Individual Tree Selection (ITS) in a Northeast Oregon Mixed Conifer Forest

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In 2005, the Oregon State University Forestry and Natural Resources Extension Program established an Individual Tree Selection (ITS) case study on 50 acres of dry mixed conifer forest in the Oberteuffer Research and Education Forest. This tract is an OSU College of Forestry satellite research forest approximately 8 miles east of Elgin, Oregon. Bill and Margaret Oberteuffer, who owned the land for 20 years, were proponents of "all-age, all-species management." They donated this 113-acre parcel to OSU in 1994 (see "The Oberteuffers," below).

Why establish an ITS case study? Many family forestland owners and state and federal managers are interested in ITS because it:

- provides a continuous forest canopy;
- potentially reduces reforestation costs;
- produces aesthetically pleasing forest conditions;
- provides complex forest structure that maintains diverse wildlife habitat and forest health; and
- allows for periodic income.

Our goals for this case study are to learn more about and document the "how to" for implementing ITS in a typical mixed conifer forest, and to learn how the stand, including the regeneration, responds to periodic harvest entries. Other questions and conditions we want to consider include:

- Does ITS promote a shift in composition to shade-tolerant trees, particularly fir?
- How does fiber production with ITS compare to even-aged methods?
- Are there fire hazard concerns in forests that have several age classes (ladder fuels)?
- How do logging costs, potential damage to large trees, and regeneration with ITS compare to even-aged methods?
- How can ITS enhance wildlife habitat, especially with snags and large, downed wood?

The Oberteuffers

The Oberteuffers were high-school teachers from Portland, Bill in biology and Margaret in counseling. They spent many summers in the mountains of Oregon and Washington. Bill devoted a number of winters to planting

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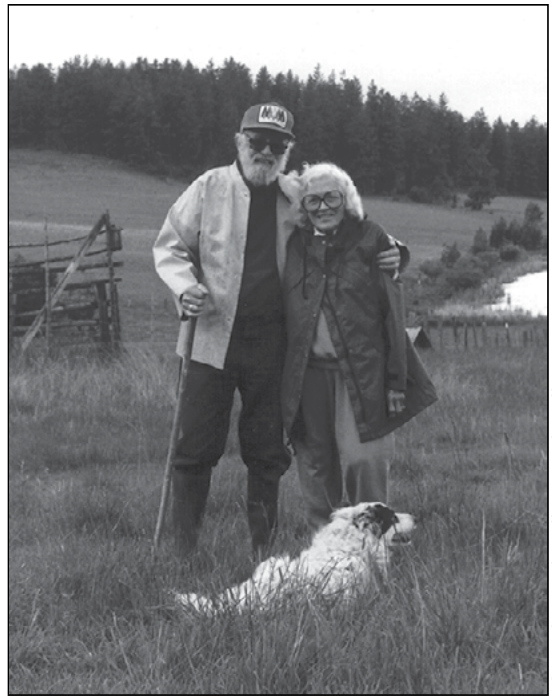
trees with his students on the Tillamook Burn and received a statewide teacher of the year award. Both loved the outdoors and the joys of living off the land. After searching for the perfect forest refuge, they found what they were looking for near Elgin, Oregon. Here they would retire from teaching and start a new life on the Smilin' O Ranch.

In 1974, they bought the first parcel of 160 acres and added another 80 acres in the 1980s. In 1994, when they retired from owning and managing the ranch, they donated 113 mostly timbered acres to the College of Forestry at Oregon State University. And so, the Oberteuffer Research and Education Forest was born, fulfilling Bill's dream of continuing his demonstration forest for the benefit of family forest owners throughout northeast Oregon.

Many on-the-ground demonstrations have been established here in reforestation and other forest management practices. Besides research, the OSU Extension Forestry and Natural Resources Program uses the forest every year for a variety of tours and forestry-related classes.



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Bill and Margaret Oberteuffer

Stand and Forest Conditions

History

The Oberteuffer forest has an interesting history. It was originally homesteaded in 1890 by George H. Taylor. The present forest apparently originated following a heavy cut or possibly a "clearcut" about 105 to 115 years ago (around 1905). Some trees are older, suggesting that they were established before the clearcut, but no trees over 120 years old have been found. Evidence of stumps from the circa 1905 clearcut showed that ponderosa pine, Douglas-fir, and larch were common in the original stand.

No large, older trees or snags from the previous stand can be found, indicating a rather complete harvest. Western larch is generally younger, suggesting that they seeded in following a disturbance. There is no evidence of fire following the clearcut, but old, remnant stumps and snags have many fire scars, suggesting a history of frequent understory fires similar to many eastern Oregon forests. There are very few large rotted logs on the forest floor, suggesting either that the previous stand was not an old growth stand with lots of snags or down woody debris, or that fire before the clearcut consumed the coarse woody debris.

