Comparing Federal Range Land Management Forage Capability Versus an Animal Centric Forage Capability Model: A GIS Approach

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What's the Issue?

- Ranchers graze livestock on Federal lands on parcels called allotments.
- The number of cattle or sheep permitted to forage is dependent on the amount of acres of suitable landcover available during the grazing season.
- We contend the Federal calculation of suitable area for grazing overestimates the livestock capacity allotments can sustain.

Revise the forage formula with GIS

- The Federal calculation is a generalized tool used nationally; there is no accommodation for regional geographic differences or animal behavior.
- With GIS a multi-criteria evaluation of the factors that influence foraging produces a calculation of suitable areas that would reduce harm to the natural environment and continue to provide area for grazing.
- This allows for local variation of topography in calculating the number of allotments can sustain.

Why all the Beef?

- We focus on cattle for our analysis. Factors that influence foraging are well documented.

Overstocking of cattle has many negative consequences for example: loss of biodiversity, polluted water, land degradation, and loss of habitat for wildlife.

Cattle are heavily influenced by 3 factors in grazing: slope of terrain, type of vegetation, and proximity to water.

Controversy Around Open Range Grazing


- Ranchers: Public land "grass-fed" beef is ethically preferable to feed lot production.
- Conservationist: Grazing destroys more wilderness than the bulldozer or chainsaws.
- Federal Rangeland Managers: Grazing reduces wildfires and generates much needed revenue.
- Environmentalist: Grazing degrades pollutes streams and rivers and natural biodiversity.
- Livestock Industry: Grazing is critical to local economies and beef production.

Case Study: The Blue Mountains

- The Blue Mountain Range is the head waters of the John Day River in Eastern Oregon!

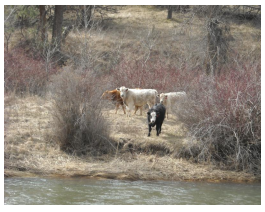
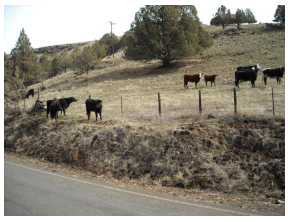

Where is the study area?

- It is located in the Blue Mountain Range along the John Day River in Eastern Oregon!

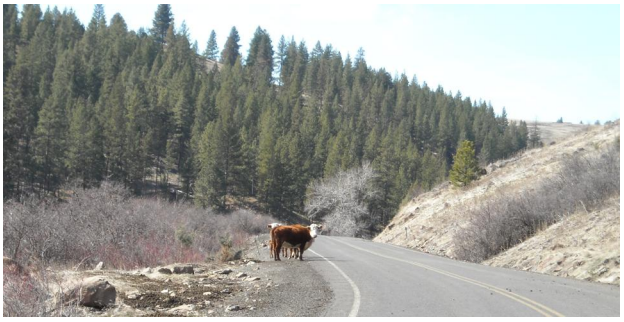
Google Earth Fly Through…

Where is the study area?

- The Blue Mountains contain three National Forests: Malheur, Umatilla, and Wallowa-Whitman. We looked at 11 contiguous allotments. The allotments are part of the watershed of the Upper and Middle Fork of the John Day River.
- The elevation ranges from 2822ft at the river to 8130ft, the area features mountainous terrain with slope gradients of 0 to 100%.

