Appendix 11. Identifying Trends in Agriculture Conversion in Oregon

DRAFT REPORT

Prepared for the Oregon Sage-Grouse Action Plan

Identifying Trends in Agriculture Conversion in Oregon

Introduction

Background

The Greater sage-grouse (*Centrocercus urophasianus*) inhabits rangelands throughout the western United States. Populations have been declining throughout the west due to habitat loss, predation, and other factors. In 2010, the US Fish and Wildlife Service decided to include the Greater sage-grouse (*Centrocercus urophasianus*) as a candidate for listing under the federal Endangered Species Act.

The State of Oregon is collaborating with federal agencies, non-profit organizations, private agricultural landowners, and other stakeholders in an effort called SageCon to develop an All-Lands, All-Threats Action Plan to help address contributors to sage grouse declines, recover sage-grouse populations, and avoid the need for a listing. The All-Lands, All Threats Action Plan will be submitted to the USFWS for consideration in 2014. A final decision for placing the species under the Act's protection will take place in September 2015.

Conversion of privately owned rangeland to more intensive agricultural use, such as dryland wheat or irrigated crops, has been identified as a threat to the sage grouse in the western US. Anecdotal information provided by staff from the USDA-Natural Resources Conservation Service (NRCS), Oregon Water Resources Department (OWRD), and Oregon Department of Agriculture (ODA), suggested that:

- There was a low risk of rangeland conversion to dryland wheat throughout the sage grouse's range in Oregon.
- There was a low risk of rangeland conversion to irrigated crops in much of the sage grouse's range in Oregon because no new surface water rights were available and there were little to no groundwater resources in these areas.
- There is a greater risk of rangeland conversion to irrigated crops in a portion of southeast Oregon because groundwater rights are available and may be successfully developed to support irrigated crops.

However, it was unknown whether, and at what rate, this type of conversion was occurring on rangelands in Oregon.

Purpose

The purpose of this analysis was to assess and quantify sage-grouse habitat conversion to agriculture use on public and private lands in the range of Greater sage-grouse (*Centrocercus urophasianus*) in Oregon.

The goals of the project were to:
1. Identify trends in sage grouse habitat conversion to agricultural cropland.
2. Examine the rate of conversion of sage grouse habitat from rangeland to agricultural cropland where water rights were issued.
3. Produce a concise report summarizing the analysis and results.

Methods

Analysis area

The area for analysis included public and private land throughout the SageCon project area. This includes public and private agricultural land throughout central and eastern Oregon identified as sage grouse habitat.

Project area map (placeholder)

Description of data and methods used

We hypothesized that the main type of agricultural land conversion in sage grouse habitat in Oregon would be irrigated cropland. Therefore, we initially thought that an appropriate method to assess rangeland-to-cropland conversion rates would be to examine surface and groundwater rights issued within the SageCon area between 2002 and 2012 and look at the acreages of rangeland converted to irrigated land during the same time frame.

To accomplish this, we downloaded the Oregon Water Resources Department Water Rights database (OWRD, 2013). OWRD has been mapping water rights in a geographic information system (GIS) since 1990. The first pass through at compiling the water rights layers for the state was completed in 1999. OWRD maps all new permits and certificates as they are issued statewide. Any spare time is devoted to cleaning up older rights.

This database includes Place of Use (POU) data as well as Point of Diversion (POD) data. Place of Use refers to the location where the water is beneficially used. For example, a 50-acre field may be the Place of Use where irrigation water can be beneficially applied according to the irrigator's water right. There may be more than one Place of Use attached to a single water right.

Point of Diversion is the point at which the water for the right is being appropriated from the source for beneficial use. For example, an irrigator may have a specified location where he or she may withdraw water from a river, stream, well, or pond. There may be more than one Point of Diversion attached to a single water right.

We interviewed Bob Harmon, GIS Coordinator at Oregon Water Resources Department, to understand several key characteristics about the data. Bob Harmon provided the following information.

- Water rights go with the POD because the POU can change.
- In a water right, there can be many PODs connected to one POU or vice versa; for example in different years, a POD could be taken from a stream, well, or pond and could be used at different locations.
- If there were multiple uses listed in the POU use_code_description, this means there is more than 1 POD for this POU.
- Irrigation District water rights are not mapped. Irrigation District water rights information is available in tabular form on OWRD's home page.
- OWRD does not have location information from the original water rights certificate for some POU. These POU's are mapped in GIS by a less than 1 acre polygon in the center of a quarter-quarter section to show there is a POU somewhere in this quarter-quarter section. A quarter-quarter section is a 40-acre portion of a 640-acre section under the Public Land Survey System.(this is one of the limitations of the WRD data; that we would see fields that were clearly irrigated not overlain by water rights and this is one possible reason why)
- Water rights issued on public lands are not included in the OWRD database.

