Examples of Truffle Cultivation Working with Riparian Habitat Restoration and Preservation

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What Are Truffles?

- Mushrooms that “fruit” underground and depend on animals to disperse their spores
- Celebrated delicacies for millennia
- They are among the world’s most expensive foods
- Most originate in the wild, but three valuable European species are domesticated and are grown on farms throughout the world

What Is Their Appeal?

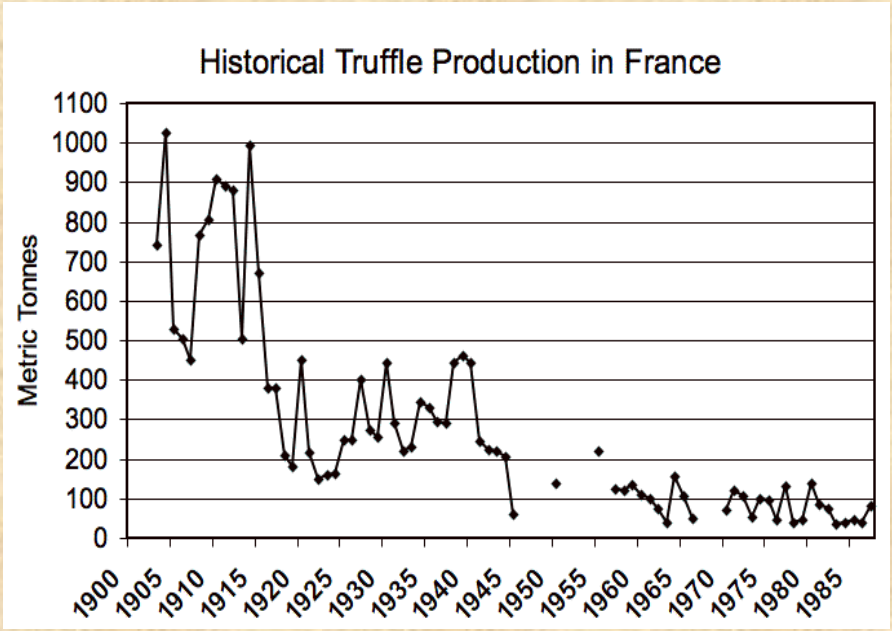
- The likelihood of their reproductive success is a function of their ability to entice animals to locate and consume them
- Produce strong, attractive aromas to capture attention of passing animals
- Androstenol and other musky compounds

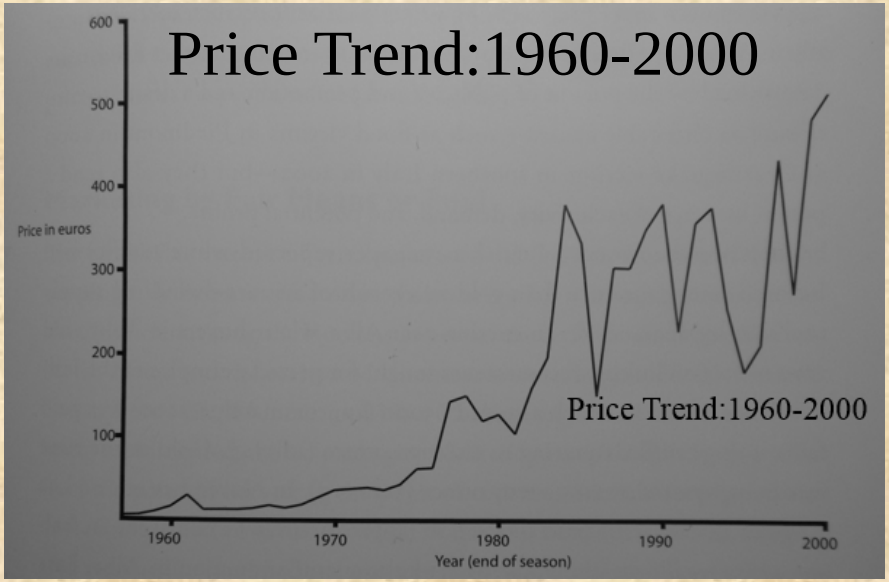
French Truffle Production Trend 1900-2000

Driving Forces:

