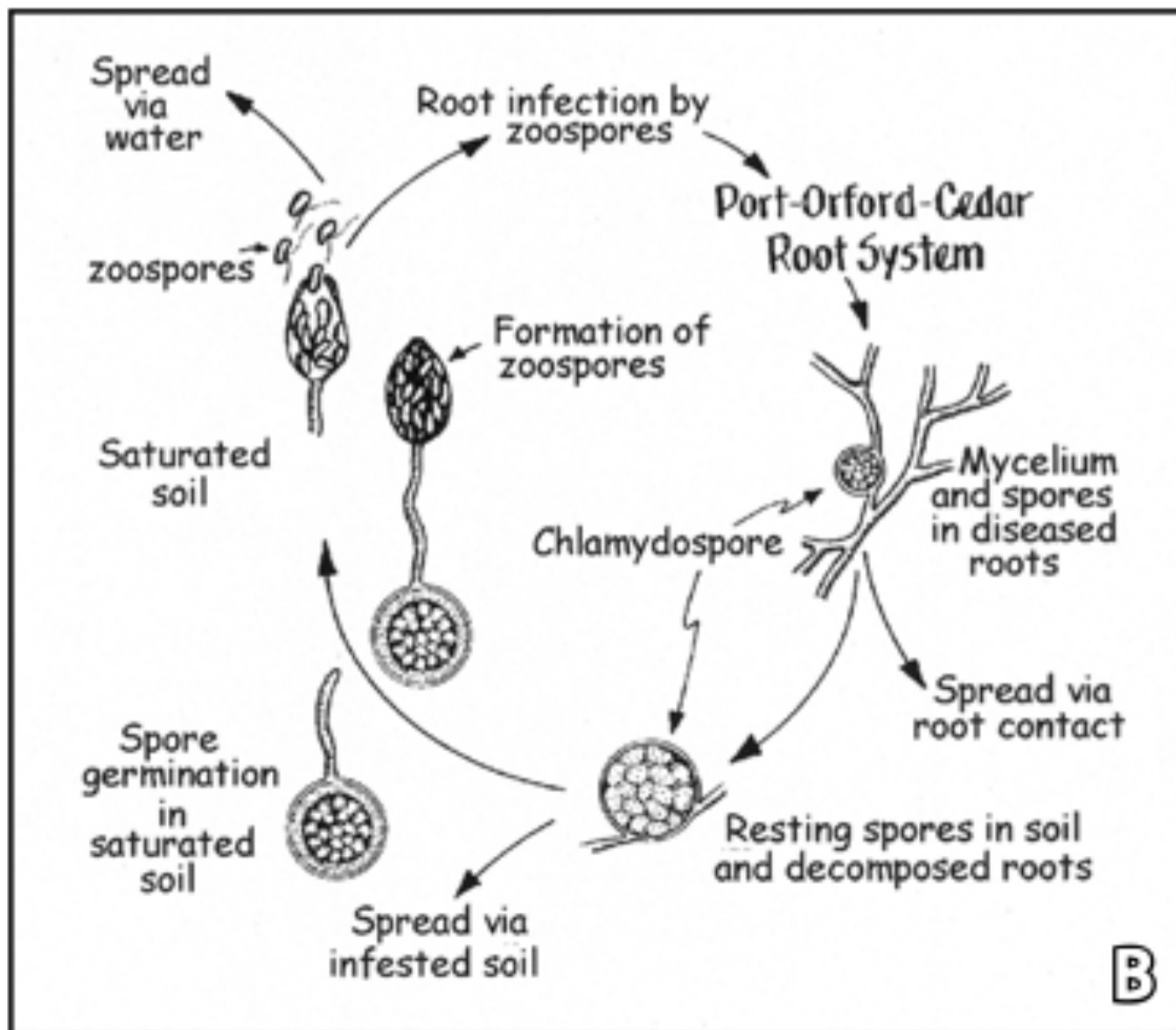
Snag retention

As stem-infected oaks and tanoaks decline and die, they are invaded by other wood decaying organisms and bark beetles. Such trees are prone to early structural failure, often breaking off several feet above ground. When selecting snags or recruitment trees for snags as a benefit for wildlife use, do not select SOD-infected trees.