Methods…

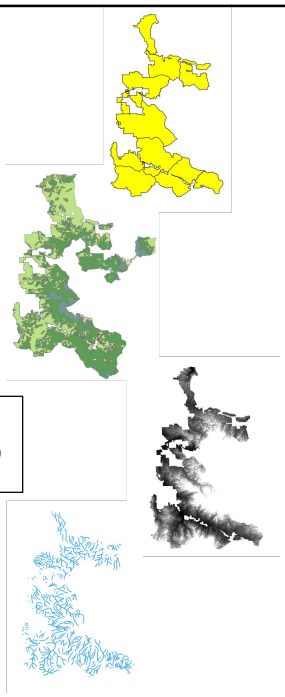


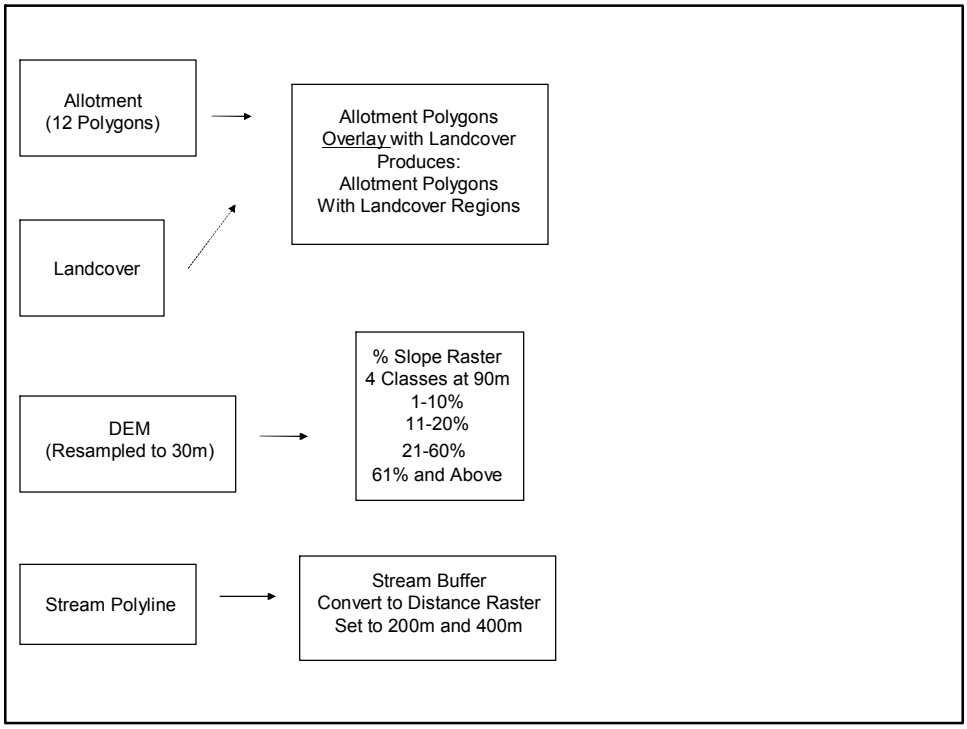
Allotment
(12 Polygons)