We clipped the OWRD Place of Use (POU) and the Point of Diversion (POD) data layer to the Sage Grouse boundary that had been buffered 10 miles. We used this 10-mile buffer to ensure inclusion in the analysis of POUs and PODs that might be on the boundary of the Sage Grouse habitat.

We then created a relationship between POD and POU over the five-year periods of interest (2002-2007, 2008-2012). This ensures that all of the PODs and POUs that were associated with the same water right would be displayed for that five-year period. She selected the time period from the POD, then related it to the POU on snp_id.

We used the POU and POD data to classify agricultural land within the SageCon area. Because some of the POU data only show that there is a POU somewhere in a given section, Diana Walker and Theresa Burcsu decided to classify land as irrigated based on the presence of a POU in that section. If a section had a POU, then all of the agricultural land in that section was considered irrigated.

We looked at the types of uses in the use_code_description attribute field in the POU data. These uses can include agriculture, municipal, From these we further grouped these to “Agriculture” or “Not Ag”. See the WRD_POU_UseCode_Freq table in the filegeodatabase called DataLib.gdb.

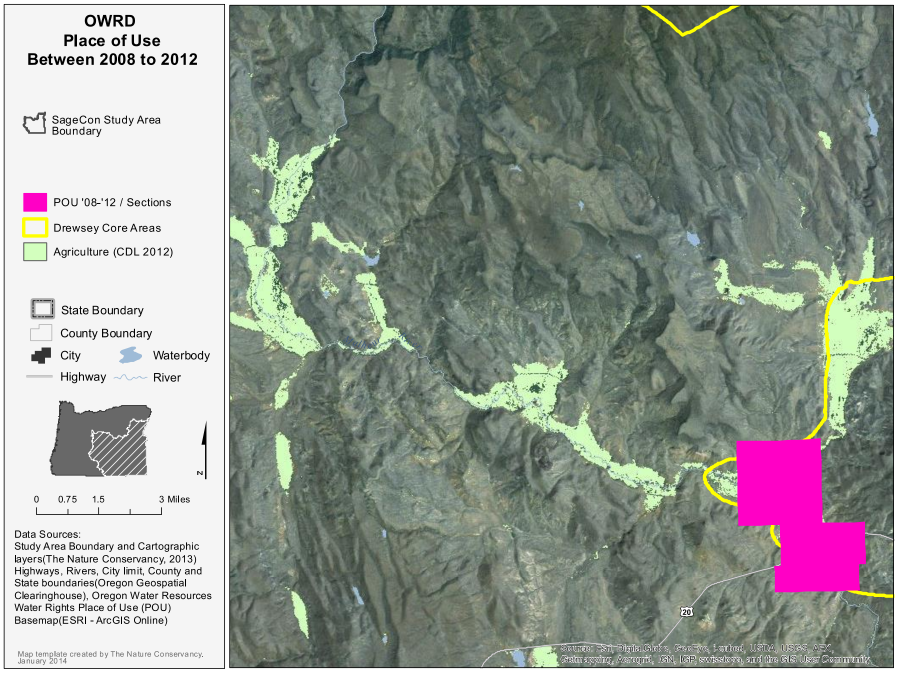
A visual comparison of the sections that were classified “Agriculture” using the POU presence/absence method, with areas that clearly appeared to be in agriculture use in the ESRI World Imagery, showed that the POU presence/absence method missed a lot of land that is being used to grow various crops. In some cases, land not overlain with POU points included fields that appeared to be irrigated with center-pivot sprinklers; in other cases, these lands appeared to be riparian pasture or hayland (Figure 1).

There are several potential reasons that land classified as “Agriculture” using the POU presence/absence method missed land that appeared to be in agricultural use. These include: some riparian pastures and haylands may be naturally wet and do not need supplemental irrigation; some agriculture land is within irrigation districts, and those water rights are not displayed in the POU database; some of the POU data only show that there is a POU somewhere in a given section or quarter-quarter section and does not show where it is actually applied, and because OWRD does not have location information from the original water rights certificate for some POU. In addition, some non-irrigated cropland was observed that would not be reflected in the POU data.

