

Estimating ecosite productivity in the Black Hills, SD

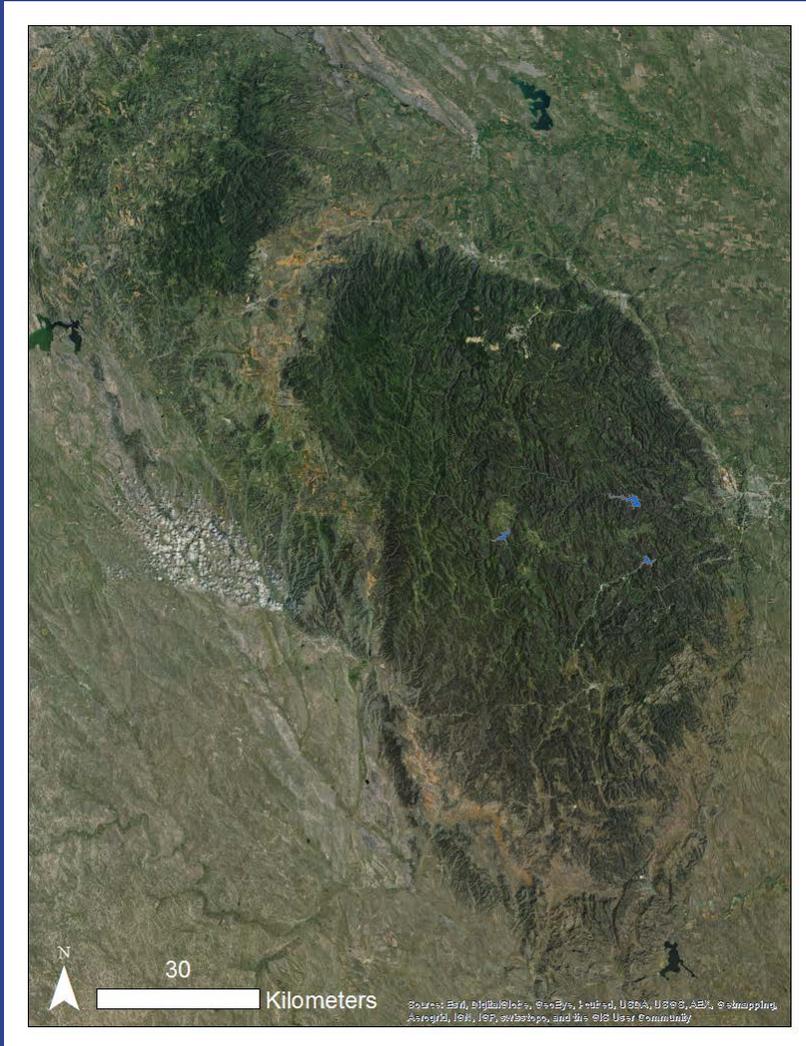
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Roger Gates



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The Black Hills



3.5 million acres

1.5 million acres of
ponderosa pine

Extensive timber harvest
and grazing on both public
and private lands



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Economically important ecosystem services



Black Hills National Forest photo



Pioneer photo -Mark VanGerpen



Wikipedia.com

- Timber production (1998-2007)
 - 163 thousand acres harvested
 - 656 million board feet of sawtimber
- Cattle production
 - 83 percent of USFS land grazed
 - 128,000 Animal Unit Months
 - (360 kg (800 lb.) bale of hay



Black Hills National Forest is also managed to maintain ecological integrity

- Upland grasslands
 - Maintain quality of desired plant communities by managing for native species
 - Not more than 5-15% bare ground depending on soil type
- Ponderosa pine forest
 - Maintain diverse understory of native grasses
 - Not more than 10% bare ground to maintain soil stability and provide wildlife habitat



How does estimated productivity relate to livestock use in the Black Hills?