The stand appears to have been released by partial cutting in or before 1957, based on a large number of trees of all species showing increased diameter growth at about this time. Douglas-fir and grand fir both show evidence of dead tops, most likely caused by defoliation that occurred during the western spruce budworm outbreak in the 1980s and early 1990s.

The Oberteuffers had done some light thinning on the ridge top in the ITS stand, and a small salvage harvest of blow-down timber occurred in 1995 in the southeast part of the unit. The area was grazed by livestock for many years before the College of Forestry acquired the property. As a result of these past disturbances, the stand is **uneven-aged**, making it perfect to study the application of ITS in this forest type.

Stand composition and productivity

The 50-acre stand contains primarily ponderosa pine (75 percent) and Douglas-fir (20 percent) with small amounts (5 percent) of grand fir and western larch. The understory is mostly snowberry, some ninebark, ocean spray, serviceberry, elk sedge, pine grass, and other native grasses and forbs.

The **site index** (100-year base) varies from 90–100 for Douglas-fir to 100–109 for ponderosa pine. Based on inventory data (1996–2005) across the property and from timber harvest records, the forest is growing at about 400 board feet per acre per year.

Soils also vary within the case study stand but are primarily Hall Ranch stony loam with occasional intrusions of Tolo silt loam containing some **Mt. Mazama ash**, which increases soil water-holding capacity and growth potential. On the ridge top, much of the soil is fairly shallow with rocky outcroppings and cobble.

The study area is at 4,000 feet of elevation with a primarily west and north aspect. It's on a gentle slope of less than 20 percent, which makes it easy for ground-based equipment to operate. The stand is in a transitional zone between rangeland and forest (Figure 1).

Wildlife

Wildlife is abundant on the property. Elk, deer, and turkey are common visitors here. There are several snags within the 50-acre ITS stand, and pileated woodpeckers and other cavity-dwelling birds use the stand and surrounding forests. One of the important objectives of this ITS case study is to provide habitat for a variety of wildlife.

uneven-aged stand—
A stand with trees of three or more distinct age classes, either intimately mixed or in small groups.

site index—
A measure of how tall dominant trees grow over a specified period (50 or 100 years). Site index reflects the combined effects of climate and soil quality on tree height growth. Trees growing on good sites (high site index) grow faster in height than trees on poor sites (low site index) over a 50- or 100-year period. The result is higher volume growth in board feet on the better site.

Mt. Mazama ash—
The eruption of Mt. Mazama south of Bend moved mostly northeast, covering 500,000 sq mi with ash including all of Oregon, Washington, northern California, Idaho, western Montana, and parts of Utah, Nevada, and Canada as far east as Saskatchewan. The caldera created by the eruption became Crater Lake.

Insects and disease

Currently, the stand is relatively free of forest insect- and disease-related mortality. However, pine bark beetles (several species) have occasionally killed trees, which benefits the stand by adding a few snags for wildlife. There is some dwarf mistletoe in the western larch. Although there is root disease on the property, no root disease has been found in the case study area.

Desired Stand Structure for ITS

In 1996, a series of permanent inventory plots was established systematically across the entire 113-acre property (Figure 2, page 4). Twenty of those plots are within the 50-acre ITS case study stand. They serve as a

Photo by Paul Oester, © Oregon State University

Figure 1. The Oberteuffer forest and the ITS stand are located at the transition between rangeland and forest.

basis for measuring growth and development and assessing ITS treatment effects on regeneration and overstory trees.

In 2005, the stand was marked for a harvest (thinning) with the goal of maintaining a **stand density index** (SDI) of 118 allocated across seven 4-inch diameter classes, resulting in a "reverse J-shaped" curve (see black bars in Figure 3, page 5). The outcome was a total residual **basal area per acre** of 71 square feet.

We specified a maximum tree diameter of 28 inches DBH (diameter at breast height). This was chosen based on site productivity, species, aesthetics, and economics. Regarding economics, for example, large-diameter ponderosa pine is one of the primary marketable species. A 28-inch maximum DBH allows the growth of large, higher premium logs. In a few cases, trees larger than 28 inches were left if they were growing well and not suppressing other trees and young regeneration. However, we will have to be careful not to exceed the 28-inch maximum DBH for other species, because local markets have a diameter limit that, if exceeded, triggers a price penalty.