- Phylloxera
- Urbanization

Current Annual U.S. Import volume: 15-20 tons



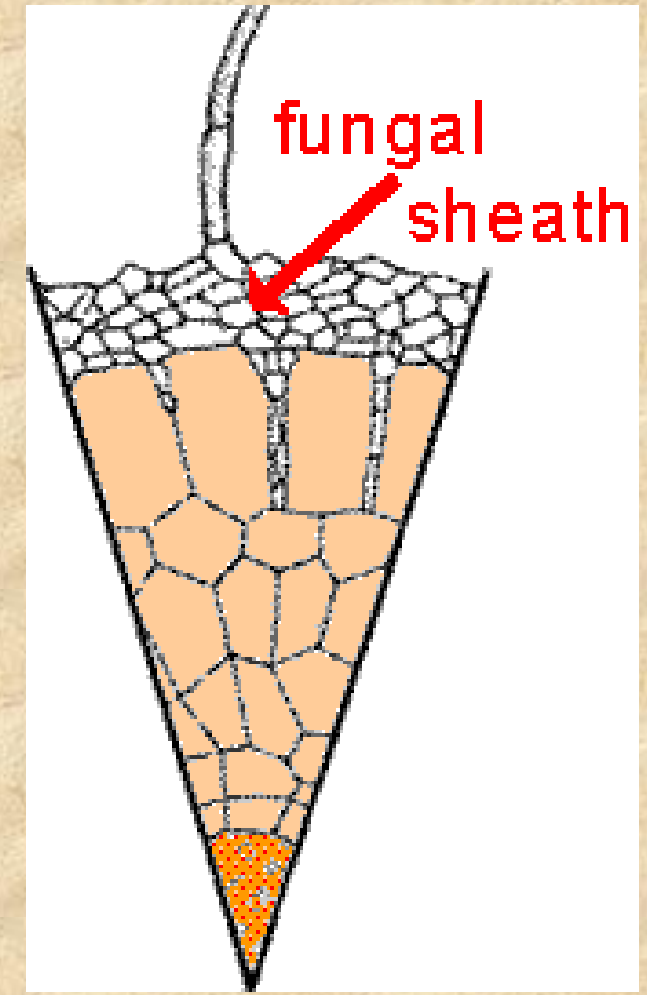


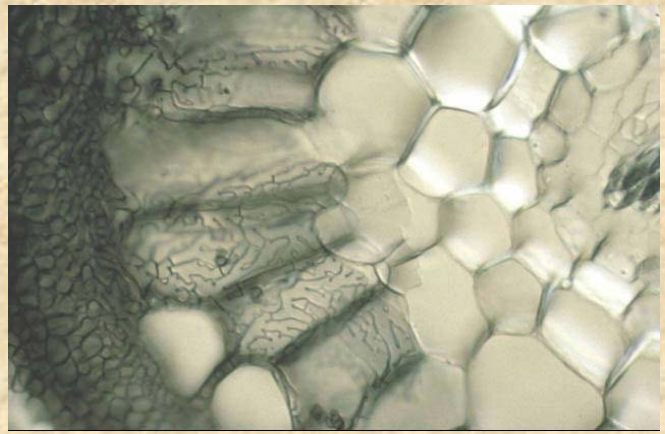
The Human-Truffle Connection

- Truffles are among those organisms that thrive in human-created environments
- Urban migration and industrialization have caused the decline of truffles not by destroying truffle habitat directly, but by eliminating forms of traditional agriculture that created new truffle habitat
- Truffles are the kind of disturbance-loving organisms that we can grow

Ectomycorrhizae:

Beneficial Symbiosis Between the Truffle Fungus and Host Tree Roots





Inoculated Seedlings

- Produced by five companies in the U.S. and Canada planting ~200 acres annually
- ~3000 acres planted per year globally
- Cultivated black truffle production now exceeds wild harvests

Orchards of Inoculated Trees

Costs

Orchard Establishment:

- $10,000-$12,000 per acre
- Includes:
  - Inoculated Seedlings
  - Irrigation System
  - Soil amendments and preparation

Orchard Maintenance:

- $2000-$2500 per acre, per year
- Includes:
  - Management of competing vegetation
  - Pruning
  - Pest management
  - Irrigation system management
  - Harvesting