Port Orford Cedar Root Disease (Phytophthora lateralis)



Reference: Disease Cycle of *Phytophthora lateralis* https://www.researchgate.net/profile/Erik-Jules/publication/249302872_Managing_Port-Orford-Cedar_and_the_Introduced_Pathogen_Phytophthora_lateralis/links/53ff7d7c0cf2194bc29a853e/Managing-Port-Orford-Cedar-and-the-Introduced-Pathogen-Phytophthora-lateralis.pdf?origin=publication_detail



Reference: Simplified Life cycle https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5346825.pdf

Port Orford Cedar Root Disease (*Phytophthora lateralis*)

https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_045315.pdf



Port-Orford-cedar Base Maintenance Funding Region 5 **SLOWING THE SPREAD OF EXOTIC FOREST DISEASES** A Partnership Between Forest Health Protection and the Klamath National Forest



Figure 1. Dead Port-Orford-cedar along Clear Creek in the Siskiyou Wilderness Area, August 2006.

Port-Orford-cedar root disease has been a major concern since the introduction of the pathogen, *Phytophthora lateralis*, into the natural range of Port-Orford-cedar in northwestern California and southwestern Oregon in the early 1950's. Since that time, the USDA Forest Service has undertaken major efforts to limit the spread and intensification of the disease. A major cause of long-distance disease spread is the transportation of infested soil by vehicles. More localized movement of the pathogen is also known to occur in organic matter in soil clinging to the feet of humans, elk and cattle. Once established in an area, the pathogen can travel downslope in water or in streams and infect and kill large numbers of Port-Orford-cedar in a watershed.

In August, 2006, the disease was discovered in Port-Orford-cedar and Pacific yew in the Siskiyou Wilderness Area, Klamath National Forest. Scattered pockets of mortality were identified along a nine-mile portion of Clear Creek, starting approximately six miles from the Young's Valley Trailhead (Figure 1). Many of the infestations were immediately adjacent to the Clear Creek National Recreation Trail.

Discovery of the disease prompted immediate action from Forest Health Protection and Klamath National Forest personnel. A follow-up trip into the Wilderness Area was done to further identify and define the areas of infestation, while public outreach and education was initiated. Because the pathogen was too well-established to eradicate, the best course of action was to protect the uninfested upstream portions of the Clear Creek watershed, while limiting additional disease spread downstream. A variety of management opportunities were identified and prioritized to reduce the movement of the pathogen by hikers and pack animals from infested areas to uninfested areas along the Clear Creek Trail, including rerouting the trail around infested areas, improving the trail surface and drainage to reduce the movement of infested mud, and removing Port-Orford-cedar and Pacific yew from strategic locations to reduce inoculum levels available for dispersal.



Figure 2. Trail improvement along the Clear Creek Trail, July 2008.



Figure 3. Trail reroute around Port-Orford-cedar root disease infestation, September 2008.

During the winter of 2006-2007, environmental groups, local tribes and other interested members of the public contributed to the overall planning effort. In the summer of 2007, Categorical Exclusion Decision Memos for the implementation of disease control measures were signed and the on-the-ground work began. A ½-acre Port-Orford-cedar/Pacific yew removal treatment at the most upstream infestation was completed, as well as trail improvements in four locations. In 2008, two trail relocations were completed and improvements were made at seven more trail locations (Figures 2 and 3). In addition, a new Siskiyou Wilderness map was completed, with information on the root disease and what visitors can do to help limit pathogen spread. All of these actions will reduce the spread of the disease. Additional trail improvements will be completed in 2009, and future rehabilitation plans include the planting of disease-resistant Port-Orford-cedar.

For more information, contact Pete Angwin at (530) 226-2436, November 12, 2008

APPENDIX E

Relevant Best Management Practice Checklists from California Invasive Plants Council

Checklist E: Inspection & Cleaning

Clothing and Gear:

Check for soil, seeds, and plant material	Inspected	Cleaned
1. Hats		
2. Hoods		
3. Collars and cuffs		
4. Clothing folds or flaps		
5. Ventilation openings		
6. Pockets		
7. Zippers		
8. Straps or Velcro grips		
9. Belts or buckles		
10. Buttons, fasteners, and rivets		
11. Laces or ties		
12. Gloves		
13. Pant cuffs		
14. Socks		