Another challenge was that dates of issuance are not attached to all water rights in the database, so it is difficult to compare land use conversion with water rights that have been recently issued on lands within the SageCon area.

Another challenge was that it is not possible to simply examine the acreages appurtenant to new water rights issued between 2002-2012. This is because the acreages documented in the permit may not be fully developed or may not accurately represent the actual water applied and location.

Figure 1. Close-up example of agricultural land that was not accounted for using the POU presence/absence method.



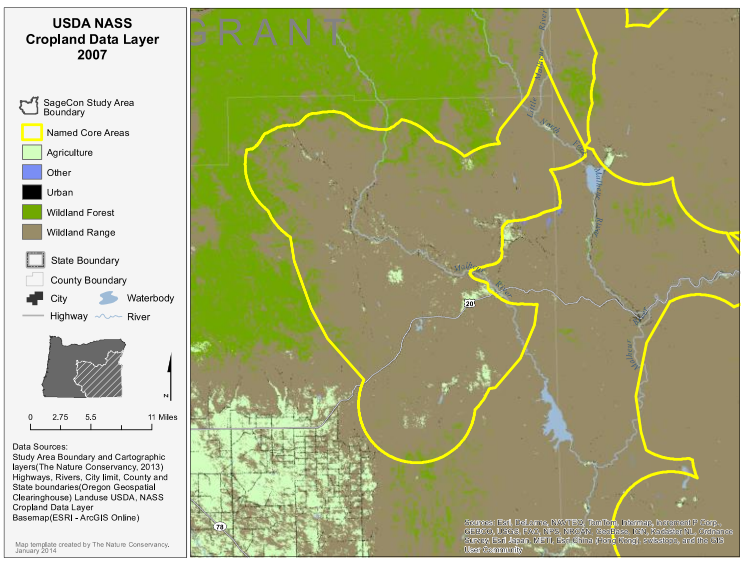
We then decided to try using the USDA, National Agricultural Statistics Service Oregon Cropland Data Layer (CDL) as an alternative method to more accurately identify and classify agricultural land. The Cropland Data Layer (CDL) is a raster, geo-referenced, crop-specific land cover data layer created annually for the continental United States using moderate resolution satellite imagery and extensive agricultural ground truth. It began as a pilot project in 1997 and was first expanded to Oregon in 2007. 2008 was the first year the CDL was created for the entire continental US.

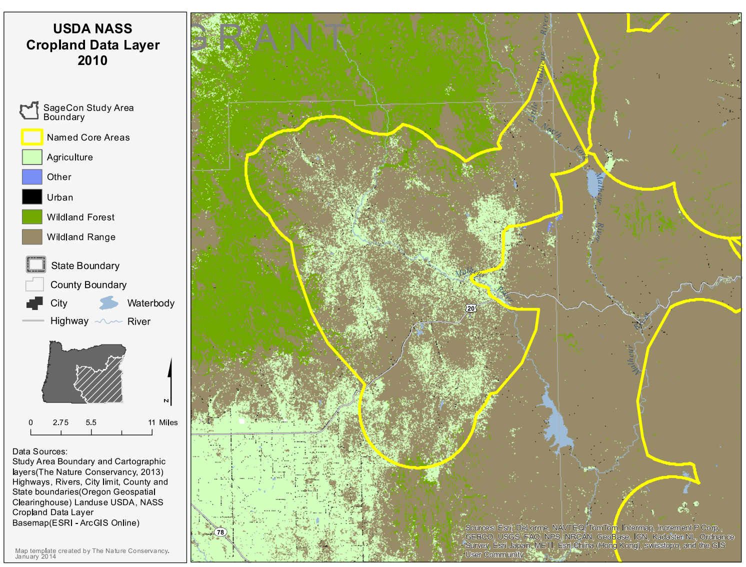
The purpose of the Cropland Data Layer Program is to use satellite imagery to provide acreage estimates to the Agricultural Statistics Board for the state's major commodities and to produce digital, crop-specific, categorized geo-referenced output products.
The years that are available for Oregon from this site are 2007 to 2012.
This data was downloaded from http://nassgeodata.gmu.edu/CropScape/

