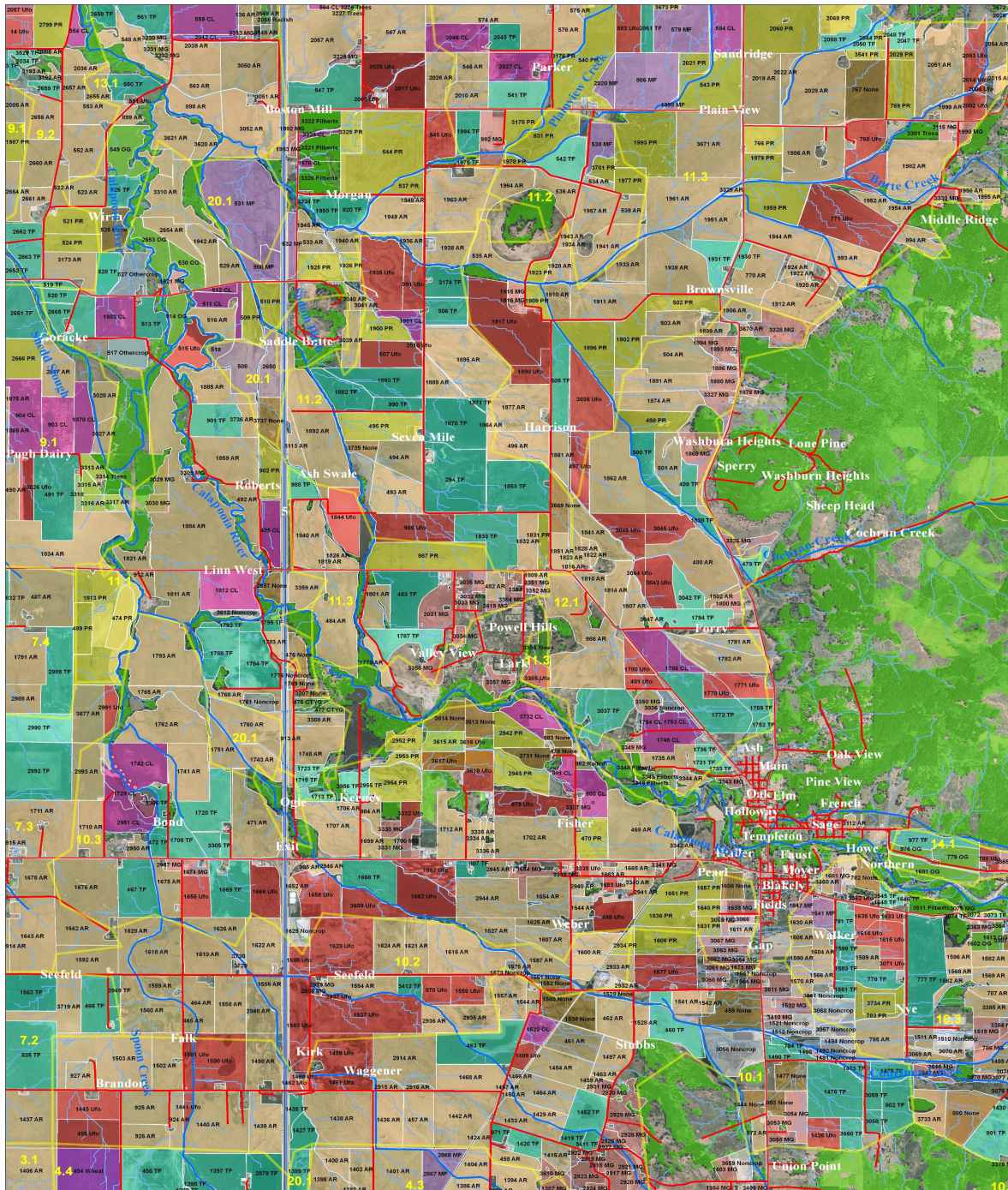


Map 5 of 8 Used in Fall 2007 Ground-truth Drive-by Census.

Fields color-coded by previously grown crop. Fields (white outline) labeled by ID number and 2007 crop. Other map elements include roads (red), streams (blue), travel route sections (yellow), trees (green), and 2006 NAIP orthophoto (background). Maps are used in the drive-by, ground-truth census to locate fields, recognize changes in crop species, and record changes in field boundaries. Actual travel route is captured from field entry order on paper records. For a follow-up, drive-by census in the spring, data sheets with fields arranged in travel route order are printed out with information collected in the fall on crop species, stand establishment status, residue management practice, and other field information.