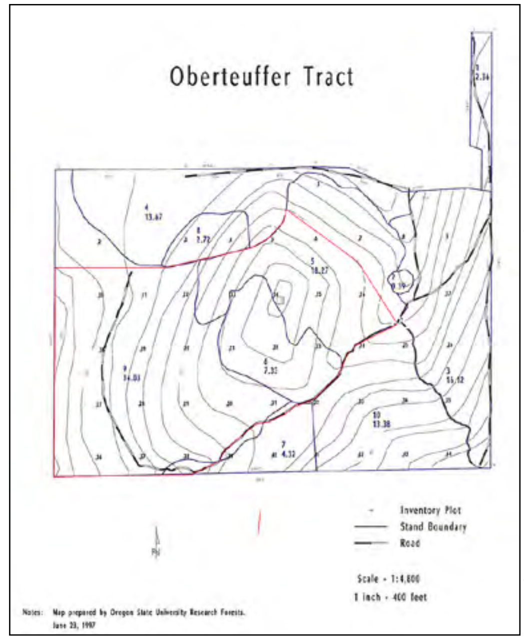


Figure 2. The red line outlines the 50-acre ITS stand with inventory plots.

Map by Oregon State University Research Forests

Harvest, Logging, and Economics

Figure 3 (page 5) shows diameter distributions in 1996, 2005 (after 9 years of growth), and 2006 after the first ITS harvest operation. Approximately 161,000 **board feet (bd ft)** were harvested across the 50-acre stand, or about 3,200 bd ft per acre. Table 1 gives a per-acre board-foot breakdown by log diameter class. Most of the volume removed per acre was in the 12- to 17-inch DBH range (Figure 4, page 5). Figure 5 (page 6) shows the residual board foot volume in 1996, in 2005, and after the harvest in 2006, which left about 7,700 board feet per acre. The purpose of this harvest was to reduce stand density to better encourage good growth of regeneration and mid-story trees.

Table 1. Breakdown of log sizes and volume per acre from 2006 harvest

Small-end log diameter (inches)	Volume per acre (bd ft)	Percent (%)
6–11	1,076	34
12–17	1,496	47
18+	628	20
Totals	3,200	100

The harvest occurred during late fall of 2006 when soils were dry and the risk of pine engraver beetle was low. Trees were felled-to-lead and the operator used a 450 John Deere dozer and a converted Kabota tractor for skidding. Areas with rocky ground dictated the use of the rubber-tired Kabota tractor. The operator was restricted to designated skid trails (Figure 6, page 6) and there was very little damage to trees from the logging operation. Snags were left to encourage cavity-nesting wildlife (Figure 7, page 7). Figures 8a and 8b (page 7) show the stand before and after harvesting, respectively. One sees a multi-aged forest that is aesthetically attractive to many landowners.

stand density index (SDI)— SDI expresses the competition stress in any stand as an index, thereby allowing comparisons between stands of differing average size and density. SDI is calculated with the following formula:

$$SDI = \frac{TPA\ (\text{average diameter})^{1.6}}{10}$$

Basal area per acre— The cross-sectional area of all trees in square feet at breast height (4.5 feet) in an acre; a measure of forest density and stocking. The basal area of one tree is calculated with the following formula:

Basal area for a tree = (DBH in inches)^2 x 0.005454

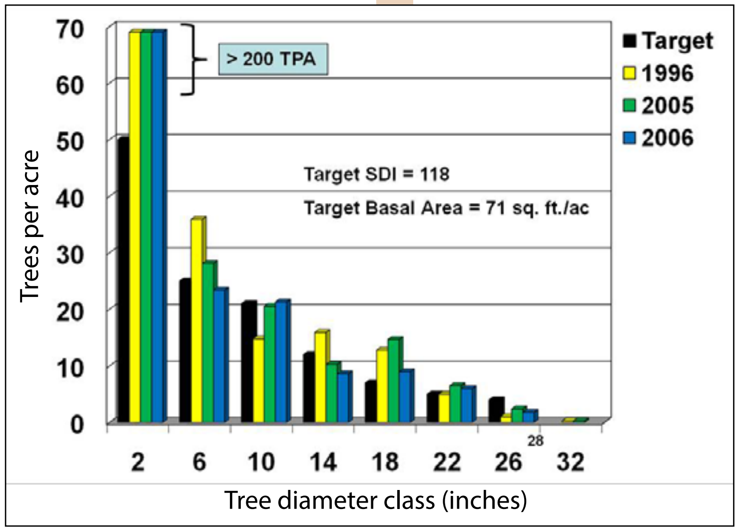
Board foot (bd ft)— A board foot is used to measure or express the amount of wood in a tree. The dimensions of a board foot are 12" x 12" x 1". To determine number of board feet:

Bd ft = [thickness (in) x width (in) x length (ft)] ÷ 12 in

The average delivered log price was $453 per **MBF**. Logging costs were $226 per MBF including cutting, limbing, bucking, skidding, loading, and transportation to the mill. Grass seeding skid trails and slash piling and burning were included in the logging contract as separate itemized costs. Total gross income was $71,000 or $1,400 per acre, and net income was $35,540 or $711 per acre. Because of openings and other areas that did not receive any thinning within the 50-acre stand, the volume removed and values on a per acre basis are somewhat low.