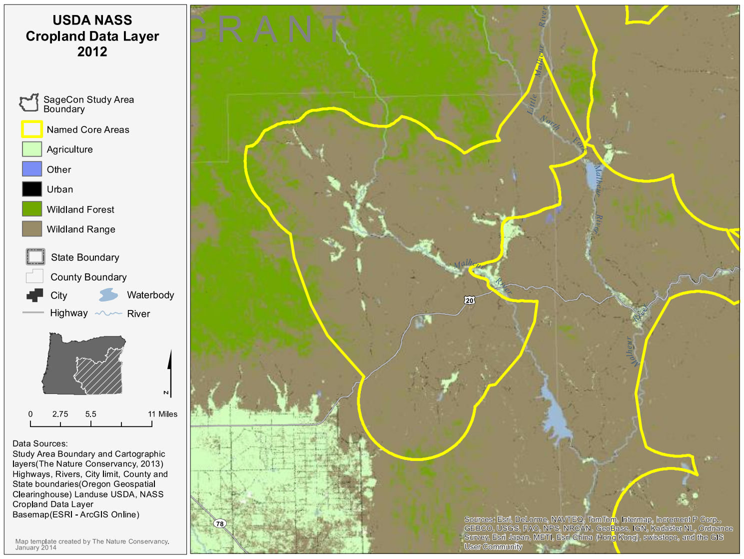
The CDL was clipped down to the SageCon Boundary. The various crops were grouped to the following categories: Agriculture, Other, Urban, Wildland Forest, Wildland Range. Appendix A includes a list of all of the specific land use types that were included in the Agriculture category. These groups are the same groups that the Oregon Department of Forestry used in a GIS land use change analysis called the Forest, Farm and People Analysis. To see how the groups were made, see the document called CDLcategories.xls. There are saved selection expressions in the folder called SelectionExpressions to help do the selections.

Then, the acreages of land classified as "Agriculture" in the SageCon area using the CDL were compared for 2007, 2010, and 2012. This was initially done through visual inspection for the entire SageCon area, to get a general sense of the amount of change that occurred over the 2007-2012 time period and to help verify the results of the quantitative analysis described below. Figures 2, 3, and 4 show examples of an area that was visually inspected for 2007, 2010, and 2012.

Figures 2, 3, and 4. Examples of the same area displayed in 2007, 2010, and 2012 as viewed by the CDL.

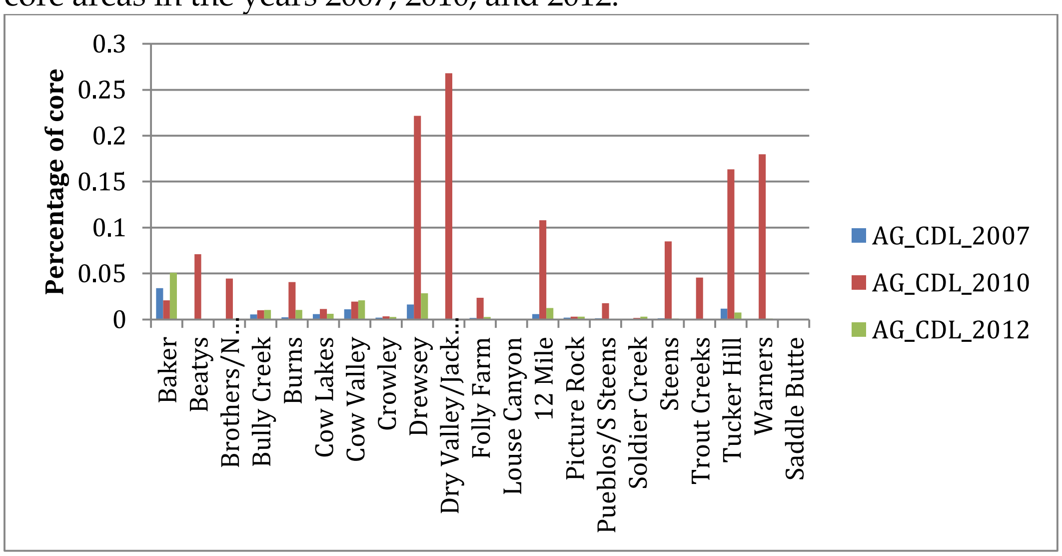






We then used Python scripts to separate out the amount of agricultural land by sage grouse core area for 2007, 2010, and 2012. A graph of the resulting data is shown in Table 1. As the table and figures 2-4 show, the CDL appeared to show much more agricultural land in 2010 than in either 2007 or 2012. This raised concerns about the accuracy of the CDL as a tool for analyzing changes at the core area scale.

Table 1. Graph of CDL data showing the amount of agriculture land in sage grouse core areas in the years 2007, 2010, and 2012.



