A Method for Examining the Impacts of Oregon Land Use Laws on Forest Lands and Farmlands

David L. Azuma[1], Gary Lettman[2], and Erica Hanson[3]

Abstract.—Over the past 8 years, the Pacific Northwest Research Station Forest Inventory and Analysis unit, in conjunction with the Oregon Department of Forestry, Oregon Department of Agriculture, and Oregon Department of Land Conservation and Development, has researched the effect of Oregon's land use laws on the conversion and development of land. The studies have used aerial photography photopoints to classify land use into broad categories and to count the number of structures in an 80-acre circle around the photopoint. Several studies have looked at the probability of management on forest land as a function of increased structures and proximity to more developed zones. A recent State ballot measure has established a system to challenge some of the land use restrictions, and a new study is under way to establish a new baseline for evaluating future development within the State. Using digital imagery, we will be capturing a digital version of the land use polygons, enabling ease of future assessments.

Introduction

Oregon's forest, range, and agricultural lands are extraordinary in their diversity and contribution to the State's economy. Three of the top four industries in the State are timber, agriculture, and tourism. Other industries can tout the quality of life partially based on the forest-farm image to attract the best employees. Maintaining and enhancing the contribution of nonurban areas is essential to the well-being of Oregonians.

In 1973, the Oregon Legislative Assembly passed the Land Conservation and Development Act. The act required counties and cities to prepare comprehensive land use plans in accordance with statewide goals; Goals 3 and 4 sought to preserve forest lands and farmlands. By the 1980s, most of the comprehensive plans were completed. Each of the plans identified lands that were already built on and committed to residential uses. These areas were zoned for continued development, and expansion into other areas was limited.

By 1996, the land use laws had been in effect for 16 years; however, no definitive study existed that showed the impacts of the laws. The Pacific Northwest Research Station Forest Inventory and Analysis (FIA) unit, in conjunction with the Oregon Department of Forestry, Oregon Department of Agriculture, and Oregon Department of Land Conservation and Development, designed a study to investigate the effects of the land use laws on non-Federal lands in western Oregon. In this study, 24,000 photopoints were interpreted from 3 sets of aerial photographs taken in 1974, 1982, and 1994. In 2002, these same locations were interpreted on aerial photographs taken in 2000. The principal finding was a decrease in the rates of conversion between the 1974–82 period and the 1982–94 period and a continued reduced rate of conversion in the 1994–2000 period (Azuma *et al.* 1999. Lettman *et al.* 2002). Together, these studies suggest that most forest land and farmland development over the past few decades has tended to occur near existing urban areas and especially within urban growth boundaries implemented under Oregon's land use laws. Where rural development has occurred, it has been correlated with reductions in private forest management. Although the conversion of land to more urbanized conditions slowed, the average number of developments per point continued to increase through the 2000 period. A similar study was conducted in eastern Oregon (Lettman *et al.* 2004).

[1] Researcher Forester, U.S. Department of Agriculture (USDA) Forest Service, Pacific Northwest Research Station, Forest Inventory and Analysis (FIA) Unit, Portland Forestry Sciences Laboratory, 620 S.W. Main Street, Suite 400, Portland, OR 97205. Phone: 503–808–2047. E-mail: dazuma@fs.fed.us.

[2] Principal Forest Economist, Oregon Department of Forestry, 2600 State Street, Salem, OR 97310. Phone: 541–945–7408. E-mail: GLETTMAN@ODF.STATE.OR.US.

[3] Forestry Technician, USDA Forest Service, Pacific Northwest Research Station, FIA Unit, Portland Forestry Sciences Laboratory, 620 S.W. Main Street, Suite 400, Portland, OR 97205.

The data from these studies was also utilized to investigate other questions. One study looked at the effect of population growth and urban expansion on private forestry practices (Kline *et al.* 2003a). Another study used structure count data to model the spatial distribution of humans in the Oregon Coast Range (Kline *et al.* 2003b). These studies have informed the debate about land use planning in Oregon.