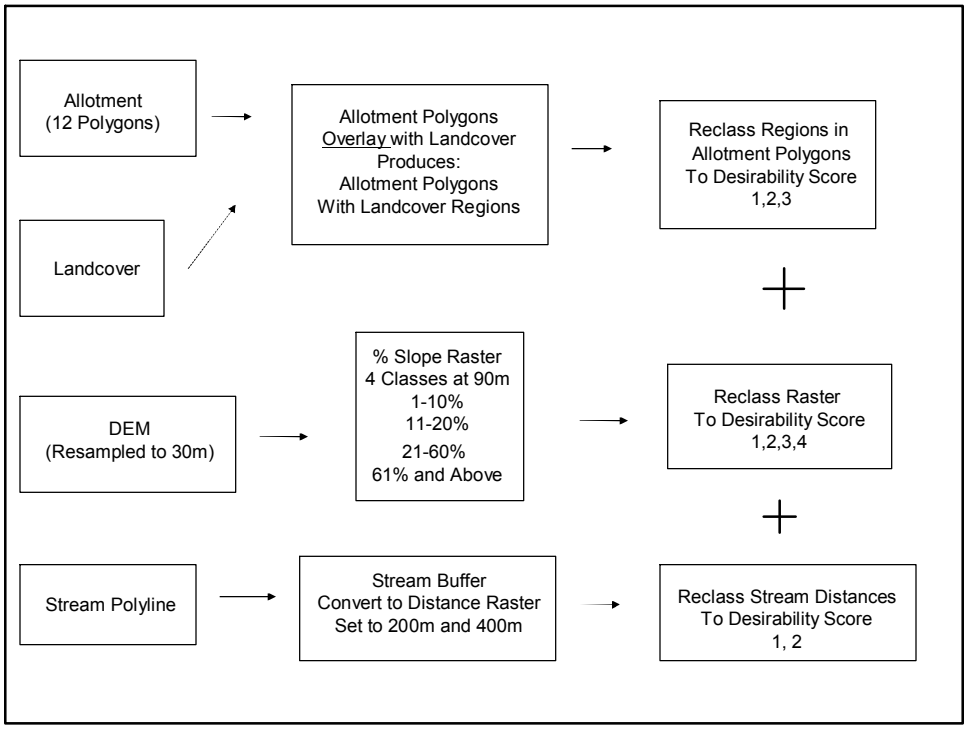
Landcover

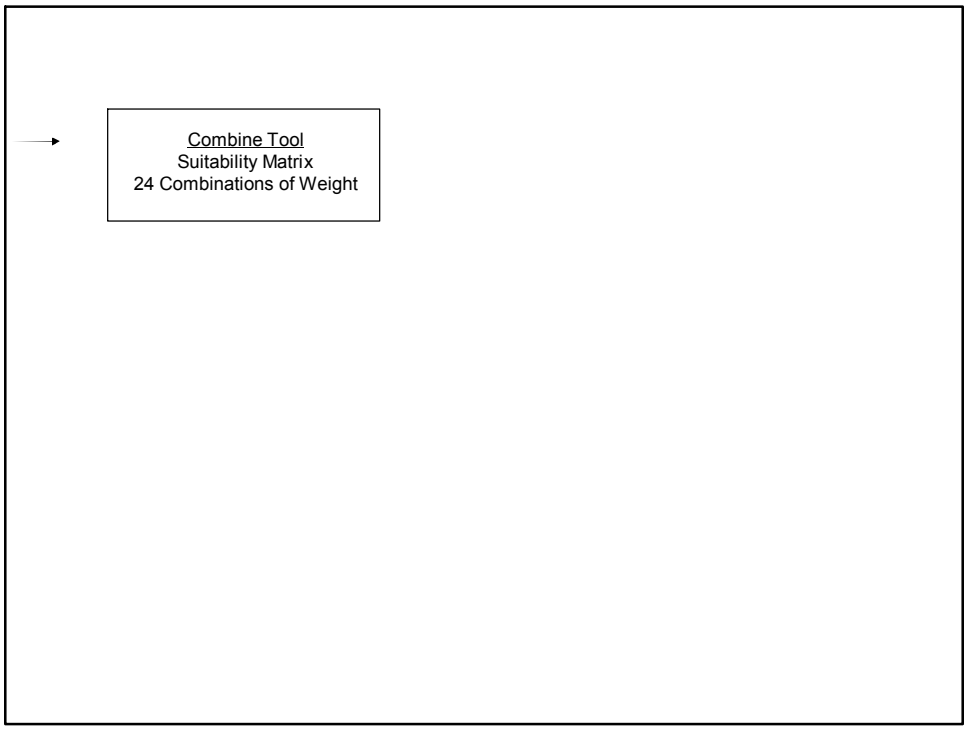
DEM
(Resampled to 30m)