This layer appeared to be a promising way to analyze changes in agricultural land, but when we attempted to analyze changes in agricultural land at the sage grouse core area level, there were large changes in agricultural land between 2007, 2010 and 2012 that are not supported by other sources of information or staff anecdotal knowledge. We determined after exploring this option that it would not answer our question regarding rangeland conversion to more intensive agricultural uses.

We also evaluated data layers created by ODF land use classifications as part of its Forest, Farm, and People Analysis. As part of this analysis, ODF studied changes in land use in Oregon over time. The land use classification layers created as part of that analysis were reviewed for possible use in the sage grouse habitat conversion mapping project. However, we were able to observe changes in the USDA-NASS Cropland Data layer over time that were not visible in the ODF land use classification layers.

Finally, we evaluated USDA National Agricultural Statistics Service Census of Agriculture Data. USDA-NASS conducts a census of agriculture every five years and publishes a variety of data at the county level, including acres of land in farms, acres of irrigated land, acres of non-irrigated land, and acreages of a variety of specific crop types.

Results

The Census of Agriculture data appeared more accurate, and appropriate for use at the county scale. First, we looked at the totals of cropland, irrigated land, and pastureland in each county for the Census years from 1982-2012 (7 Censuses altogether). Figures 5 through 7 show cropland, irrigated land, and pastureland acreage over time.

Figure 5. Total cropland acreage for counties in sage grouse range from 1982-2012 Census of Agriculture data.

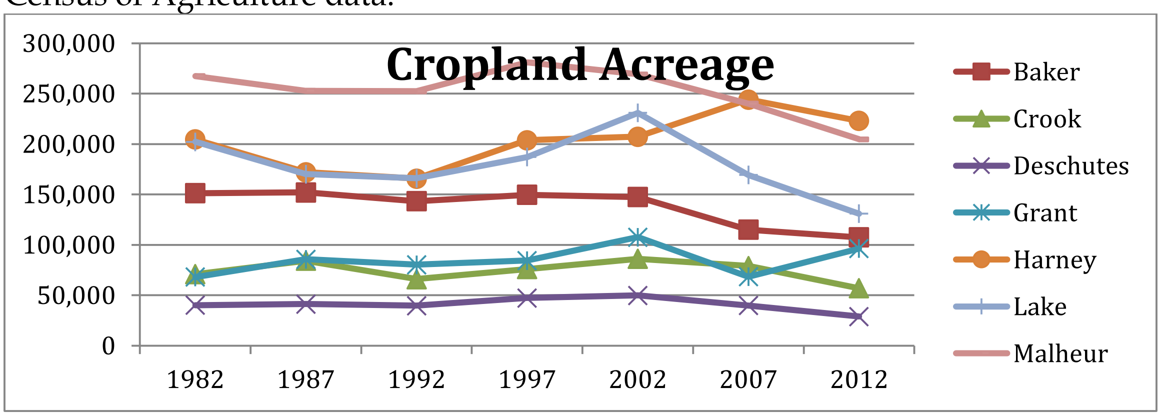


Figure 6. Total irrigated land acreage for counties in sage grouse range from 1982-2012 Census of Agriculture data.