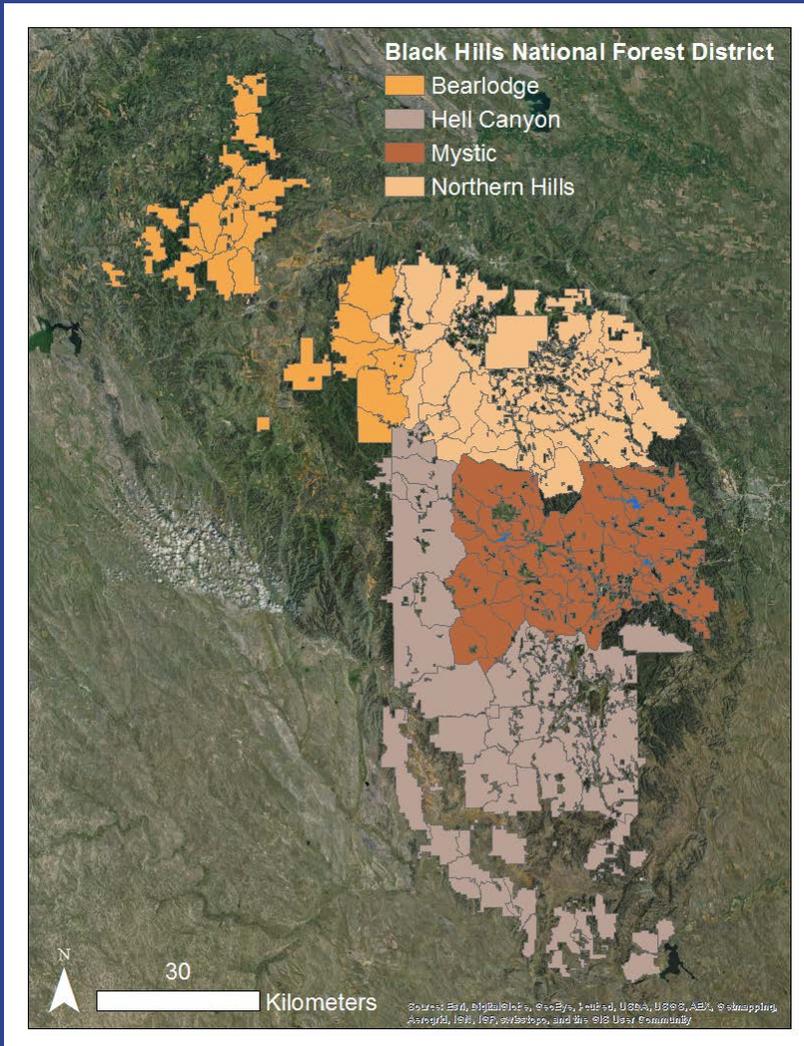
Change.com



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The Mystic Range District



181,000 ha (292,000 acres)

35 allotments

180 pastures

Mean pasture size - 620 ha
(1532 acres)



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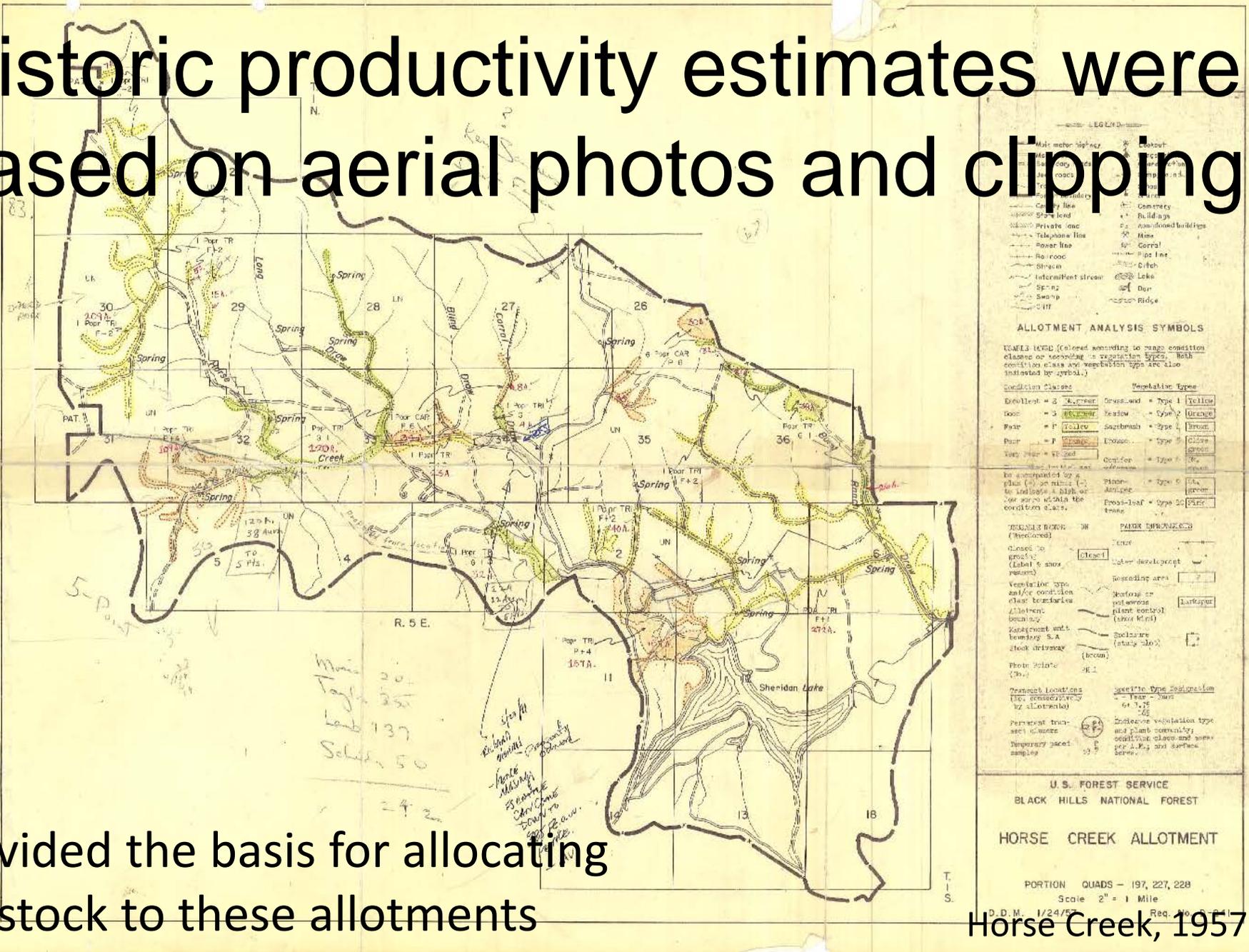
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Measuring productivity