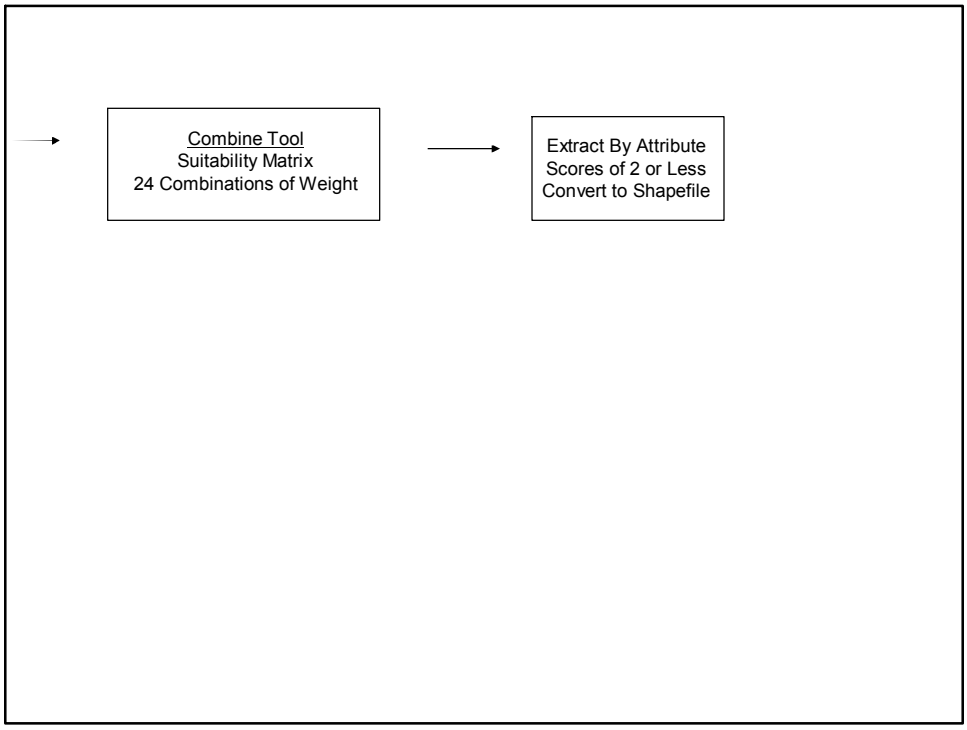
Stream Polyline

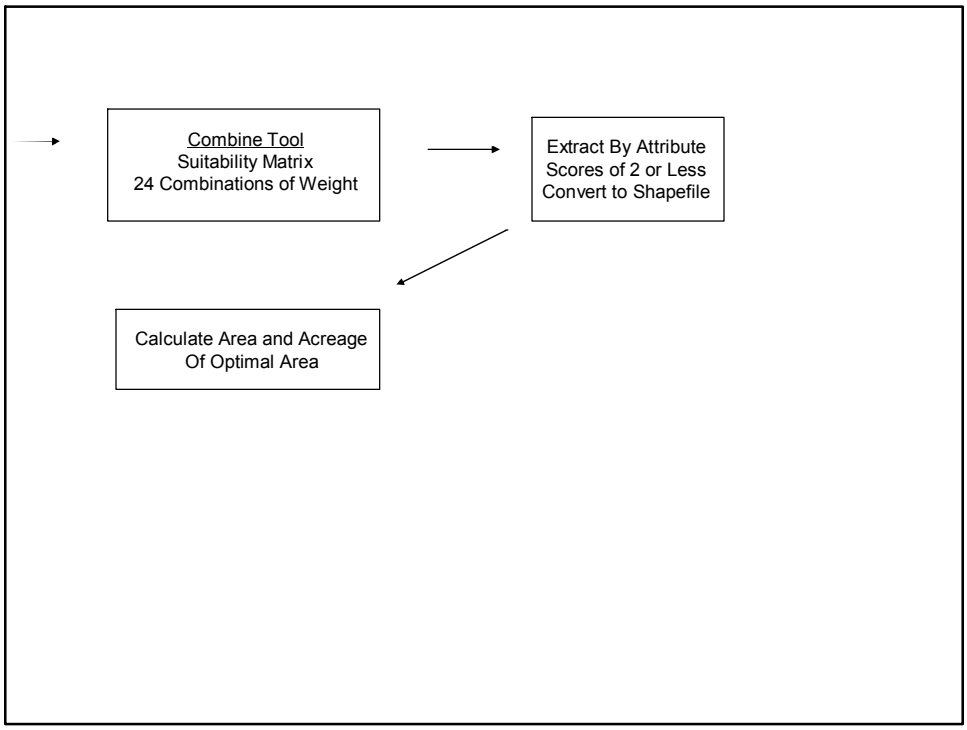


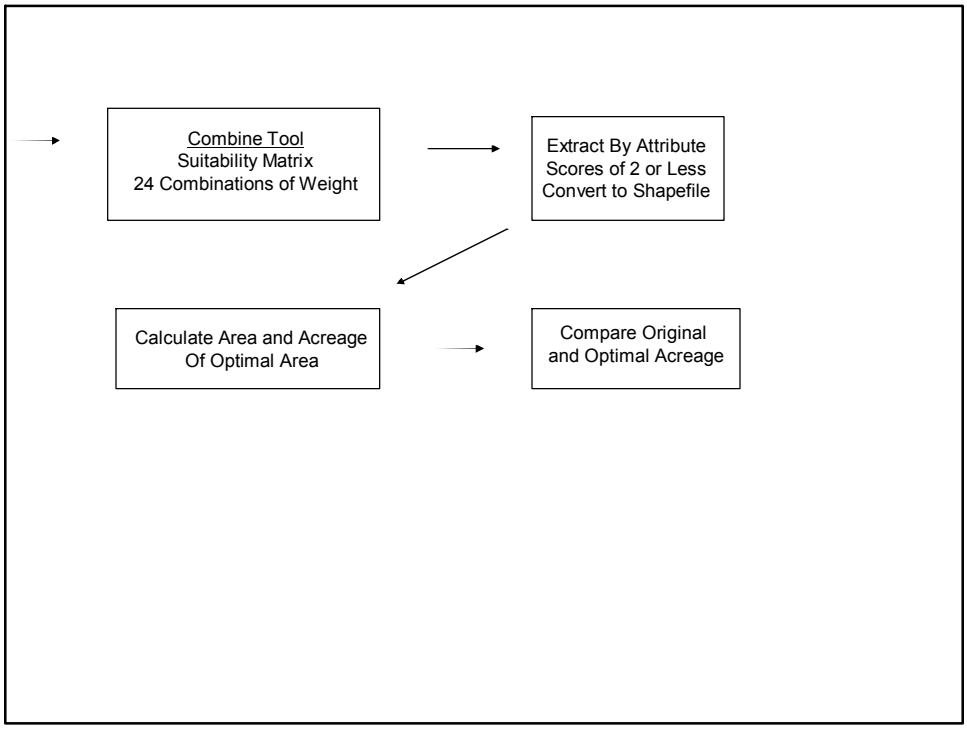

Allotment
(12 Polygons)
Allotment Polygons
Overlay with Landcover
Produces:
Allotment Polygons
With Landcover Regions
Landcover
% Slope Raster
4 Classes at 90m
1-10%
11-20%
21-60%
61% and Above
DEM
(Resampled to 30m)
Stream Polyline
Stream Buffer
Convert to Distance Raster
Set to 200m and 400m