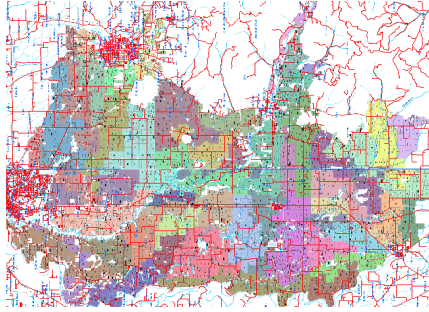
- ### 2007 Crops
- NewLinn06Crops**
- <all other values>
- Crop07**
- Alfalfa hay crop
 - Annual (Italian) ryegrass
 - Apple, cherry, etc.
 - Assorted other crops
 - Assorted shrubs
 - Bentgrass species
 - Bromus species
 - Bush beans
 - Christmas trees
 - Christmas trees middle age bare ground
 - Christmas trees middle age grassy
 - Christmas trees old age
 - Christmas trees young bare ground
 - Christmas trees young grassy
 - Clover
 - Filbert orchard
 - Firs & other evergreen forest
 - Flowers
 - Hybrid or tetraploid ryegrass
 - Meadowfoam
 - Mint
 - Mixed broadleaves
 - Mixed grasses
 - No current crop
 - Non Crop Land
 - Nursery crops
 - Oaks
 - Orchardgrass
 - Peas
 - Perennial ryegrass
 - Radish, Brassica, etc.
 - Raspberry Blackberry Blueberry etc.
 - Row crop not listed
 - Strawberry
 - Sweet corn or field corn
 - Tall fescue
 - Trees
 - Unidentifiable seedling crop
 - Vineyard
 - Wheat, oats, barley (winter or spring)
 - 0 trees within field polygons
 - 1 all other trees

Multi-Year GIS of Western Oregon Cropping Systems

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Ground-truth Census Travel Routes

Map on left shows details of the center section of overall travel route map below.



Abstract.

Knowledge of agronomic practices across the landscape, including crops grown and conservation practices employed, is a critical requirement for success of the Conservation Effects Assessment Program (CEAP). To help achieve the goals of the Calapooia River Sub-Basin competitive grant CEAP project in western Oregon, we are developing a multi-year GIS of cropping system practices in this region, dominated by grass seed production. A drive-by census of current crop production, stand establishment status, and conservation practice employment has been conducted for three consecutive growing seasons on approximately 3,000 fields in the Calapooia Sub-Basin and adjoining areas of Linn County, Oregon. Primary disturbance factors likely affecting water quality and indicator species biology are tillage, non-selective herbicide treatment, and choice of rotational crops or fallow methods between destruction of one grass seed stand and establishment of another. Although perennial grasses are grown on the majority of fields, yearly tillage of many of the fields producing Italian ryegrass seed may represent the most significant source of nitrate nitrogen in the Calapooia Sub-Basin. Classification of Landsat images into categories defined by crop species, stand age/establishment status, and conservation practice from the multi-year GIS is being used to extend our knowledge of cropping system practices across the entire Willamette River Basin. Current classification accuracy within the Calapooia Sub-Basin is approximately 65%, while accuracy is slightly lower in other randomly sampled fields in western Oregon. The greater diversity of crops produced across the entire Willamette Basin compared to the Calapooia Sub-Basin is a major factor limiting classification accuracy in the larger area.

Cropping System Practices

Number of fields by primary crop species, residue management practice, and stand establishment status in 2004-05, 2005-06, and 2006-07 growing seasons.

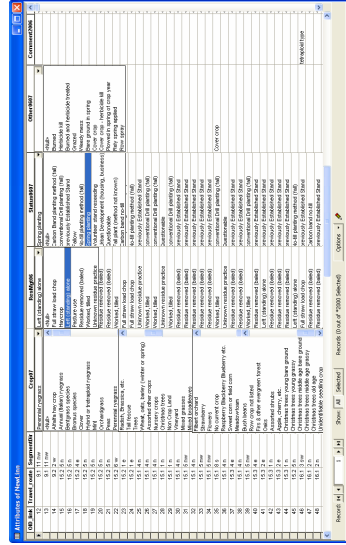
Some differences among years represent greater inclusion of non-grass seed fields in later years. Shift in grass seed production over time from perennial ryegrass to tall fescue has been reported by other sources.

Crop species	2004-05	2005-06	2006-07
Perennial ryegrass	464	429	348
Tall fescue	551	604	698
Orchardgrass	126	119	121
Italian ryegrass	1348	1483	1361
Pasture grass (not for seed)	205	404	419
All others	451	521	720
Residue management			
Full straw load chop	459	392	509
Residue removed	575	879	700
Worked, tilled	1058	1359	1361
All others	995	932	1095
Establishment status			
Previously established	1190	1482	1516
Volunteer stand reseeded	171	457	501
Conventional drill (fall)	252	1072	981
Fallow	164	161	147
All others	1350	393	520

GIS Domain Value Options

GIS attribute table for five columns of 2006-07 growing season data.