- Field based methods
 - Clipping and weighing
 - Ocular estimation
 - Robel Pole
- Modeling methods
 - Aerial photographs
 - Estimates based on soil type
 - Based on slope, and vegetation community



Historic productivity estimates were based on aerial photos and clipping



Provided the basis for allocating livestock to these allotments

Horse Creek, 1957



Modern tools provide productivity estimates for rangeland soils

The screenshot displays the Web Soil Survey interface. At the top, there are navigation tabs: "Area of Interest (AOI)", "Soil Map", "Soil Data Explorer", "Download Soils Data", and "Shopping Cart (Free)". Below these, a dropdown menu shows "View Soil Information By Use: All Uses". The main content area is divided into several sections. On the left, there is a "Search" panel with a "Soil Reports" list. The "Soil Reports" list includes categories like "Vegetative Productivity" and "Rangeland Productivity". The "Rangeland Productivity" report is selected, and its description is displayed in a pop-up window. The main map area shows a topographic map with a soil map overlay. The soil map is color-coded, and a legend is visible on the left. The "Rangeland Productivity" description window contains the following text:

Description — Rangeland Productivity

Rangeland Productivity

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

This table shows, for each soil that supports rangeland vegetation, the ecological site and the potential annual production of vegetation in favorable, normal, and unfavorable years. An explanation of the column headings in the table follows.

An *ecological site* is the product of all the environmental factors responsible for its development. It has characteristic soils that have developed over time throughout the soil development process; a characteristic hydrology, particularly infiltration and runoff, that has developed over time; and a characteristic plant community (kind and amount of vegetation). The hydrology of a site is influenced by development of the soil and plant community. The vegetation, soils, and hydrology are all interrelated. Each is influenced by the others and influences the development of the others. The plant community on an ecological site is typified by an association of species that differs from that of other ecological sites in the kind and/or proportion of species or in total production. Descriptions of ecological sites are provided in the Field Office Technical Guide, which is available in local offices of the Natural Resources Conservation Service (NRCS).

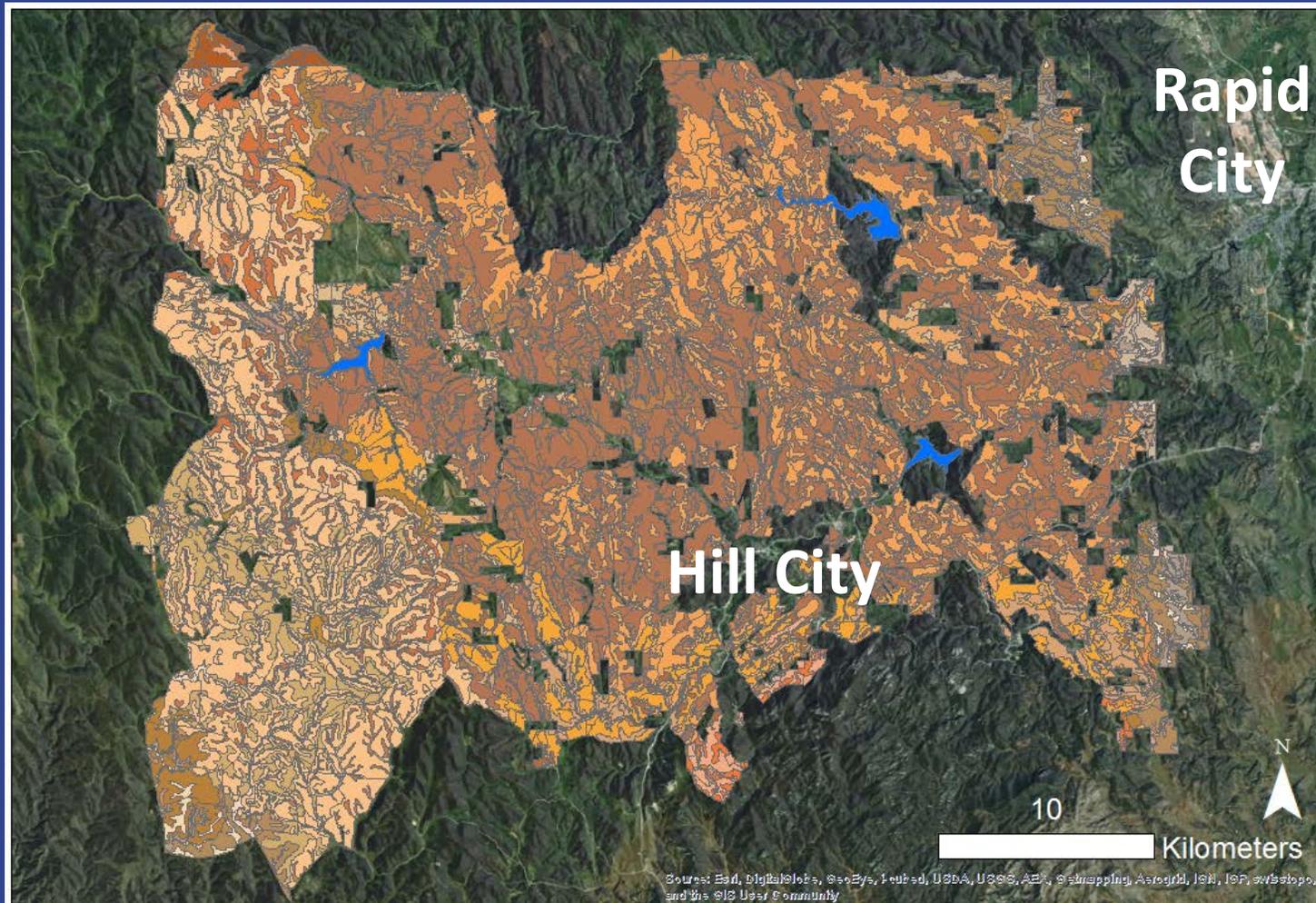
Total dry-weight production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural

Methods

1. Intersect soil type and canopy cover
2. Incorporate herbaceous production for each soil type and canopy cover
3. Sum herbaceous production by pasture
4. Estimate animal unit months (AUM)
 - Based on a 450 kg (1000 lb.) cow consuming 11.8 kg (26 lb.) per day for 30.5 days per month
5. Compare to recent use estimates based on 9 years of annual operating instructions



44 Different soil Types each with a productivity estimate



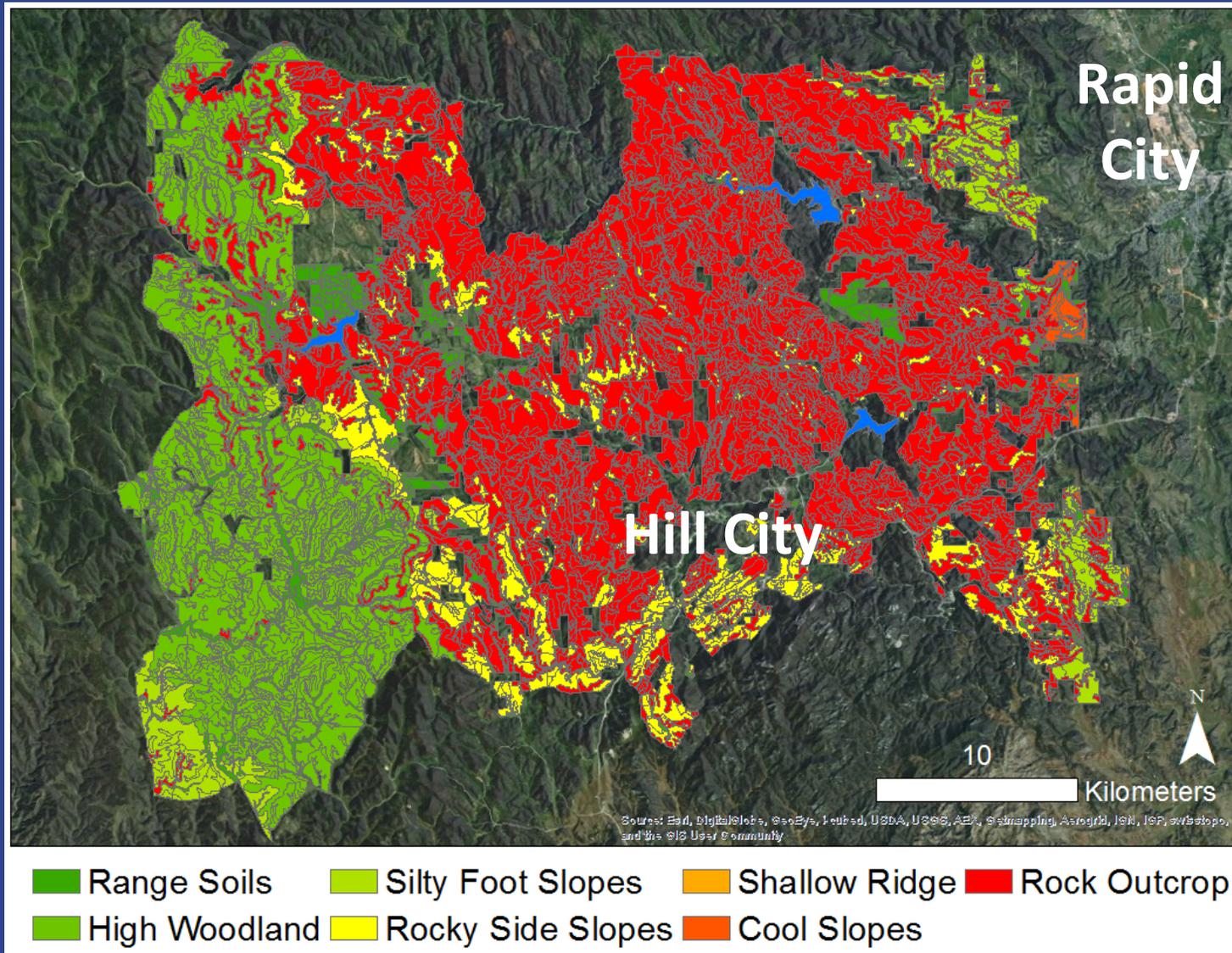
14 rangeland soils, and 30 woodland soils
Extensive rock outcrops in the eastern portion