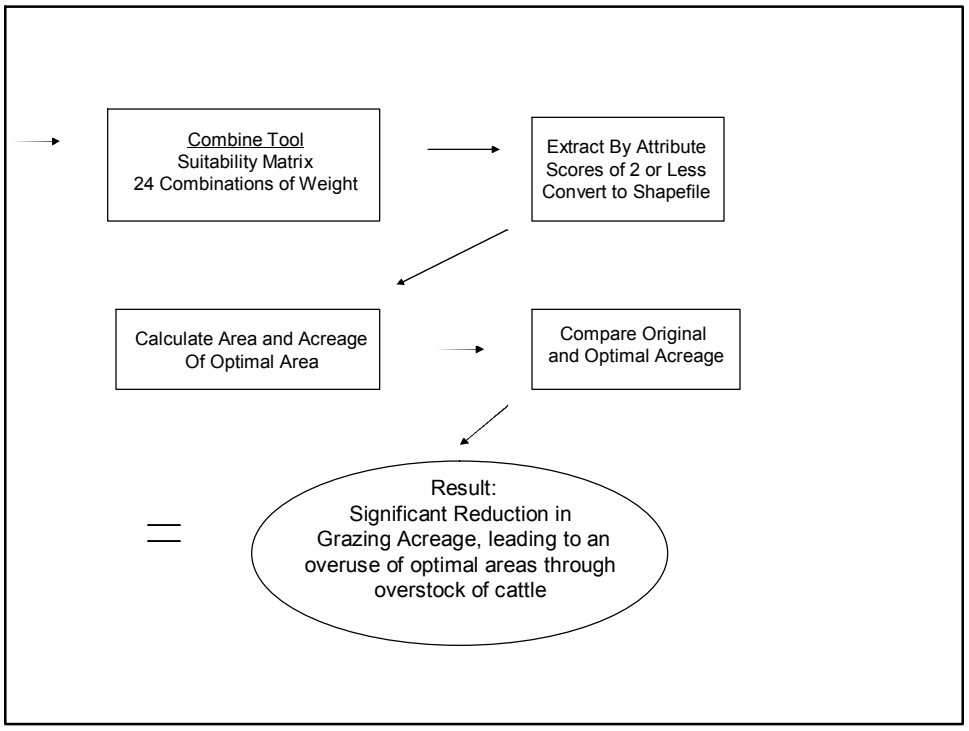

Allotment
(12 Polygons)
Allotment Polygons
Overlay with Landcover
Produces:
Allotment Polygons
With Landcover Regions
Reclass Regions in
Allotment Polygons
To Desirability Score
1,2,3
Landcover
% Slope Raster
4 Classes at 90m
1-10%
11-20%
21-60%
61% and Above
Reclass Raster
To Desirability Score
1,2,3,4
DEM
(Resampled to 30m)
Stream Polyline
Stream Buffer
Convert to Distance Raster
Set to 200m and 400m
Reclass Stream Distances
To Desirability Score
1, 2


Combine Tool
Suitability Matrix
24 Combinations of Weight


Combine Tool
Suitability Matrix
24 Combinations of Weight
Extract By Attribute
Scores of 2 or Less
Convert to Shapefile


Combine Tool
Suitability Matrix
24 Combinations of Weight
Extract By Attribute
Scores of 2 or Less
Convert to Shapefile
Calculate Area and Acreage
Of Optimal Area


Combine Tool
Suitability Matrix
24 Combinations of Weight
Extract By Attribute
Scores of 2 or Less
Convert to Shapefile
Calculate Area and Acreage
Of Optimal Area
Compare Original
and Optimal Acreage

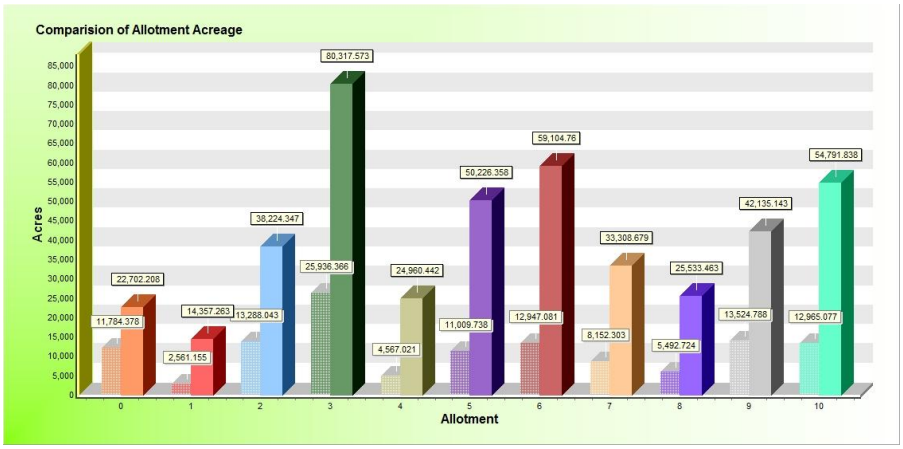


Results & Conclusions...