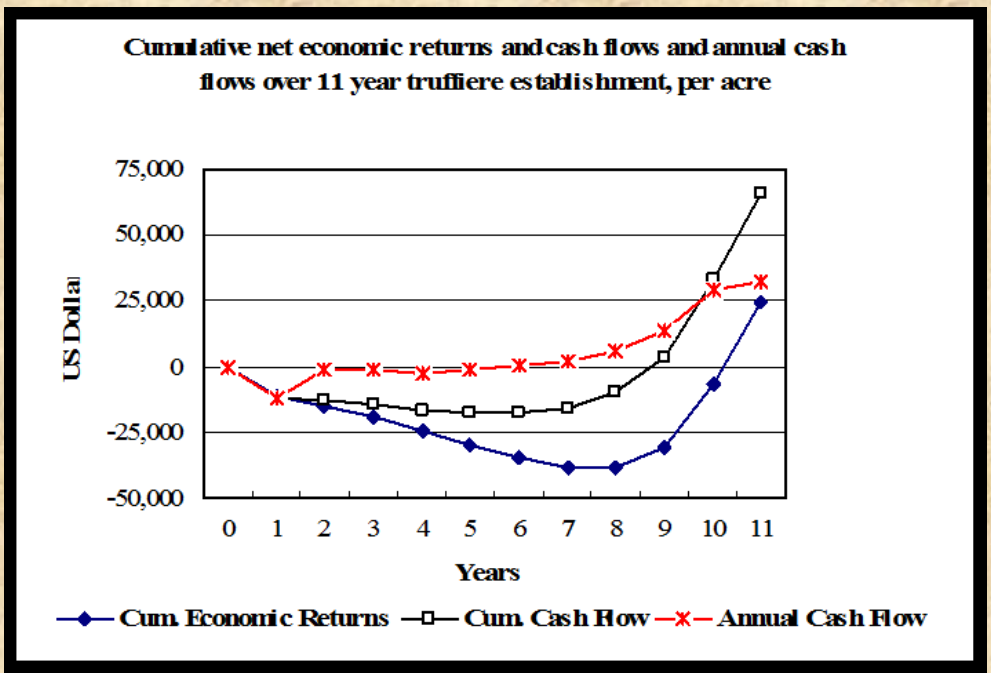
Returns:

- Returns Per Acre at Full Production

- Cumulative Returns

Estimated Per Acre Returns Over Cash Costs at Varying Yields and Prices.				
	---------- Pounds/Acre ----------			
Price/Lb	7	21	35	49
$400	$324	$5,924	$11,524	$17,124
$700	$2,424	$12,224	$22,024	$31,824
$1,000	$4,524	$18,524	$32,524	$46,524
$1,300	$6,624	$24,824	$43,024	$61,224

Estimated Per Acre Returns Over Total Economic Costs at Varying Yields and Prices.				
	---------- Pounds/Acre ----------			
Price/Lb	7	21	35	49
$400	-$1,836	$3,764	$9,364	$14,964
$700	$264	$10,064	$19,864	$29,664
$1,000	$2,364	$16,364	$30,364	$44,364
$1,300	$4,464	$22,664	$40,864	$59,064



Risk

Avoidable Risks

- Poor site selection
- Failure to manage competing vegetation, irrigation, and pests
- Failure to follow-through with truffle dog training