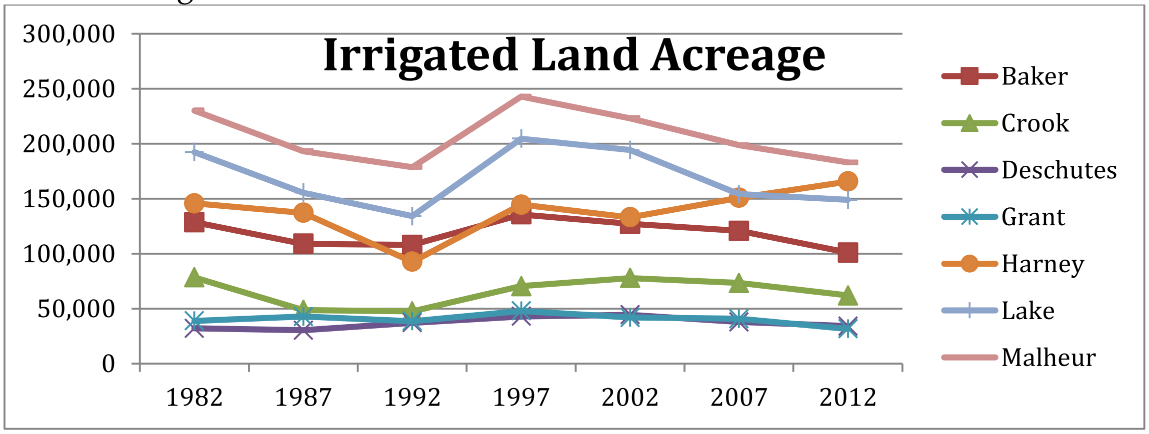
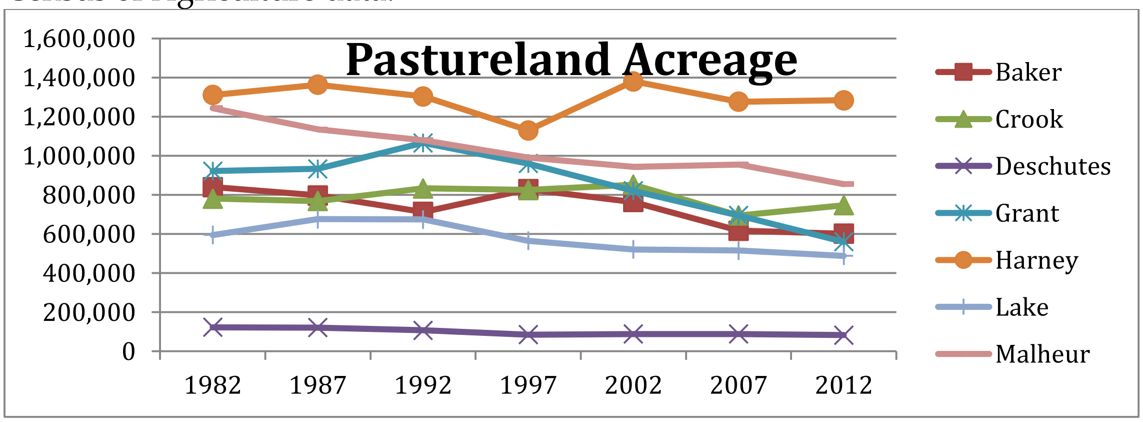


Figure 7. Total pastureland acreage for counties in sage grouse range from 1982-2012 Census of Agriculture data.



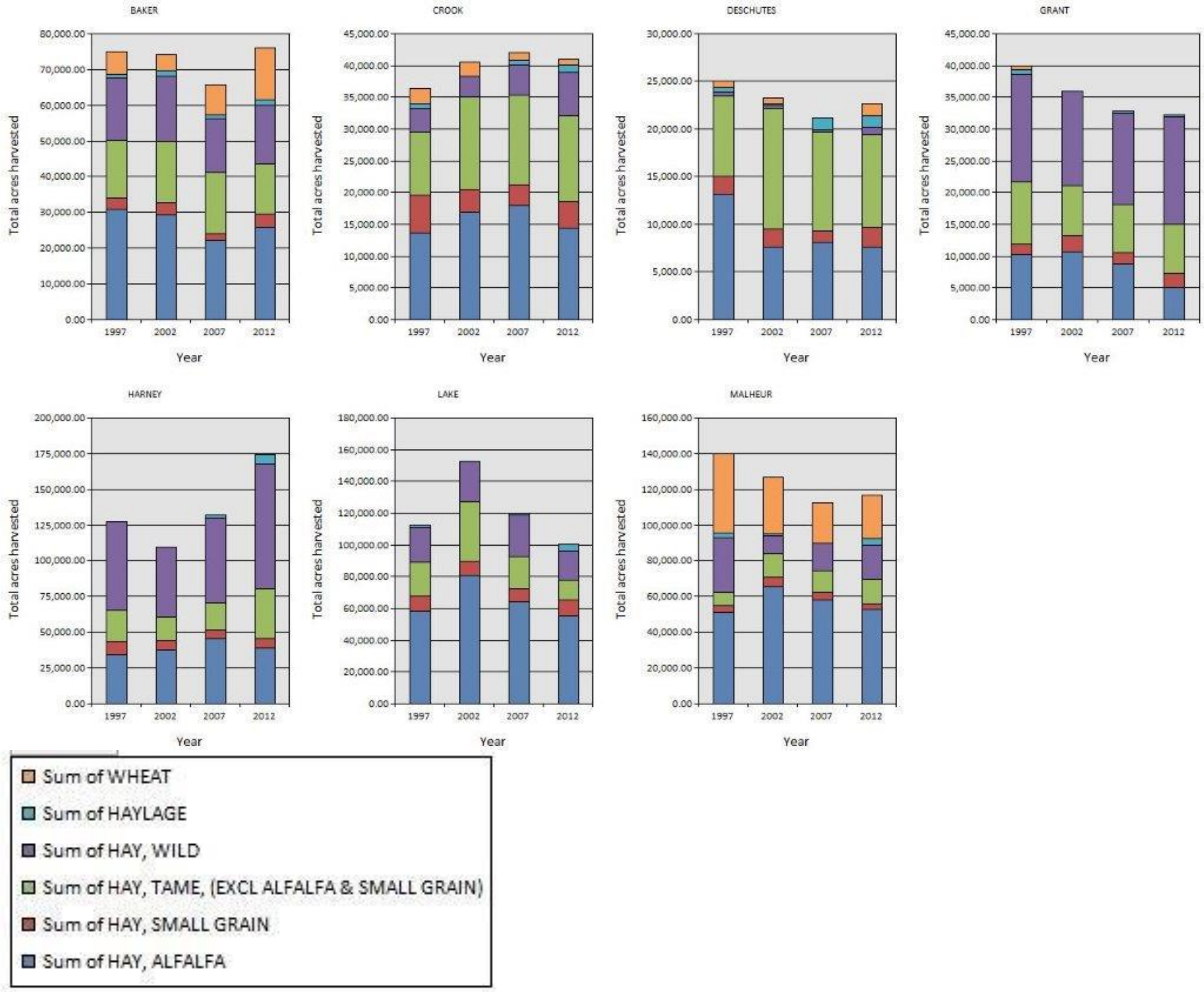
In Harney County between 1982 and 2012, both cropland and irrigated land acreage increased by roughly 20,000 acres. Pastureland acreage in Harney County declined over the same time period by roughly 27,000 acres.