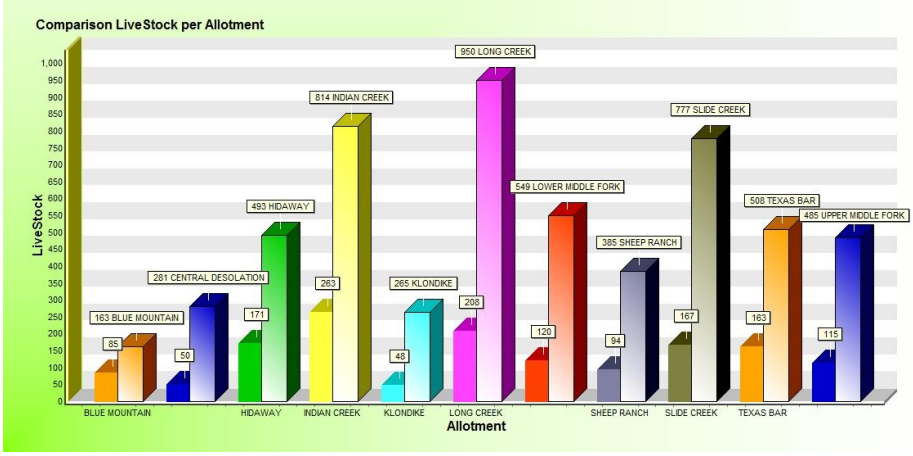
Results

- The model reveals areas optimally suited for cattle grazing. This area is converted into acreage. This acreage is used to determine how much livestock can forage on the optimal area.
- By stocking at the federal rates on area that can sustain fewer cattle the negative effects of overgrazing bound to occur.

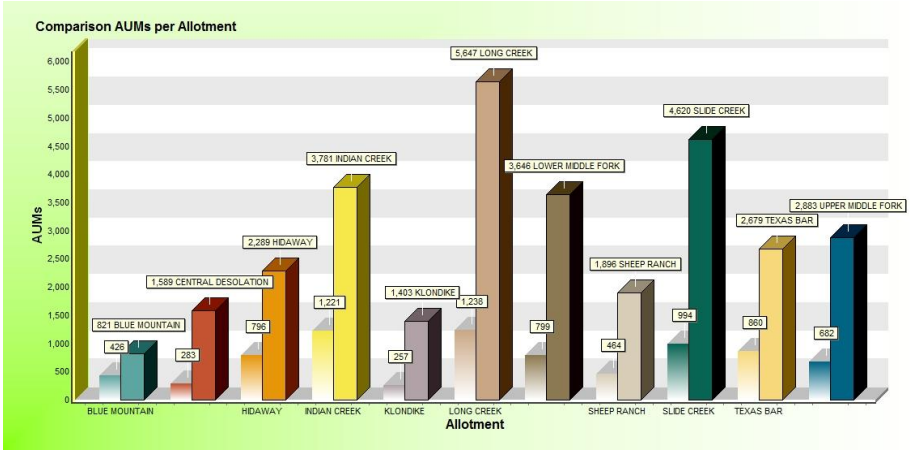
The differences between the federal calculation and this model are dramatic



Number of Cattle on Allotments

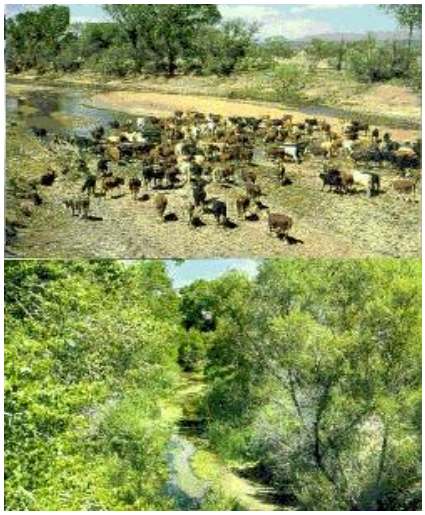


Forage Available Measured in AUM*



* AUM is a unit of measurement of the amount of forage need per animal per month.