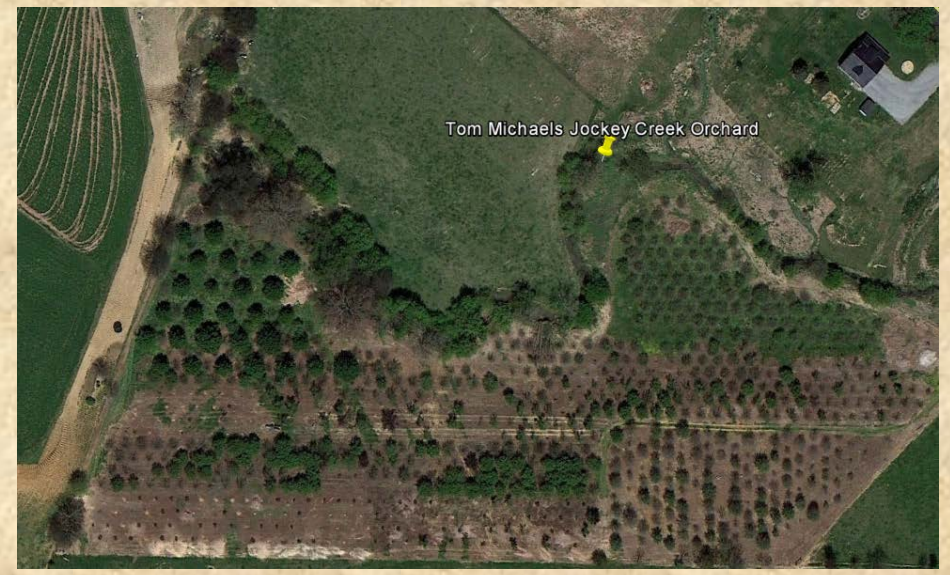
Unavoidable Risks

- Uncertainty regarding suitability of soils outside the truffle's natural habitat
- Uncertainty regarding novel problems associated with new geographic regions, including diseases, pests, and climatic stresses
- Uncertainty associated with the relative youth of truffle cultivation generally

North American Orchards with Confirmed Truffle Production

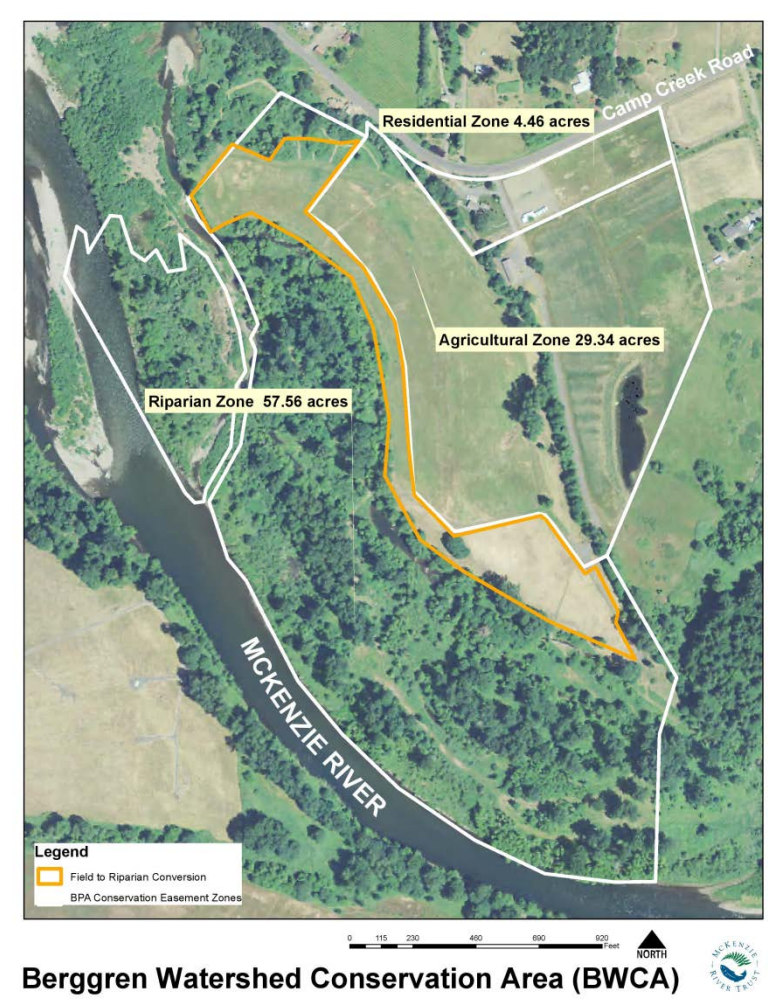
North America's Top Truffle Producers

- Tom Leonard
- Tom Michaels



Berggren Farm: A Working Example of Truffle Orchards Employed within a Riparian Habitat Restoration Initiative

The Berggren Watershed Conservation Area on the lower McKenzie River in Lane County, Oregon features an extensive, intact and dynamic network of side channels that provide habitat for a number of sensitive and endangered species. The property also includes nearly a mile of river frontage, an intact floodplain forest, and 30 acres of farmland that has become the Berggren Demonstration Farm. Truffles were included on the farmland to enhance and protect the riparian habitat while serving as a source of agricultural income.