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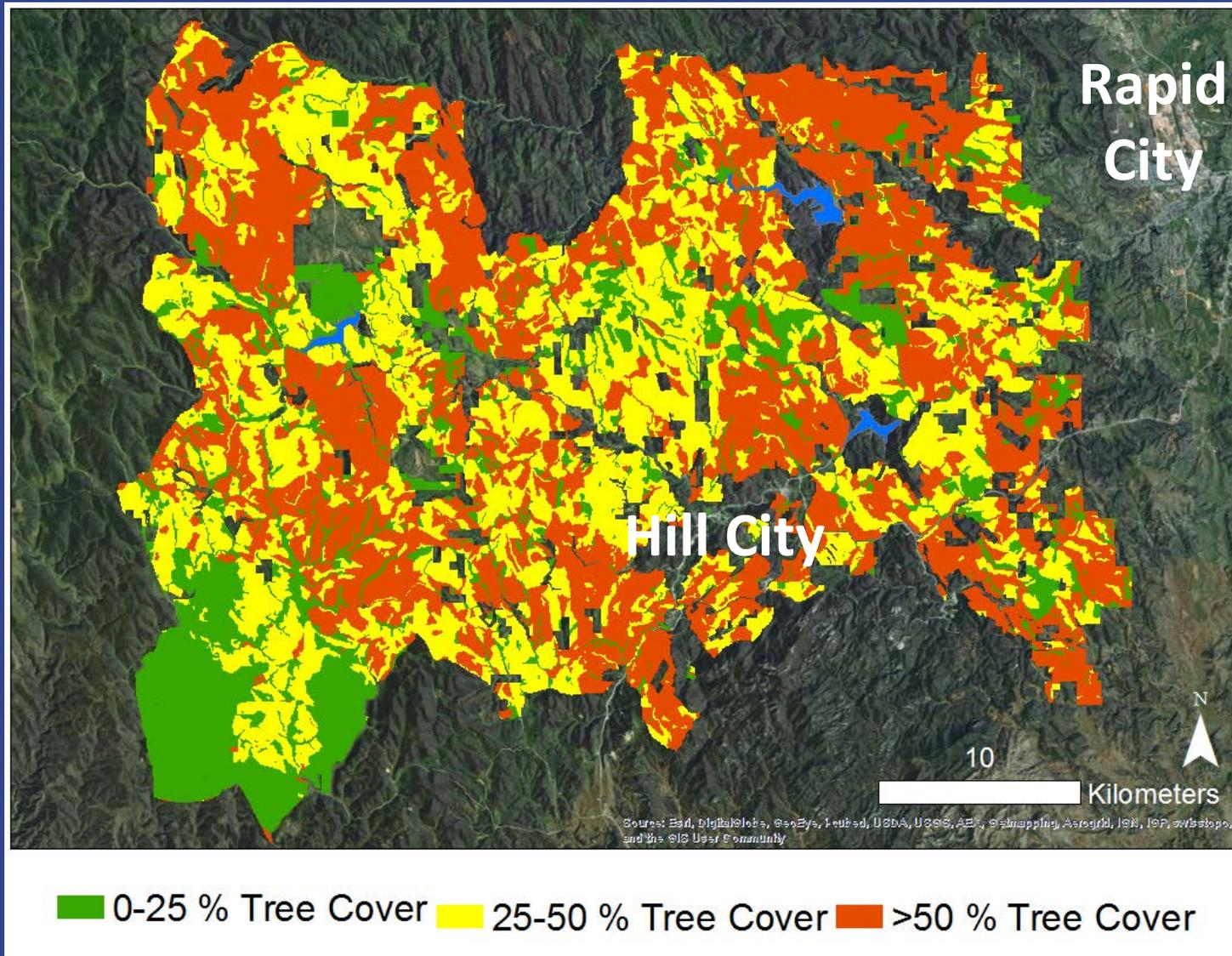
Extensive rock outcrops are a potential limitation to estimating production