Before & After: Reducing Cattle



Problems & Further Study:

- Fences are also used to contain cattle movement. Not all national forests make the Fences dataset publicly available.
- Wells and water troughs are used to keep cattle grazing in areas distant from streams. This data set had temporal accuracy discrepancies.
- There are two kinds of cattle in herds: "climbers" and "groupers." Typically there are very few "climbers" in every herd. Researchers are currently studying if this is a genetic or personality trait of individual cows.

Exclusions from Analysis

Attributes of allotment_rmu_unit_raw

OBJECTID *	DATA_SOURCE	ACCURACY	Forest	Shape_Length	Shape_Area	AUM	LiveStock
1	Other	<Null>	Umatilla NF	268109.42083	2009407643.08835	1952	1850
2	Other	<Null>	Umatilla NF	212703.925719	1087127259.15719	1403	265
3	Other	<Null>	Umatilla NF	277787.807426	1664823493.17013	2289	493
4	Other	<Null>	Wallowa Whitman NF	330555.179315	1871273013.07506	<Null>	<Null>
5	Other	<Null>	Wallowa Whitman NF	330351.880757	1450726450.63001	1896	385
6	Other	<Null>	Umatilla NF	310822.977349	1835154301.78783	2679	508
7	Other	<Null>	Umatilla NF	199561.233339	1397002277.94273	<Null>	<Null>
8	Other	<Null>	Umatilla NF	248000.123087	625316340.975286	1589	281
9	Other	<Null>	Umatilla NF	359782.593517	3498152149.3454	3781	814
10	Other	<Null>	Malheur NF	366947.27046	2574249147.71998	3646	549
11	Other	<Null>	Malheur NF	238906.235724	1112084604.53322	4620	777
12	Other	<Null>	Malheur NF	351600.814413	2386404109.04378	2883	485
13	Other	<Null>	Malheur NF	174829.542764	988772129.657992	821	163
14	Other	<Null>	Malheur NF	283050.922807	2187559144.51015	5647	950
15	Other	<Null>	Malheur NF	219856.340913	2021429527.77219	<Null>	<Null>

Records: 1 Show: All Selected Records (4 out of 15 Selected) Options

Allotments we want to exclude: No data, or sheep graze there

References & Resources:

- Brock, B. and Owensby, C. 2000. Predictive Models for Grazing Distribution: A GIS Approach. *Journal of Range Management,* Vol. 53, No. 1 (Jan., 2000), pp. 39-46
- George,M. et al 2007. Factors and Practices that Influence Livestock Distribution. *Rangeland Management Series, Publication 8217, University of California.*
- Carter, J. 2007. Updating the Animal Unit Month. *Western Watersheds Project*.
- Gillen, R. L. et al 1984. Cattle Distribution on Mountain Rangeland in Northeastern Oregon. *Journal of Range Management,* Vol.37, No.6 p. 549-553
- Wade, T. G. et al 1998. Modeling the Potential Spatial Distribution of Beef Cattle Grazing Using a Geographic Information System. *Journal of Arid Environments,* Vol. 38, p. 325-334.
- Dr. Geoffrey Duh
- PSU GIS Data Library (aka I: Drive)
  - Digital Elevation Models (Courtesy of ODOT)
  - Land cover (courtesy of ODOT)
- Umatilla National Forest GIS Library (http://www.fs.fed.us/r6/datalibrary/gis/umatilla/)
  - Allotment Shapefiles (Range Management Unit.gdb)
  - Streams (Streams.gdb)

Questions?