Boots or Shoes:

Check for soil, seeds, and plant material	Inspected	Cleaned
1. Shoelaces or ties		
2. Straps or Velcro grips		
3. Shoe tongues		
4. Treads		

Hand and Power Tools:

Check for soil, seeds, and plant material	Inspected	Cleaned
1. Chainsaw chain		
2. Hand saw blades		
3. Mower deck and blades		
4. Weed-eater blades		
5. Crevices on other tools		

Hand and Power Tools:

Check for soil, seeds, and plant material	Inspected	Cleaned
1. Chainsaw chain and body		
2. Hand saw blades		
3. Mower deck and blades		
4. Weed-eater blades and guard		
5. Crevices on all other tools		

Checklist E: Inspection & Cleaning *(continued)*

Vehicles and Large Equipment (including ATVs, OHVs, motorcycles and bikes):

Check for soil, seeds, and plant material	Inspected	Cleaned
1. Truck bed		
2. Exhaust systems		
3. Vent openings		
4. Grills: Front and back		
5. Tray under radiator		
6. Top of transmission		
7. Stabilizer bar		
8. Shock absorber joint with axles		
9. Front and rear axles		
10. Top of front suspension units		
11. Wheel well/quarter panels		
12. Ledges under bumper (front and rear)		
13. Tire rims and treads		
14. Between rear wheel brake drums and the rim of the wheel		
15. At the bend in the fuel inlet tube		
16. Spare tire and mounting area		
17. Under the floor mat (inside cab)		
18. Under the seat (inside cab)		
19. Upholstery (inside cab)		
20. Beneath foot pedals (inside cab)		
21. Gear shift cover folds (inside cab)		

Key to BMP Chapter Acronymns

CB – Clothing, Boots and Gear Cleaning BMPs, Chapter 5, page 23

PL – Planning, Chapter 1 , page 9

PM – Project Materials, Chapter 2 , page 15

RL – Revegetation and Landscaping, Chapter 9 , page 31

SD – Soil Disturbance, Chapter 7 , page 27

TE – Tools, Equipment and Vehicle Cleaning, Chapter 4 , page 21

TR – Travel, Chapter 3 , page 19

VM – Vegetation Management, Chapter 8 , page 29

WD – Waste Disposal, Chapter 6, page 25

Reference Resources and Links

-California Department of Fish and Wildlife.

<https://wildlife.ca.gov/>

<https://wildlife.ca.gov/Conservation/Invasives/Species/NZmudsnail>

-Western IPM Center Tribal Work Group.

<http://westernipm.org/index.cfm/center-projects/project-websites/tribal-work-group/>

-Tribal Pest Field Guide Cards (draft) <http://westernipm.org/index.cfm/center-projects/project-websites/tribal-work-group/tribal-pest-cards-view-singles-final-pdf/>

-DOI. USGS. Wetland and Aquatic Research Center. Provides detailed collection information as well as animated map.

[Nonindigenous Aquatic Species Database: Point Map - Quagga Mussel](#)

-DOI. USGS. Wetland and Aquatic Research Center.

Includes comparison: *Dreissena polymorpha* (Zebra mussel) vs. *Dreissena bugensis* (Quagga mussel).

[Nonindigenous Aquatic Species Database - Quagga Mussel Images](#)

-California Oak Mortality Task Force

<https://www.suddenoakdeath.org/diagnosis-and-management/best-management-practices/>

-A Reference Manual for Managing Sudden Oak Death in California.

https://www.fs.fed.us/psw/publications/documents/psw_gtr242/psw_gtr242.pdf

-Port Orford Cedar Root Disease.

https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5346825.pdf

-California Invasive Plant Council Best Management Practices (BMPs)

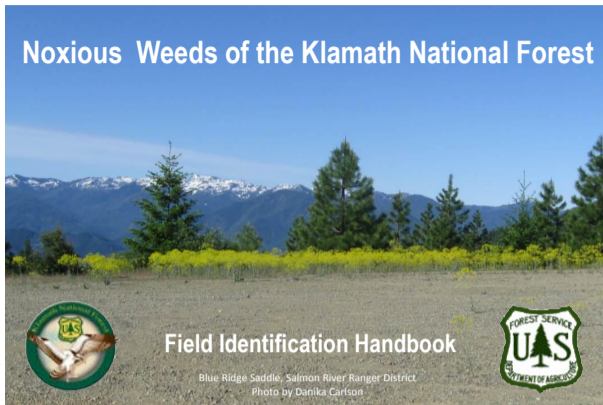
<https://www.cal-ipc.org/resources/library/publications/landmanagers/>