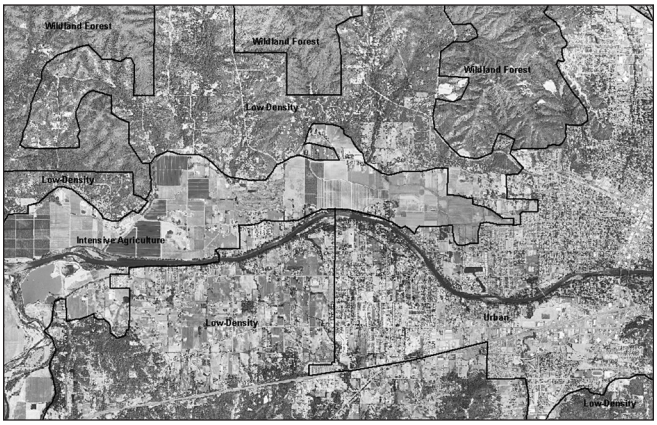
In 2004, Oregon voters passed Ballot Measure 37. The measure provides that a private landowner is entitled to receive just compensation when a land use regulation, implemented after the landowner obtains the property, restricts the use of the property and reduces its fair market value. Alternatively, Measure 37 would allow governments to remove, modify, or not apply the regulation rather than paying compensation. As of December 1, 2006, around 3,600 claims existed of which 2,360 were in the northern Willamette Valley. More than 100,000 acres would be affected by these claims, with the majority of the effect being on farmland. With the prospect of modified land use planning going into effect, we decided to initiate a new study to capture another snapshot of land use in 2005. This article reports on the pilot portion of the new study. New techniques and imagery were used in Josephine County in western Oregon.

Methods

This study uses 2005 National Agriculture Imagery Program (NAIP) imagery (0.5-m resolution) as the base layer for evaluating land use zones. The land use zone polygons from the 2000 National Aerial Photography Program (NAPP) aerial photographs were hand digitized onto the new NAIP imagery, photopoints were located, and zones were labeled (fig. 1). During the transference of 2000 NAPP polygons onto the 2005 NAIP imagery, any changes to the 2000 polygons were made on the 2005 imagery.

The coordinates from the 1990 systematic aerial photography grid (0.85-mi scale) were overlaid onto the NAIP imagery. The coordinates had varying levels of accuracy depending on how they were acquired. As a first check, 30 aerial photo images with a pinprick for a point were compared to the coordinates located on the digital imagery by visual estimate of where

Figure 1.—*Example of land use zone polygons on National Agriculture Imagery Program imagery for Josephine County, OR.*



the pinprick was on the imagery. Most of the coordinates corresponded well, within 30 m; in 3 out of 30 test points, a difference of more than 30 m occurred, with one point being 1,100 m off. Because of the location differences, all points that had large changes in either the number of structures, distance to other zones, or the zone call itself were checked for location correspondence between the digital imagery and the aerial photography. In cases where the point on the imagery differed by more than 30 m, the point was moved to correspond to the pinprick on the aerial photograph.

At each of the 741 locations in Josephine County, three attributes were collected; the land use zone, distance to other zones, and number and location of structures within an 80-acre circle around the point. The land use zones collected included the following:

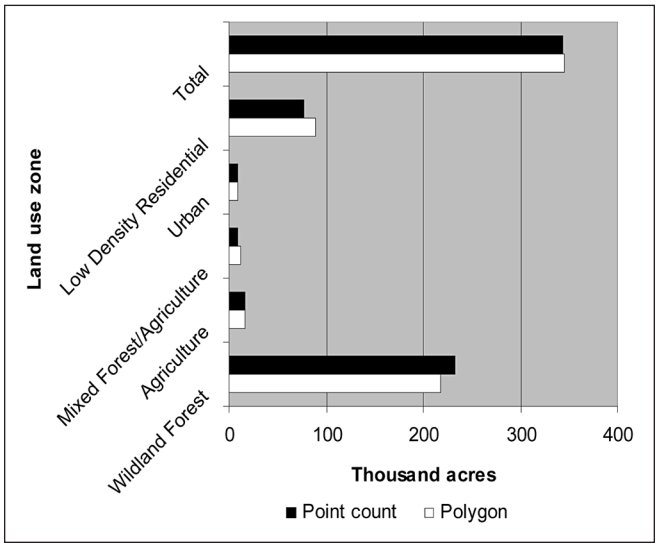
- Wildland forest.
- Intensive agriculture.
- Mixed forest/agriculture.
- Urban.
- Low-density residential/commercial.