Berggren Farm Truffle Orchard

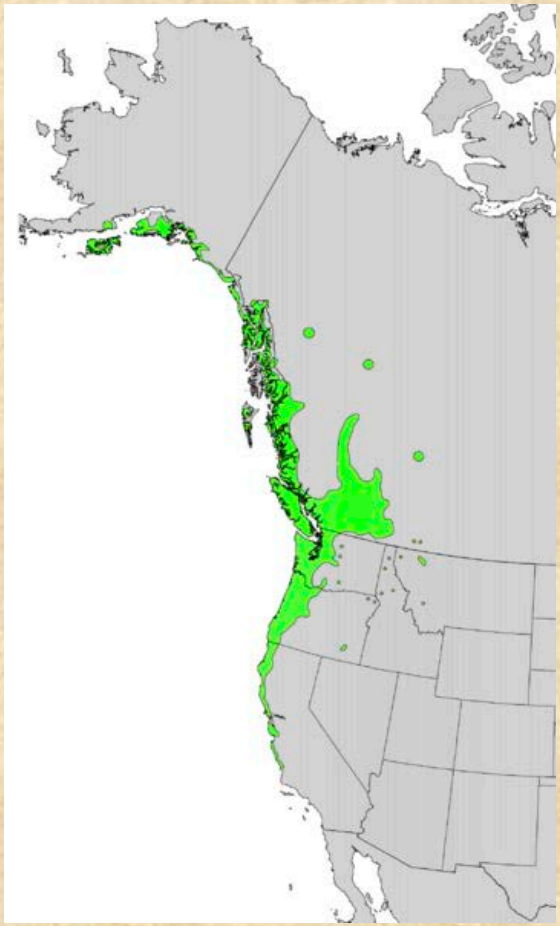
Truffle orchard layout (not to scale). *Blue borders represent European species; green represents native species.*
*1. European Black truffle; 2. Burgundy truffle; 3. Bianchetto truffle; 4. Garlic truffle; 5. Italian White truffle; 6. Oregon White truffle; 7. Oregon Black truffle; 8. Oregon Brown truffle. *NWT will advise selection for this plot.*

Truffle Species to be planted at Berggren Farm

	Truffle Species	Host Trees	Soil pH	Planting Density (trees/ acre)	Likelihood of successful cultivation	Approximate Wholesale price (per lb.)	Harvest Season
1	***Tuber melanosporum*** (French black truffle)	Broad Host Range: Mainly Hazel and oak	7.5-8.3	200	Very high	$1,000	Winter
2	***Tuber aestivum*** (Burgundy truffle)	Broad Host Range: Mainly Hazel and oak	7.5-8.3	400	Very high	$400	Fall-Winter
3	***Tuber borchii*** (Bianchetto truffle)	Broad Host Range: Mainly Hazel and oak	7.0-8.0	400	Very high	$400	Winter-Spring
4	***Tuber macrosporum*** (Smooth black truffle)	Hazelnuts English oaks	7.5-8.3	TBD	Experimental	$800	Fall
5	***Tuber magnatum*** (Italian white truffle)	English oak Poplar Willow	7.5-8.0	400	Has not been cultivated outside of its natural habitat	$2,000	Fall
6	***Tuber oregonense*** (Oregon white truffle)	Douglas fir	5.5-6.5	400	Experimental	$300	Winter
7	***Leucangium carthusianum*** (Oregon black truffle)	Douglas fir	5.5-6.5	400	Experimental	$300	Winter-Spring
8	**Kalapuya brunnea** (Oregon brown truffle)	Douglas fir	5.5-6.5	400	Experimental	$300	Winter-Spring
9	***Tuber borchii*** (Pecan truffle)	Broad Host Range: Mainly pecans	5.5-6.5	400	Very High	$300	Summer-winter

Example of North American Willows Hosting European Truffles

Tuber magnatum (Italian white truffle) ectomycorrhizae with *Salix spp.* (*hookeri*, *lasiandra*, *sitchensis*, etc.)