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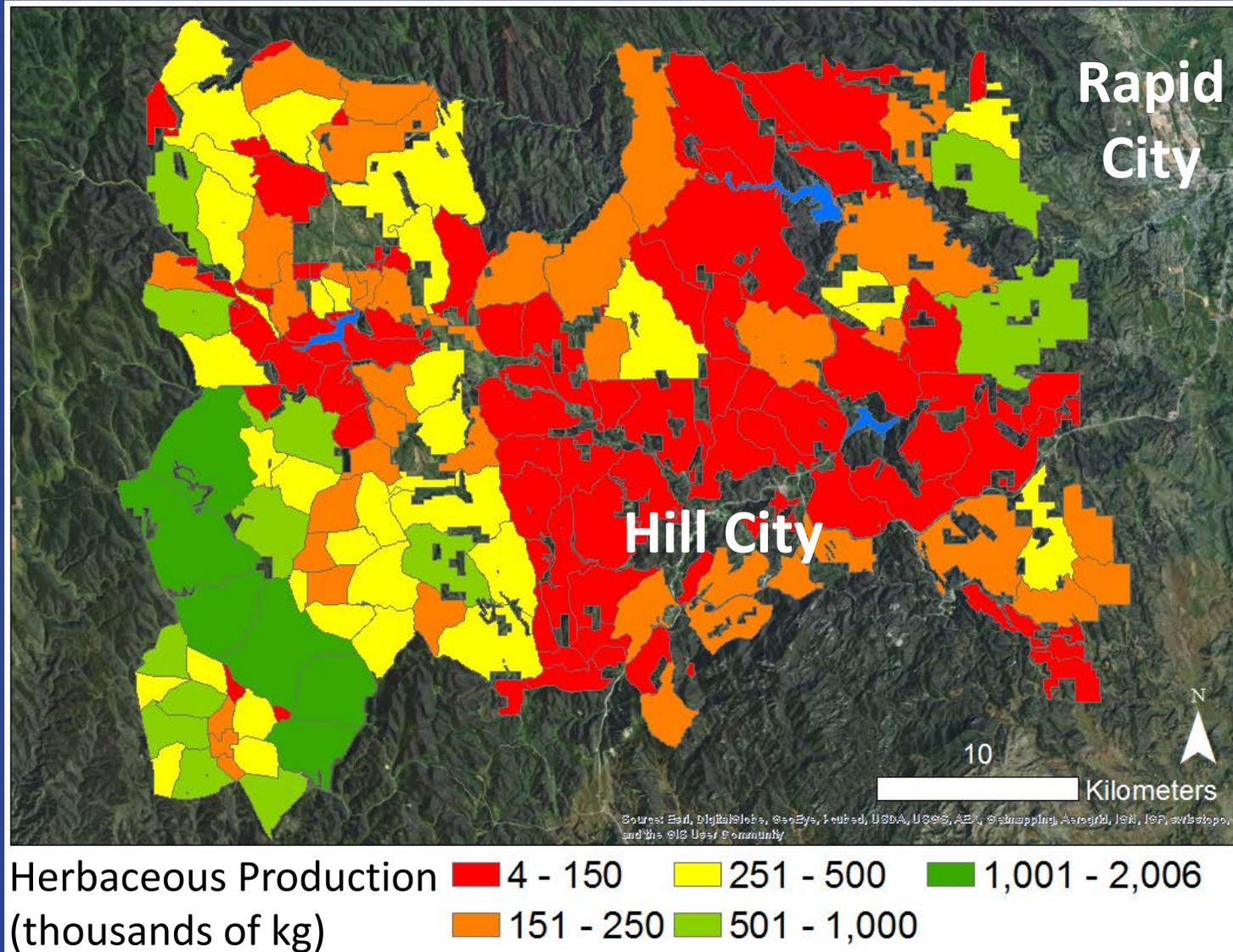
Canopy cover classes influence woodland soil productivity