The GIS is currently implemented in ArcGIS Desktop 9.2 personal geodatabase format. Crop domain has 39 entry options, post-harvest residue management domain has 7 options, stand establishment status domain has 11 options, and other information domain has 11 options. While not all options within a domain make sense in combination with particular selections from other domains, validity of selections is not currently enforced by the GIS. Field boundaries were derived from FSA CLU polygons, but have been modified on the basis of observations in previous drive-by censuses. In ArcGIS screenshot below, Crop07 refers to crop harvested in summer 2007, ResMgt06 refers to post-harvest residue management practices in summer 2006 (which set the stage for grass seed production in the 2006-07 growing season), Status0607 describes planting method/establishment status for crop harvested in 2007. Other0607 adds further detail for that growing season, and Comments2006 allows free-form entry of additional comments.



Remote Sensing Classification Procedures and Results

Classification category description, field frequency, and correctness of pixel classification for 20 categories of grass seed cropping practices based on six Landsat images in the 2004-05 and five images in the 2005-06 growing seasons.

Overall per pixel classification accuracy and kappa values were 64.92% and 0.5675 in 2004-05 and 63.96% and 0.5367 in 2005-06. Clouds partially obscured two of six images in 2004-05 and two of five images in 2005-06. Supervised training signatures, classification probabilities, and maximum likelihood classifications were developed for each Landsat image in cloud-free areas using all seven bands plus NDVI. Classifications were conducted separately by stripes for image dates with visually obvious striping. Classification probabilities were summed for all fully cloud-free images (4 in 2004-05 and 3 in 2005-06) and for those images plus the cloud-free areas of one or both of the partially clouded images. Single image classification probabilities were generated using the "SAMPLE: A priori probability weighting option" in the Class Probability Tool in the Multivariate Toolset of ArcGIS. Simply adding the sample-weighted probabilities together tended to over-represent the most common classification categories, and both classification accuracy and kappa improved when a Python optimizing script was run. The Python script called the ArcGIS geoprocessor in a series of runs optimizing weights applied to the multi-image summed probability rasters, adjusting category weights up or down based on whether individual categories had been under- or over-represented in the previous run. Requests for Python script should be sent to George.Mueller-Warrant@ARS.USDA.GOV. Converting from per pixel to per field classification improved overall accuracy in the second year but not the first. Creating new, cleaner training samples from only those fields correctly classified on a per polygon basis in both years slightly increased accuracy within those training fields, but slightly decreased accuracy over the entire area covered by the GIS. Many of the misclassifications involved permutations among categories 1 and 15-18 (bare/disturbed ground in late summer), and when they are merged into a single group the overall accuracy increased by approximately 5%. The GIS has been used to select sub-basins for intensive sampling of water quality and diversity and abundance of fish, amphibians, birds, and invertebrates based on variation in late summer bare/disturbed ground, which ranged from less than 20 to over 70% of total agricultural field area within sub-basins. Preliminary analyses of wildlife diversity and abundance were dominated by the impact of free cover on birds and distance to perennial water on fish, and those factors will have to be carefully accounted for in measuring impacts of agricultural practices.

No.	Category description	Number of fields by harvest year					Number of correctly classified pixels	Incorrectly classified into category
		2004-05	2005-06	2004-05	2005-06	2004-05		
1	Bare/disturbed ground - other crops (not 15-18)	163	192	10547	17640	12951	16794	
2	Full straw load chop Italian ryegrass	166	205	17277	17011	20204	22589	
3	Spring plant	47	58	4340	396	5154	358	
4	Established perennial ryegrass	286	329	53154	62067	25915	42527	
5	Established orchardgrass	120	113	8797	2276	5337	360	
6	Established tall fescue	464	503	66496	88776	28452	37752	
7	Pasture grass	179	358	9916	19780	9474	17458	
8	Established clover	37	54	4176	8113	3315	4953	
9	Established mint	15	7	2344	1661	940	804	
10	Hay crop	19	35	199	21	299	111	
11	Other Italian ryegrass (not 1 or 15)	273	141	708	589	4178	1267	
12	Perennial ryegrass - other fall plant (not 16)	34	1	281	275	2062	119	
13	Noncrop	26	51	830	1689	2531	4416	
14	Poplar trees	8	9	443	828	316	930	
15	Bare/disturbed - Italian ryegrass	914	1136	168513	214615	54280	96750	
16	Bare/disturbed - new perennial ryegrass	129	86	12196	196	15870	174	
17	Bare/disturbed - new tall fescue	35	41	851	149	740	401	
18	Bare/disturbed - new clover	29	64	2309	2558	2096	1809	
19	All wheat	88	25	3154	433	3715	497	
20	All meadowfoam	10	44	1007	6492	751	943	
Total all 20 cases		3042	3452	367538	445555	198580	251012	
Other cases not included in the 20 categories		103	113					