MBF—
Thousand board feet. See "board foot," page 4.

Following the harvest, a contractor precommercially thinned regeneration and small, pole-size thickets across the stand and hand piled the slash at a cost of $100 per acre. In areas where precommercial thinning was light, the trees were just cut and lopped (not piled) and left to decay.



Graph by Stephen Fitzgerald, © Oregon State University

Figure 3. Diameter distribution in 1996, 2005 (before harvest), and 2006 (after harvest) compared to the target or desired stand diameter distribution (black bars). There are more than 200 trees per acre in the 2-inch diameter class.

After harvest, the inventory plots were measured again to determine after-harvest stand structure, which provided three data points for comparison to the target stand structure. The post-2006 harvest stand came very close to our target stand structure (Figure 3; compare blue bars to black bars) except in the regeneration size-class, where we have an overabundance of seedlings and saplings. We have a deficit in the 26-inch DBH class, but that will correct itself over time as excess trees in the 22-inch class grow into the 26-inch diameter class. Although spot pre-commercial thinning was conducted after the 2006 harvest to reduce the number of seedlings and saplings, they are still far above the desired target level. These excess small trees will be thinned between now and the next harvest entry, proposed for 2016 or sooner.

Photo by Paul Oester, © Oregon State University

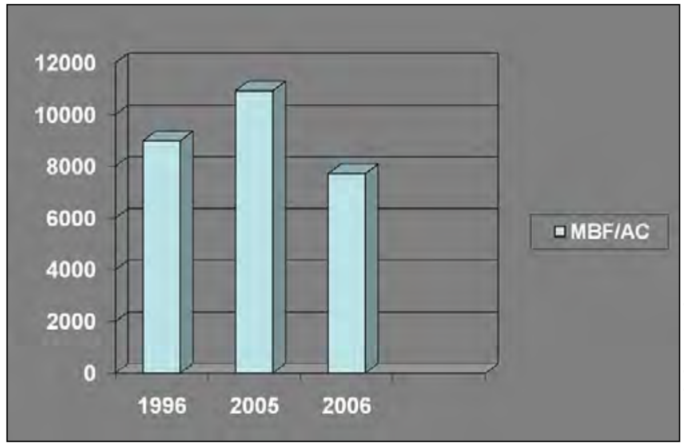
Figure 4. High quality, 12- to 17-inch (small-end diameter) ponderosa pine sawlogs from the 2006 harvest.

What's next? In the fall of 2011, we conducted a 5-year postharvest measurement. If our measurements and analysis of diameter growth in larger trees and height growth in regeneration indicate too much overstory competition, we may initiate another light commercial harvest before 2016, depending on log markets. In addition, pre-commercial thinning will be needed to reduce overabundant regeneration. Our goal for the future is to conduct harvest entries roughly every 10 years to maintain the uneven-aged character. See "Past, Present, and Future Stand Treatments and Events" (page 8) for a synopsis of management activities.

Regeneration: Composition and Growth

For ITS to work in the long run, it's important that regeneration not only establish but grow to replace larger trees as they are harvested over time. Based on the 1996, 2005, and 2006 inventory plot information (see Table 2), we have too many trees in the seedling and small sapling size-class (2-inch size-class and less) which will recruit (grow), if allowed, into a 6-inch size-class. For example, regeneration increased from 380 trees per acre in 1996 to 656 trees per acre in 2005. In 2006 after harvest, trees per acre in the 2-inch and less diameter class decreased to 574, likely due to some logging damage and precommercial thinning. Most of the postharvest (2006) regeneration is ponderosa pine (71 percent) and Douglas-fir (24 percent), and the remainder is a mix of grand fir and a trace amount of western larch.