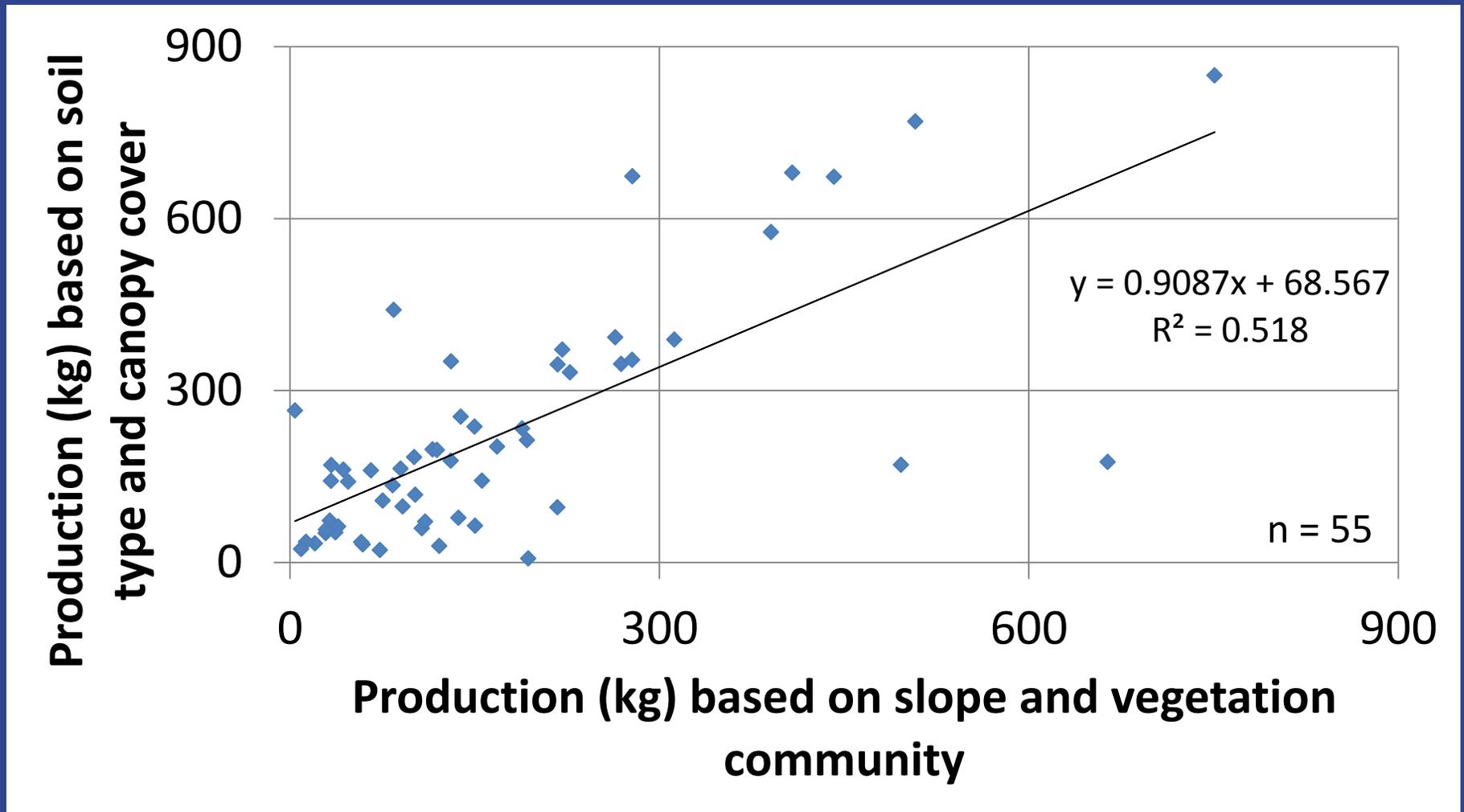
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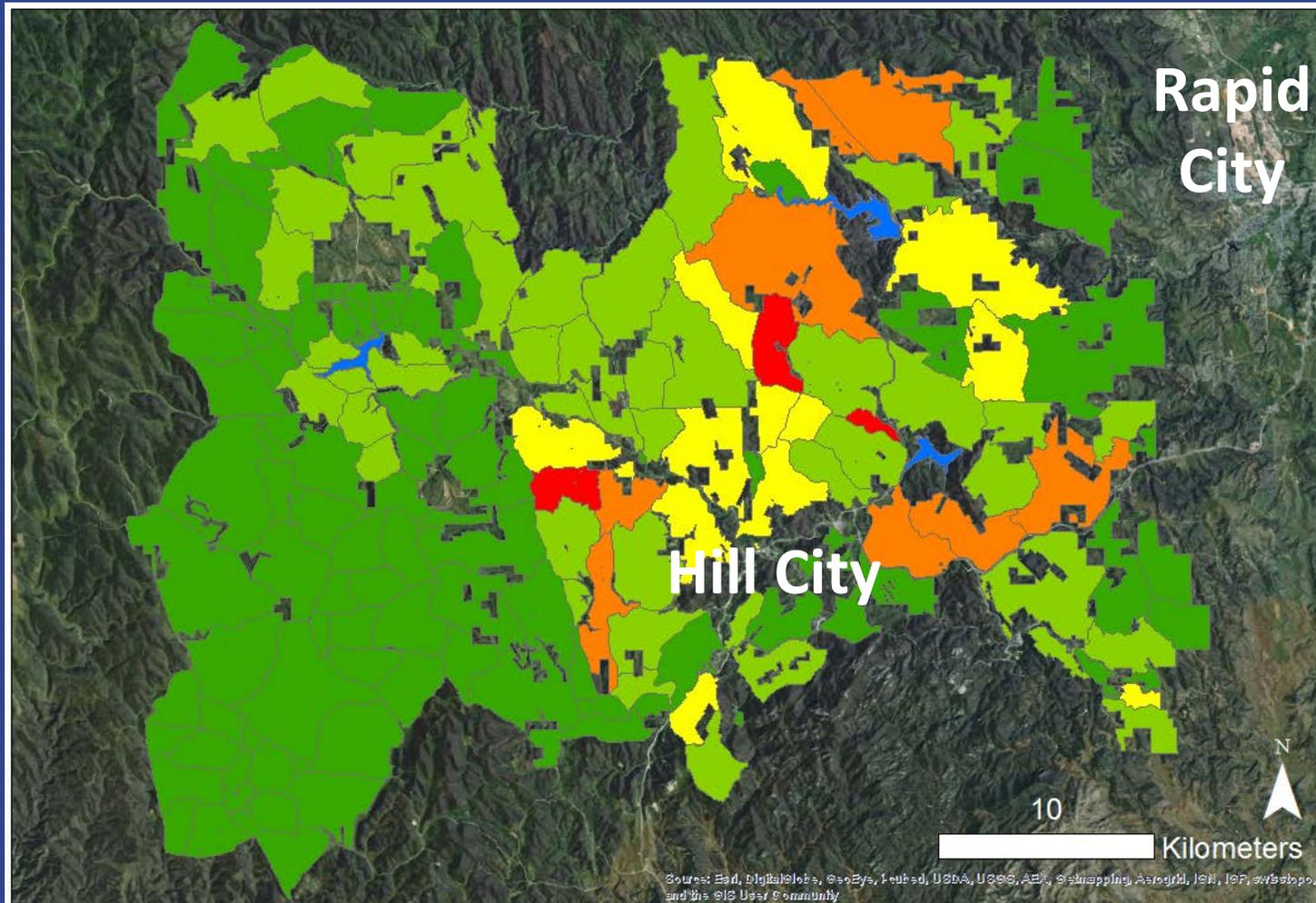
There is high variability in herbaceous production across the Mystic district



