### Assessment of *Phytophthora* at restoration sites in the Midpeninsula Regional Open Space District Ebba Peterson, Jennifer Parke, Joyce Eberhart, Neelam Redekar Oregon State University



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## Movement of Phytophthora in Wildlands



## Wildlands

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### Objectives

- Determine the distribution of *Phytophthora* at MROSD revegetation sites & surrounding wildlands.
- Be able to identify future planting sites as either a high or low risk for *Phytophthora*.



## Methods: Site Selection

- Revegetation (<u>Planted</u>) Sites
- <u>Unplanted-disturbed</u> Sites
  - Planned projects & un-remediated areas
- <u>Unplanted-control</u> Sites
  - Adjacent forest / similar habitat
  - Shared species
  - Upstream / uphill of reveg sites and major disturbances
- December 2017: 20 planted sites
  7 unplanted-disturbed sites
  18 unplanted-control sites



## Methods: Soil & Plant Collection



#### For each site:

- 6 soils samples (2 individuals for 3 species)
  - mimulus, madrone, toyon, coffee berry (45%)
- Preferentially sampled those with dieback symptoms





#### <u>Illumina MiSeq (10 g)</u>



DNA sequences ~150 base pairs

aagtgtcgccac aacggcctactg aagtacgtcata aaggcgtaggc aaggcgtaggc

"OTU" – Operational Taxonomic Unit DNA sequences that are similar enough to be classified as coming from the same species (or group of species)

"cluster" – distinct species, but we cannot differentiate between them with Illumina

"complex"- differentiation between species unclear or under recent review

P. nemorosa, P. ilicis, P. pseudosyringae, o P. pluvialis

P. cryptogea, P. pseudocryptogea, P. erythroseptica, P. sp."kelmania", or P. himalayensis

<u>Illumina</u>	<u>MiSeq (10 g)</u>
	DNA sequences ~150 base pairs
5 reads of 4 OTUs	aagtgtcgccac aacggcctactg aagtacgtcata aaggcgtaggc aaggcgtaggc
<i>P. ilicis, ngae,</i> or	<u>99% match</u> <i>R cinnamomi</i> <i>P. nemorosa</i> -cluster
itoaea	<i>P. cryptogea</i> -complex <i>P.</i> sp. unknown



Benefits

Drawbacks

- Can process large amounts of soil
- Selects for those species that can be baited
- Success is subject to seasonal changes

## <u>Illumina MiSeq (10 g)</u>



DNA sequences ~150 base pairs

*P. cinnamomi P. nemorosa*-cl. *P. cryptogea*-co. *P.* sp. unknown *P.* sp. unknown

- Can detect multiple species and genera in a single sample
- Can only process small amounts of soil
- Not all species detected may be capable of causing disease

### 274 samples collected



168 cultures submitted for identification

260 samples submitted for Illumina MiSeq sequencing

#### Baiting (+) Illumina (+)

# **Skyline Ridge**

Planted Sites

ambivo

000

cactorum-complex sp. unknown clandestina

> Unplanted-<u>Disturbed Site</u> no *Phytophthora* no *Phytophthora*

#### Unplanted-Control Site

P. cambivora-complex P. formosa P. quercina P. nemorosa-cluster P. uliginosa-cluster

#### Baiting

#### Isolated *Phytophthora* from 32 samples (11.7% of those baited)

Spaciae (O total)	No.
Species (9 total)	samples
P. cambivora	13
P. cactorum	7
P. ramorum	5
P. cinnamomi	2
P. multivora	1
P. cryptogea	1
P. erythroseptica	1
P. nicotianae	1
P. syringae	1

OTU (25 total)	No. samples
P. nemorosa-cluster	51
P. cactorum-complex	29
P. sp.unknown	15
P. syringae	12
P. quercina	13
P. uliginosa-cluster	12
P. chlamydospora	7
P. lateralis	5
P. cryptogea-complex	5
P. citricola-complex	4
P. ramorum	4
P. cambivora-complex	4
P. cinnamomi	3
other sp. (12 OTUs)	24

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# *Phytophthora* represents a small proportion of total OTU reads



# *Phytophthora* equally prevalent in planted and unplanted sites



# *Phytophthora* equally prevalent in samples from planted and unplanted sites









#### Species composition does vary slightly by site-type

no. samples in which a species was detected



# Phytophthora ramorum



250

500 Feet

Cape Ferrelo Curry County OR

# Phytophthora ramorum



250

500 Feet

Cape Ferrelo Curry County OR

# Phytophthora nemorosa

# P. pluvialis

#### P. nemorosa (+)

Timeus Ranch, Brookings, OR Google maps captured 02/06/14



#### Species composition does vary slightly by site-type

no. samples in which a species was detected



*P. quercina* detected 2016 (first detection in U.S.) *Quercus lobata* planted 2002

# Phytophthora quercina



#### Conclusions & Caveats:

- *Phytophthora* was detected in nearly all sites, but some were much more infested than others.
- Planted and disturbed areas had a greater diversity of species, likely resulting from the introduction of *Phytophthora*.
- Unplanted areas still had a large number of species, including those known to be invasive.
  - Complex disturbance histories contributes substantially to *Phytophthora* diversity.
  - Environment is very conducive for establishment, but not all species are everywhere!



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#### Conclusions & Caveats (cont.):

- DNA-only detections may be remnants of prior introductions. Not all introduced species establish, and not all cause substantial disease.
- ... however the long-term outlook is poorly understood:
  - *Phytophthora* can persist in soils and may cause disease later on or on different hosts
  - Disease development may be slow
  - Disease may only occur at specific stages like regeneration
- BMPs should be implemented to minimize *Phytophthora* movement.



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  - Dr. Neelam Redekar
  - Joyce Eberhart
  - The many undergraduates







#### **Recovery by Plant Health**



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