Experimental Combinations of Native California Host Trees with European Truffles

Host Tree Species	Truffle Species	Status
Valley oak (*Quercus lobata*)	*T. melanosporum*	Underway
Coast live oak (*Q. agrifolia*)	*T. melanosporum*	Underway
Tan oak (*Lithocarpus densiflorus*)	*T. melanosporum*	Successful
Canyon live oak (*Q. chrysolepis*)	*T. melanosporum*	Successful
Oregon white oak (*Q. garryana*)	*T. melanosporum*	Successful
Willows (*Salix spp*.)	*T. Magnatum* *T. melanosporum*	Successful
Pacific willow (*S. lasiandra*)	*T. magnatum* *T. borchii*	Underway Underway
Black cottonwood (*Populus trichocarpa*)	*T. magnatum*, *T. borchii*	Underway Underway
Quaking aspen (*P. tremuloides*)	*T. Magnatum* *T. borchii*	Underway Underway

Example of Successful Truffle Production Using Novel Host-Truffle Combinations

Natural Habitat of *Tuber magnatum* (Croatia)

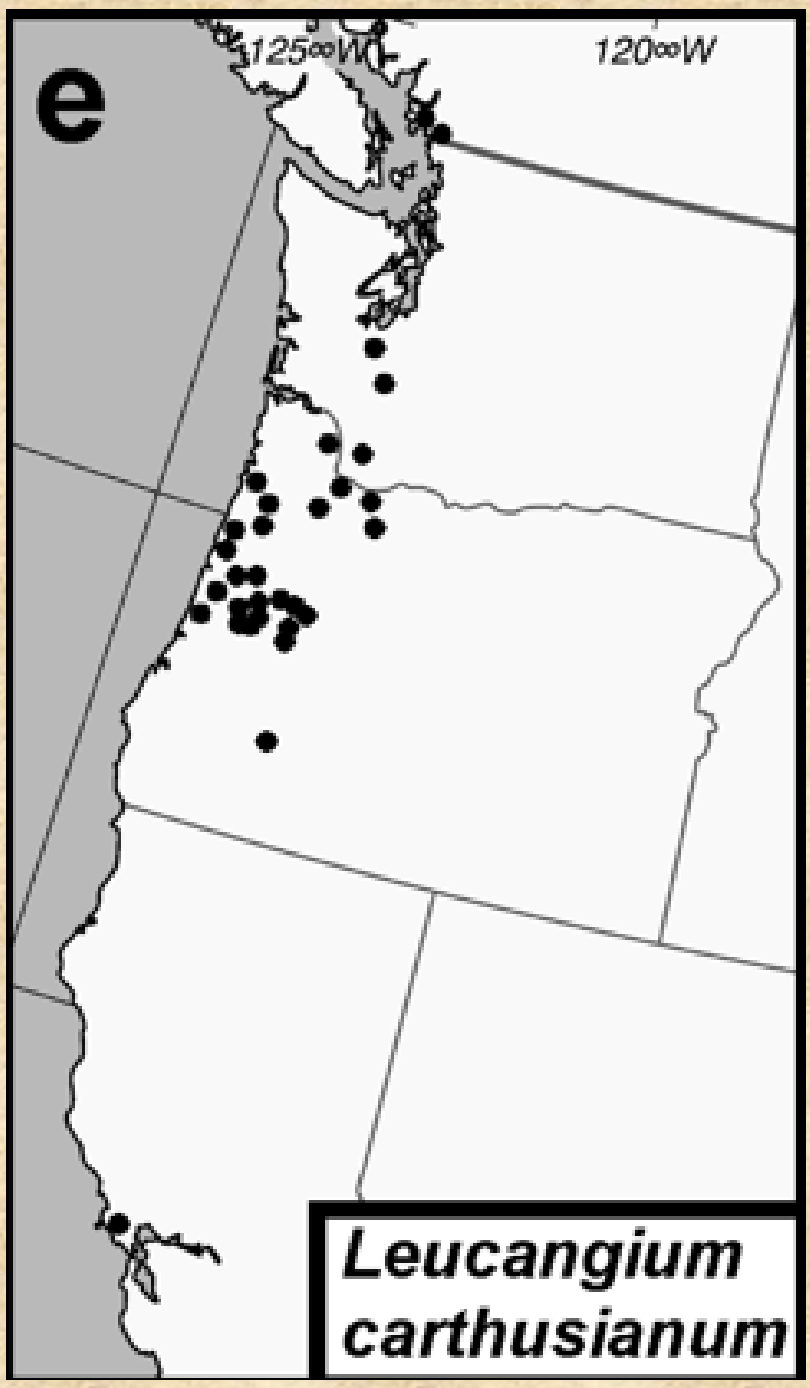
Natural Habitat of *Tuber magnatum* (Tuscany)