Production estimates based on soil type compare reasonably well with estimates based on slope, & vegetation community



The area required for each AUM varies greatly across Mystic



Area per AUM by pasture (ha/AUM) (1.2 – 380 acre/AUM)

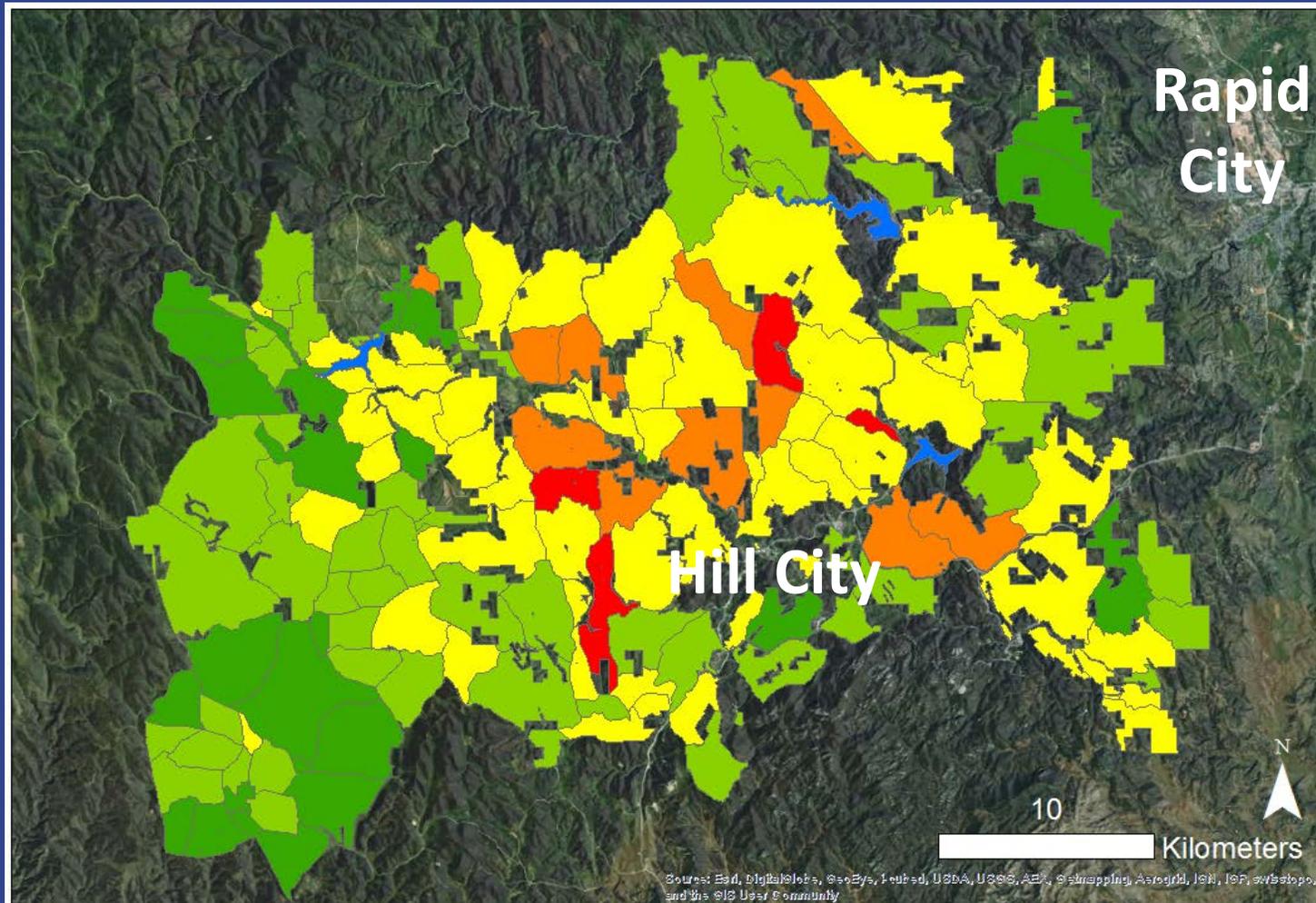
0.5 - 5.0 5.1 - 15.0 15.1 - 25.0 25.1 - 50.0 50.1 - 154.3



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AUM based on 25 % utilization by a 450 kg cow eating 11.8 kg/day for 30.5 days/month

45 percent of the pastures use more than their estimated production



Annual Operating Instruction Use / estimated AUMs

0.1 - 0.5	0.6 - 1.0	1.1 - 3.0	3.1 - 6.0	6.1 - 18.8
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AUM based on 25 % utilization by a 450 kg cow eating 11.8 kg/day for 30.5 days/month

Conclusion

- Estimated productivity based on soil type and canopy cover compares well to estimates based on slope, and vegetation community
- Almost half the Mystic pastures are utilized more than their site potential based on soil type
- Accounting for canopy cover may enhance adaptive management opportunities



Future work

- Measure productivity across different management practices using field based methods
- Explore relationships among:
 - plant community composition,
 - ponderosa pine regeneration,
 - and livestock use
- Develop forest density maps to refine estimates of herbaceous production



Thank you

Mark Vedder
John Rongstad
Ken Marchand



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