(Lettman *et al.* 2002)

A comparison of the area in various land use zones was made between the expanded point estimate and the area from the polygons created on the NAIP imagery.

Structure counts were taken at all nonurban classified points and consisted of a count of structures within an 80-acre template centered over a point. When a structure was identified, the location was recorded. Structure (or "dwelling") counts include individual buildings and/or clusters of buildings, and these buildings may or may not be related to the management of the land they are on. For example, a farmer's house would be included in the count. A cluster of barns, storage sheds, and other associated buildings on rural land would be considered one "structure" for the count. Where four houses might appear clustered, however, such as on the corners of a road intersection, they would be counted as four separate structures because they likely represent four different parcels of ownership, each with a house built on it.

Figure 2.—*Area comparison of expanded photo-interpreted points and Geographic Information System polygons.*



Results

As one might expect, very little change occurred between the 2000 photography and the 2005 imagery. A total of 6 points out of 741 changed land use zones during the period, all due to low density or urban zones expanding on the 2005 imagery. Four other points also changed land use zones, but closer examination showed a difference in how the polygon was interpreted or, in one case, that the point had been moved. The acreages computed by point expansion and summation of polygon area were remarkably close; the totals differed by less than 0.5 of a percentage point (fig. 2).

In about 200 points, the distance to other zones changed between the 2000 and 2005 estimates. A closer look at these differences shows that actual change occurred on only 35 of these points. The rest of the changes were attributed to a slightly different photo scale in the NAPP imagery, 1:43,000 instead of 1:40,000, and to areas where the zones lines were drawn differently even though no actual change occurred.

The structure count data is the most subjective piece of data because it depends on the ability of the photo interpreter to be able to identify the structures. The new Geographic Information System imagery allows a user to "zoom" in for a closer look at what could be a structure. While more than half the points had the same 80-acre count, many had changed, mostly due to an increase in the count by one to four structures but in about one-third of the cases a decrease in count occurred. Some of these differences maybe accounted for by the up-to-30-m difference in the location of the coordinates compared with the pinprick location. It is very unlikely that structures were removed; the count decreases were mostly due to the ability of the interpreter to better distinguish clusters of structures. In areas where structures are more abundant, individuals are more likely to have differing counts.

Discussion

With new ballot measures taking effect in Oregon, it is critical that we track changes in forest, range, and agricultural lands. This study provides an approach that can be easily repeated in the future to detect change. The added location information on the structure count data will provide ease of comparison with future time periods. To evaluate differences in structure counts from past studies, it may be necessary to adopt some threshold for what we will consider to be real change. In areas where structures are more abundant, it may not be feasible to obtain precise comparisons with results from previous studies. In other areas, such as wildland forest, increases of more than two structures may be sufficient to represent real change. Further

investigation as to whether we can stratify the points to obtain the actual change in numbers of structures is needed. This data will also provide distance-specific information for structures when used with FIA's plot data and may provide some assessment of the effects of population density on forest management.

Literature Cited

Azuma, D.L.; Birch, K.R.; DelZotto, P.; Herstrom, A.A.; Lettman, G.J. 1999. Land use change on non-federal land in western Oregon, 1973-1994. Salem, OR: Oregon Department of Forestry. 55 p.

Kline, J.D.; Azuma, D.A.; Alig, R. 2003a. Population growth, urban expansion, and private forestry in western Oregon. Forest Science. 50(1): 33-43.

Kline, J.D.; Azuma, D.A.; Moses, A. 2003b. Modeling the spatially dynamic distribution of humans in the Oregon (USA) coast range. Landscape Ecology. 18: 347-361.

Lettman, G.J.; Azuma, D.L.; Birch, K.R; Herstrom, A.A.; Kline, J.D. 2002. Land use change on non-federal land in western Oregon, 1973-2000. Salem, OR: Oregon Department of Forestry. 48 p.

Lettman, G.J.; Azuma, D.L.; Birch, K.R.; Herstrom, A.A.; Kline, J.D. 2004. Land use change on non-federal land in eastern Oregon, 1975-2001. Salem, OR: Oregon Department of Forestry. 42 p.