Natural Habitat of *Tuber magnatum* (Tuscany)

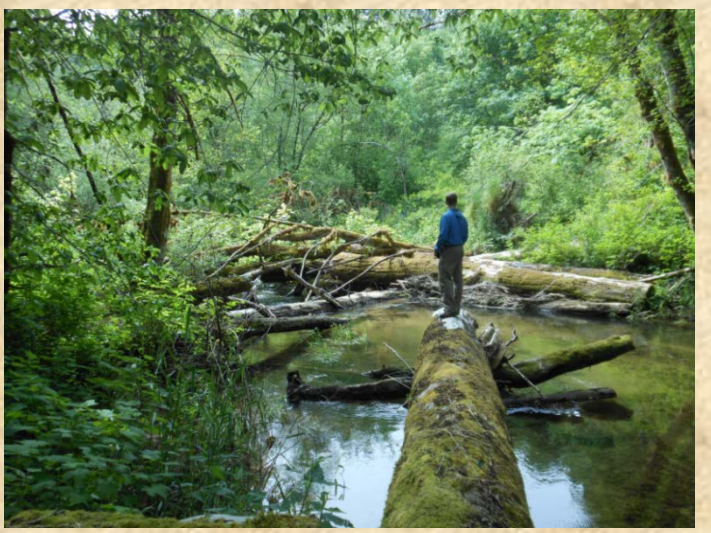
Oregon Black Truffles

Leucangium carthusianum

- Point Reyes through Vancouver, BC
- Specific to Douglas fir
- Abundant in ‘overgrown Christmas tree farms’

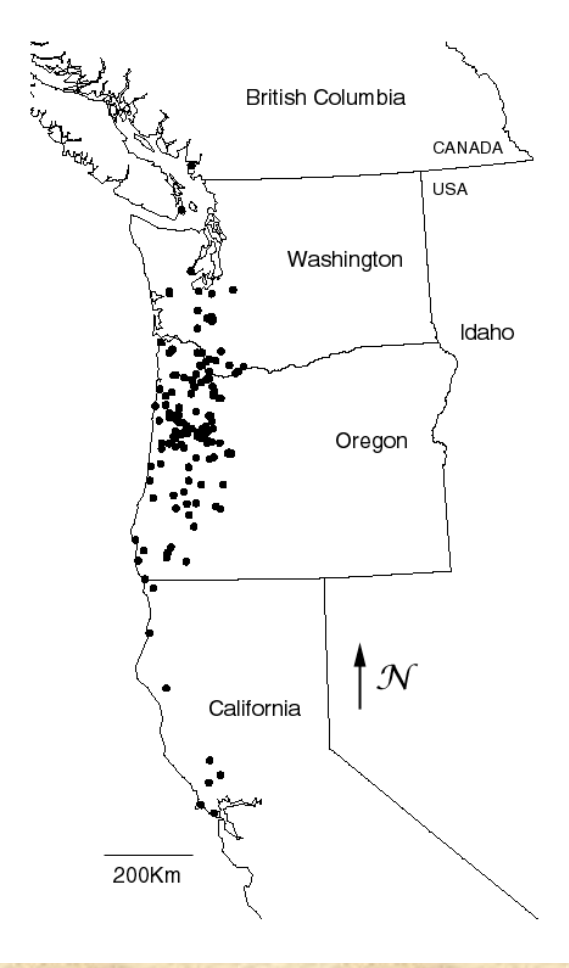


A Working Example of Salmon Spawning Habitat Restoration in Conjunction with Oregon Black Truffle Production



Oregon White Truffles

- Marin County, CA through Quadra island, BC
- Specific to Douglas fir
- Abundant in ‘overgrown Christmas tree farms’