-USDA Six Rivers Aquatic Restoration Project, Pages 199-200

https://www.fs.usda.gov/nfs/11558/www/nepa/96257_FSPLT3_4529205.pdf

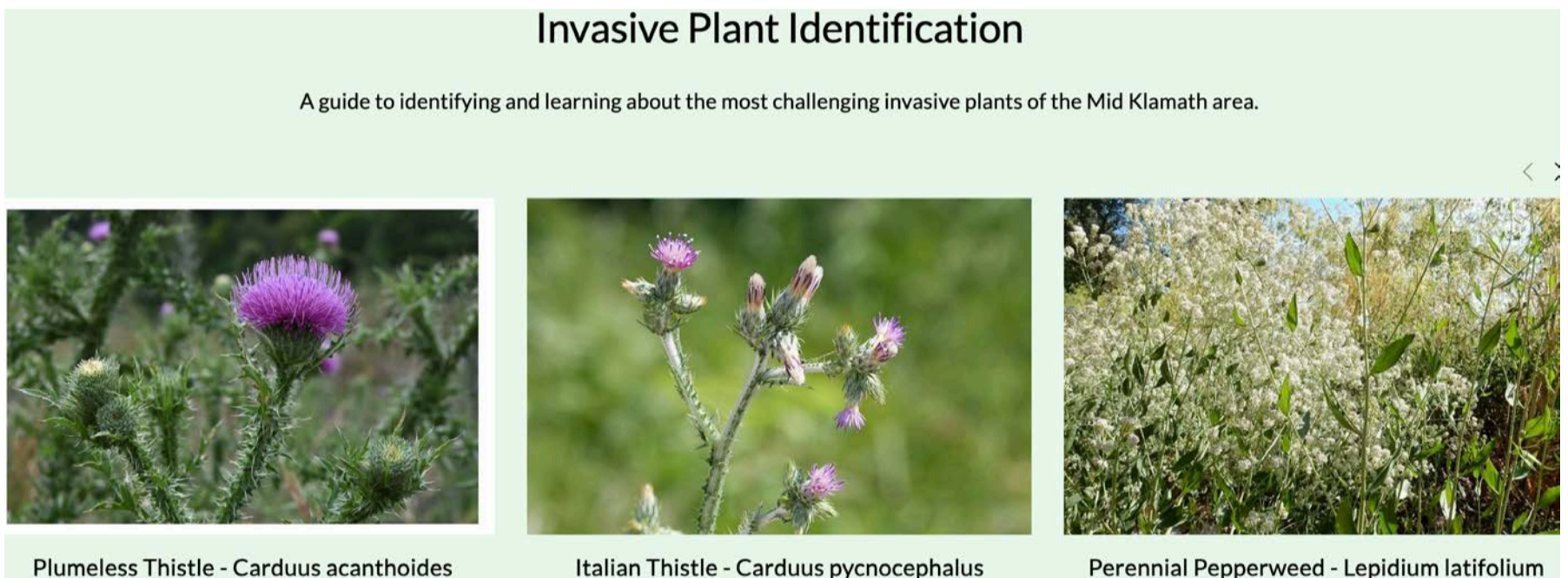
Reference Resources and Links

-Klamath National Forest Noxious Weed Field Guide



https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd496403.pdf

-Mid Klamath Watershed Council's Plants Invasive Plant Identification Guide



<https://www.mkwc.org/plants>.

-Mid Klamath Watershed Council's Sudden Oak Death Reference Material



Pathogens

The mid-Klamath is at high risk of *Phytophthora ramorum* (sudden oak death, SOD) infestation. MKWC works with Partners, especially the Karuk Tribe, to prevent SOD establishment and monitor for SOD occurrence. Other pathogen work includes Port-Orford-Cedar root disease (*Phytophthora lateralis*) monitoring.

[LEARN MORE ABOUT SOD](#)

<https://www.mkwc.org/sudden-oak-death>