Cropland acreage in Grant County increased by 28,322 acres from the 1982 to 2012 census, while both irrigated land acreage and pastureland acreage declined. Deschutes County had a slight increase in irrigated land acreage over the same time period, while cropland and pastureland acreage both declined significantly.

Significant decreases in cropland, irrigated land, and pastureland acreages were reported over the 1982-2012 time period in Baker, Crook, Lake, and Malheur Counties.

For each county within the sage grouse range, we also graphed the acreages of the dominant crops – wheat, hay grown for haylage, wild hay, tame hay, small grain hay, and alfalfa hay – for the census years 1997, 2002, 2007, and 2012. Results are shown in Figures 8 through 14.

Figures 8 through 14. Graphs of crop acreages in Baker, Crook, Deschutes, Grant, Harney, Lake, and Malheur Counties for the census years 1997, 2002, 2007, and 2012.



Discussion

Question for reviewers: what do you make of the trends in the Census of Ag graphs? Can we translate any of the results into a level of threat of habitat conversion??

Potential areas for further work

POU where land is not being irrigated

The OWRD POU database shows some water rights that have been issued, but that have not resulted in a conversion of rangeland to irrigated cropland. There are several potential reasons for this. Many of these types of water rights are observed in areas where only groundwater rights, and no surface rights, are available. It is possible that the landowner attempted to drill a well and was unable to locate water to irrigate the property. It is also possible that the landowner has not attempted to develop the water right. For water rights that have been issued but are obviously not being used, it is very difficult to know how many of these will result in future conversions of rangeland to cropland.

Conclusions

Recommendations for improving the analysis

Due to time constraints, this analysis looked at change over time in all types of agricultural land across the entire SageCon area. It would be beneficial for future analyses to separate dryland crops from irrigated crops, to verify the general consensus that conversion of rangeland to irrigated cropland is a greater threat to sage grouse than conversion of rangeland to dryland crops. In addition, it would be beneficial to look at changes in agricultural land over time in each of the sage grouse core habitat areas.

Limitations of the analysis

While the analysis shows the amount of conversion of rangeland to agricultural land between 2007-2012, it is difficult to predict the amount of land that will be converted in the future. Many factors will influence the rate of conversion, including availability of surface and groundwater rights, landowners' success or failure to develop wells at groundwater right locations, and prices and demand for crops that can be grown within the SageCon area.

The data available for examining trends in agriculture and their relationship to sage-grouse habitat presented a number of challenges. Water rights, while mapped, are mapped for different purposes and were not conducive to spatial threat analyses in which the desired product is the amount and location of overlap between water rights features, agriculture development, and sage-grouse habitat. Likewise, efforts to spatially map agriculture, such as the CDL, while robust for capturing broader spatial patterns and trends, are sensitive to annual variation in agriculture practices in response to local markets, conditions, weather patterns, economic patterns, etc. Finally, Census of Agriculture Data showed promise for illuminating trends, but was not spatial.