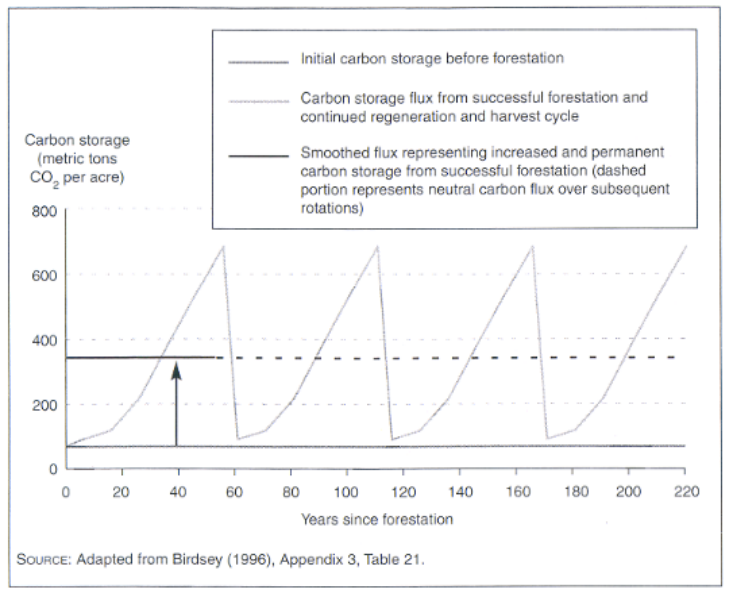


Winter: *Tuber oregonense*

Spring: *Tuber gibbosum*

Oregon White Truffle Habitat

A Working Example of Carbon Sequestration In Conjunction With Oregon White Truffle Production



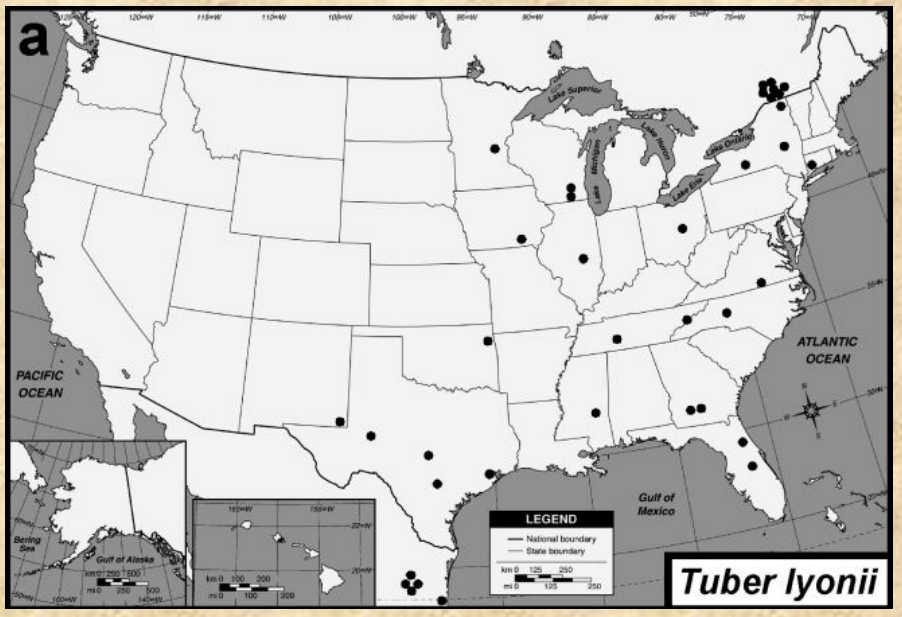
SOURCE: Adapted from Birdsey (1996), Appendix 3, Table 21.

Figure 1. **Permanent carbon storage from the forestation of underproducing lands managed for timber production over a perpetual even-aged harvest and reforestation cycle.**

Pecan Truffles

Tuber lyonii

- Northern Mexico Through Southeast Canada
- Broad host range
- Best known from commercial pecan orchards



Pecan Truffles (*Tuber lyonii*)

Resources

- Oregon Truffle Festival
  - Truffle Growers' Forum
  - Truffle Dog Training Seminars
  - www.oregontrufflefestival.com
- Taming The Truffle by Dr. Ian Hall
- The Oregon Culinary Truffles Feasibility Study
  - excellent resource for truffle farming economics
  - www.oregontruffles.org

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