The Map of Annual Grasses in the Owyhee Uplands – Overview

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The Product:

This project maps a quantitative index for annual grasses based on percent ground cover, across the Owyhee Uplands plus a surrounding 25 km buffer zone. Most annual grasses in the region are invasive exotic species, with cheatgrass and medusahead (*Bromus tectorum* and *Taeniatherum caput-medusae*) accounting for the majority.

The general pattern of little or no annual grasses in most of the southern and eastern Owyhee Uplands, contrasting with frequent heavy production of annual grasses to the north and west is mapped appropriately. Within the southern and eastern portions (plateau cut with canyons) annual grasses are mapped primarily along canyon slopes; field experience suggests that this general pattern is true but that annual grasses are actually somewhat more extensive on canyon slopes than is mapped. Within the northern and western areas, two locations of particularly heavy production are mapped, one to the south of Rome, Oregon, and one to the north. Additionally, invasion fronts appear to be rising into the Uplands from the Snake River Plains along the northeastern side, and along the southwestern side from the Lahontan Trough.

The annual grass index map covers the 10.2 million acres of the Owyhee Uplands, or 18.4 million acres when including the buffer. Of the Uplands specifically, 48 percent of the area is detected as having some degree of invasion and 24 percent is detected as being heavily invaded (index value greater than 10).

Methods:

Strategy. To map this vast area quickly and efficiently, the map was built by detecting the early seasonality of annual grasses with satellite imagery, and calibrating with field samples. These grasses generally green up in spring earlier than native perennial species. They also dry out in late-spring to early-summer, before most native perennial plants. Thus they increase the greenness of the land as seen in early season satellite imagery and decrease the greenness in late season satellite imagery. Reductions in greenness seen in the imagery as the season progresses relates to the quantity of annual grasses present. Thus for a site where greenness reduces dramatically, annual grass cover is likely high. Conversely, where greenness does not reduce over the season, little or no annual grasses are to be expected.

Field Sampling. We sampled 412 field plots during the spring and summer of 2006. Sampling was broadly distributed across the mapping area and all sampling was performed on public land. Sampling plots were circular areas of 0.1 ha (about a quarter acre). The ground-cover percentage for annual grasses was estimated across the entire plot, along with numerous other data variables. Percent ground cover includes bare ground so annual grasses are measured as a proportion of the total area, not just a proportion of the vegetation.

Map Building. Statistical models were formulated for annual grasses, then applied to satellite imagery and a climate map. To analyze greenness in satellite imagery, the Normalized Difference Vegetation Index (NDVI) was calculated for the images. Chlorophyll in green leaves strongly reflects near-infrared. So rather than using the green part of the spectrum, NDVI uses the near-infrared, as a ratio to the red part of the spectrum.

The model also used the brightness of the land in the blue portion of the spectrum, and one climatic factor, average minimum temperature. Minimum temperature may serve to limit the distribution of annual grasses, though a correlative study like this cannot pin-point it as a definite cause.

Assumptions and Limitations:

Obviously, no map can cover a vast area at high resolution for low cost and be perfectly accurate. When using this map to guide land management, no decisions should be finalized without verifying the situation on the ground. The following is a list of significant assumptions and limitations with regards to land management.

- The leveraging of annual grass seasonality to build the map makes an assumption that the seasonality of plants is uniform across the region and that annual grasses are clearly distinct from all other plants. While there is reasonable truth to a general pattern following that assumption, there are many exceptions. These exceptions appear to have been of little detriment to the map. However, users should be aware:
    - The native Sandberg bluegrass (*Poa secunda*) can have an early seasonality and be mistaken for annual grasses. Judging from field experience with this project, early drying of Sandberg bluegrass was not a significant mapping problem over most of the Owyhee Uplands except in the area to the south of Big Grassy Mountain in Oregon. In previous maps for Nevada, an exotic forb, clasping peppergrass (*Lepidium perfoliatum*), has caused similar false detections of annual grasses.
    - Satellite imagery dates were targeted for the Owyhee Uplands, not the Snake River Plains or other low-elevation areas in the mapped buffer zone. Thus the seasonality may be inappropriately measured in some of the buffer, with uncertain results for annual grass estimates.
    - Cultivated areas have not been masked from the map. Where cultivation was active at the time of the early season satellite imagery, but less active in the late season, the cultivars may be mapped as annual grasses.
- Pixel size of the GIS data is 28.5 m X 28.5 m (roughly appropriate for a 1:100,000 scale map). Although values for individual pixels are not always accurate (below), relative values in local areas often show minor increases and decreases over the landscape. Thus zooming-in with the GIS data can still show general relative patterns, though absolute values of individual pixels should be questioned.
- The satellite imagery used for the map comes from 2006 and should be used to understand the patterns of invasion as of 2006. Annual grass production varies from one year to the next, so the map will become inaccurate in future years.

Accuracy:

Accuracy of the map has been examined from several independent datasets, but the best evaluation will come from people comparing the map to their own field experience. Independent field sampling data used for the Southwest Regional GAP landcover map, data collected in Oregon for the Shrubmap project, and a re-examination of the data used for modeling this annual grass map provide some insight on the accuracy of the map. Data collected in Idaho for the Shrubmap project were determined not to be useful, in part due to few points being collected within the Owyhee Uplands.

In comparing the index values to on-the-ground measurements of percent ground-cover, a general trend is apparent that high-cover sites tend to be underestimated. The average error for any given location is around 10 – 16 percent (depending on the dataset used for comparison). The average error may be somewhat misleading as error is actually skewed. Across all three datasets, half of all ground plots are estimated by the model to within 6 percent of measured ground-cover, while 75 percent of ground plots are estimated to within 14 percent.