Application of the analysis

This analysis informed stakeholder discussion about the threat of agriculture to sage-grouse by providing a wide array of information about the recent history of agriculture in Oregon. By providing stakeholders with analyses about the types of agriculture data that are commonly available, they were able to decide that they wanted to examine more complex products. Issues and concerns expressed with the data analyzed included:

- were too broad in scale or scope (the finest resolution data was the Census of Agriculture Data)
- were difficult to interpret due to year-to-year variation
- concerns were voiced by stakeholders about the reliability of the responses received by the NASS.

Further analyses might help to align the data sets used and paint a more complete picture of the agriculture landscape, but were not implemented due to lack of stakeholder support.

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Appendix A. Cropland data layer categories that were classified as "Agriculture" for the purposes of the analyses described in this report.

VALUE	CLASS_NAME	VALUE	CLASS_NAME
0	Background	49	Onions
1	Corn	50	Cucumbers
2	Cotton	51	Chick Peas
3	Rice	52	Lentils
4	Sorghum	53	Peas
5	Soybeans	54	Tomatoes
6	Sunflower	55	Caneberries
10	Peanuts	56	Hops
11	Tobacco	57	Herbs
12	Sweet Corn	58	Clover/Wildflowers
13	Pop or Orn Corn	59	Sod/Grass Seed
14	Mint	60	Switchgrass
21	Barley	61	Fallow/Idle Cropland
22	Durum Wheat	62	Pasture/Grass
23	Spring Wheat	63	Forest
24	Winter Wheat	64	Shrubland
25	Other Small Grains	65	Barren
26	Dbl Crop WinWht/Soybeans	66	Cherries
27	Rye	67	Peaches
28	Oats	68	Apples
29	Millet	69	Grapes
30	Speltz	70	Christmas Trees
31	Canola	71	Other Tree Crops
32	Flaxseed	72	Citrus
33	Safflower	74	Pecans
34	Rape Seed	75	Almonds
35	Mustard	76	Walnuts
36	Alfalfa	77	Pears
37	Other Hay/Non Alfalfa	81	Clouds/No Data
38	Camelina	82	Developed
39	Buckwheat	83	Water
41	Sugarbeets	87	Wetlands
42	Dry Beans	88	Nonag/Undefined
43	Potatoes	92	Aquaculture
44	Other Crops	111	Open Water
45	Sugarcane	112	Perennial Ice/Snow
46	Sweet Potatoes	121	Developed/Open Space
47	Misc Vegs & Fruits	122	Developed/Low Intensity
48	Watermelons	123	Developed/Med Intensity

VALUE	CLASS_NAME	VALUE	CLASS_NAME
124	Developed/High Intensity	236	Dbl Crop WinWht/Sorghum
129		237	Dbl Crop Barley/Corn
130		238	Dbl Crop WinWht/Cotton
131	Barren	239	Dbl Crop Soybeans/Cotton
141	Deciduous Forest	240	Dbl Crop Soybeans/Oats
142	Evergreen Forest	241	Dbl Crop Corn/Soybeans
143	Mixed Forest	242	Blueberries
152	Shrubland	243	Cabbage
171	Grassland Herbaceous	244	Cauliflower
181	Pasture/Hay	245	Celery
190	Woody Wetlands	246	Radishes
195	Herbaceous Wetlands	247	Turnips
204	Pistachios	248	Eggplants
205	Triticale	249	Gourds
206	Carrots	250	Cranberries
207	Asparagus	254	Dbl Crop Barley/Soybeans
208	Garlic		
209	Cantaloupes		
210	Prunes		
211	Olives		
212	Oranges		
213	Honeydew Melons		
214	Broccoli		
216	Peppers		
217	Pomegranates		
218	Nectarines		
219	Greens		
220	Plums		
221	Strawberries		
222	Squash		
223	Apricots		
224	Vetch		
225	Dbl Crop WinWht/Corn		
226	Dbl Crop Oats/Corn		
227	Lettuce		
229	Pumpkins		
230	Dbl Crop Lettuce/Durum Wht		
231	Dbl Crop Lettuce/Cantaloupe		
232	Dbl Crop Lettuce/Cotton		
233	Dbl Crop Lettuce/Barley		
234	Dbl Crop Durum Wht/Sorghum		
235	Dbl Crop Barley/Sorghum		