Based on height growth assessment in 2005 before harvest, seedlings and saplings were slowing down in height growth, indicating that overstory density was too high. The goal of the harvest in 2006 was to reduce stand density to maintain and, possibly, increase the height growth of understory trees to avoid severe height-growth suppression, particularly in the shade-intolerant ponderosa pine. With respect to species composition, the goal of this ITS case study is to maintain approximately 60 percent ponderosa pine, 30 percent Douglas-fir, and 5 percent a combination of grand fir and western larch. Based on the 2006 inventory in Table 2, it appears we are approaching that desired range. To increase the proportion of western larch in the stand, we may need to plant seedlings in created openings in the next harvest entry, since western larch is very shade-intolerant.



Graph by Paul Oester, © Oregon State University

Figure 5. ITS standing board foot volume for 1996, 2005, and 2006 (after harvest).

Photo by Stephen Fitzgerald, © Oregon State University

Figure 6. Logging was confined to pre-designated skid trails to minimize soil and stand damage.

Table 2. Number of seedlings/saplings per acre less than 2" in diameter from 1996, 2005, and 2006.

	1996		2005		2006	
Species	TPA*	Percent	TPA	Percent	TPA	Percent
Ponderosa pine	217	57	435	66	410	71
Douglas-fir	125	33	171	26	135	24
Grand fir	17	4	29	4	25	4
Western larch	21	6	21	3	4	1
Totals	380	100	656	100	574	100

*TPA: trees per acre

Lessons Learned

- This stand achieved the goal of economic viability as well as many other objectives, including visual beauty, diverse wildlife habitat, and a healthy forest and watershed. Many people visit this forest and come away wanting their property to look similar.
- The stand had some uneven-aged characteristics before our 2006 harvest due to past treatments and disturbance and therefore had substantial structural diversity, making the application of ITS much easier than if we had started with an even-aged stand.
- Selecting a logging operator whose operational skill and equipment was compatible with the logging situation and landowner's goals was critical in minimizing damage to larger trees, understory trees, and vegetation.
- Designating skid trails with the operator and requiring that the logger stay on them was important for keeping stand damage low.
- At the time of logging, log prices were relatively high. This made implementation of ITS on this site profitable while still meeting our stand goals.
- A rocked road through the stand allowed us to harvest later into fall and early winter, instead of stopping operations and delaying work until the following summer when soils would be dry and less vulnerable to damage.
- A detailed logging contract helped make the logging process go smoothly, and objectives were met.
- Because the application of ITS is more complicated than even-aged management methods, marking trees prior to harvest was essential to reaching our goals.
- Although we have a stand target and vision of how we want the stand to look, we still have to adjust our tree marking as we move from place to place within the stand; that is, remove overstory trees to release regeneration or remove excess mid-size trees or trees that are diseased or damaged.
- The overabundant regeneration needs to be aggressively managed in future entries to prevent overstocking and to maintain an appropriate level of Douglas-fir and grand fir.
- Possessing accurate inventory plot information (trees per acre by diameter class and species) helped us decide what direction the stand should go. Without accurate information, it can be very hard to determine how many and what size-class of trees should be removed or left.
- Developing a clear vision of what we wanted the stand to look like upon completion helped us meet our visual quality goals.

Photo by Stephen Fitzgerald, © Oregon State University

Figure 7. Snags left for cavity-nesting wildlife.

Photo by Stephen Fitzgerald, © Oregon State University

Figure 8a. ITS stand before harvest.

Photo by Stephen Fitzgerald, © Oregon State University

Figure 8b. ITS stand after harvest. Note that the stand contains a mix of size classes and is slightly more open when compared to Figure 8a.

Literature—

Dyksterhuis, E.L. and C.T. High. 1985. *Soil Survey of Union County Area, Oregon.* USDA Soil Conservation Service. 195 pp.

Past, Present, and Future Stand Treatments and Events

Early 1900s	**The stand was likely clearcut, followed by natural seeding and recruitment of trees.**
1950s	**Some partial cutting**
1980s	**Light thinning on the ridge area in the ITS stand by the Oberteuffers. Some intermittent grazing of horses on property**
1994	**113 acres transferred to the Oregon State University College of Forestry**
1995	**Salvage harvest of wind-thrown trees, including some light salvage in the ITS stand**
1996	**Permanent inventory plots established**
2004	**Roads improved and rocked**
2005	**Measured inventory plots again in the 50-acre ITS stand**
2006	**First commercial harvest, and measured 50-acre stand again**
2006–07	**Precommercial thinning of thickets of saplings and pole-size trees by private contractor**
2008	**Additional spot precommercial thinning on the west end of stand**
2011	**Measured inventory plots again**
2011–13	**Conducted precommercial thinning where necessary**
2016	**Conduct second commercial harvest**
2021	**Measure inventory plots again**
2021–22	**Conduct third commercial harvest. Conduct precommercial thinning, if necessary**

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