

Bison Effects on Yellowstone Grasslands

Update for 2015-16

Acknowledgements

Dr. Chris Geremia, Yellowstone National Park

Rick Wallen, Yellowstone National Park

Dr. Douglas Alan Frank, Syracuse University

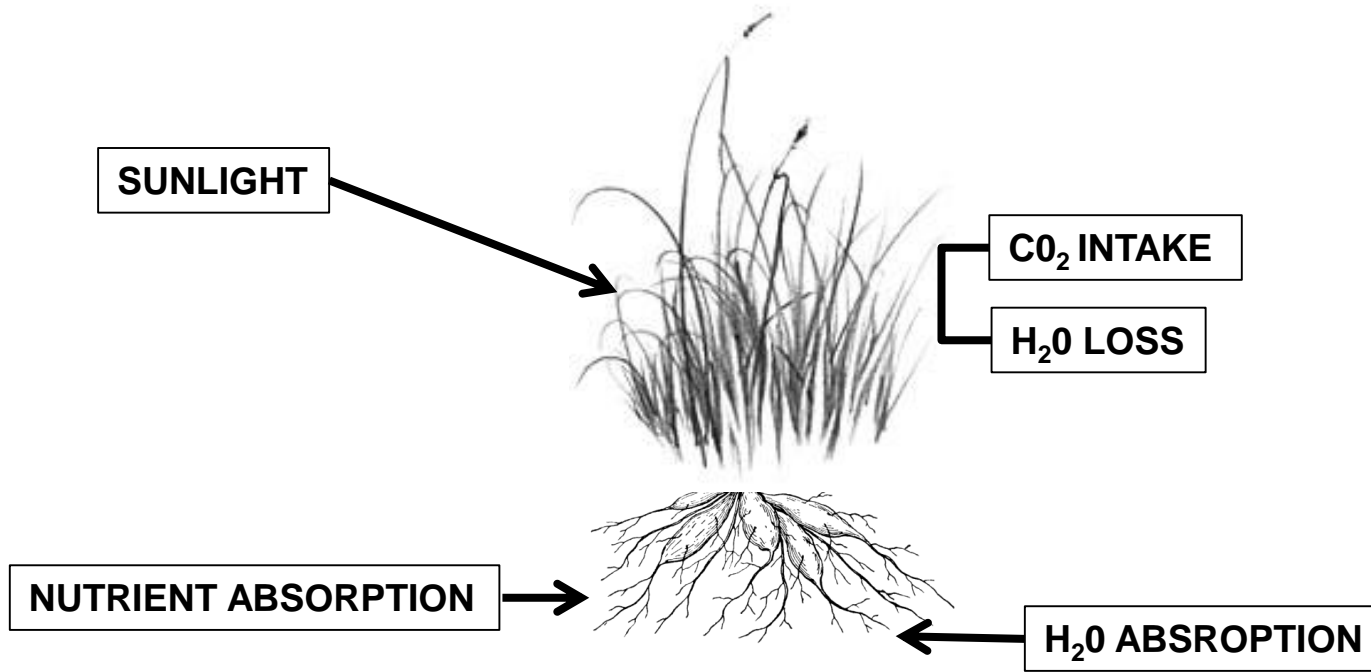
Dr. Bill Hamilton, William and Lee University

Dr. P.J. White, Yellowstone National Park

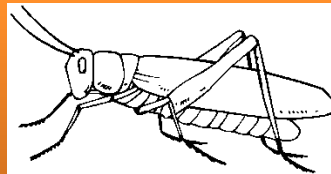
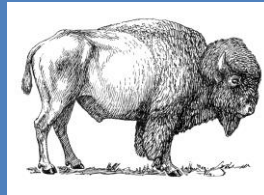


What is Production (ANPP)?

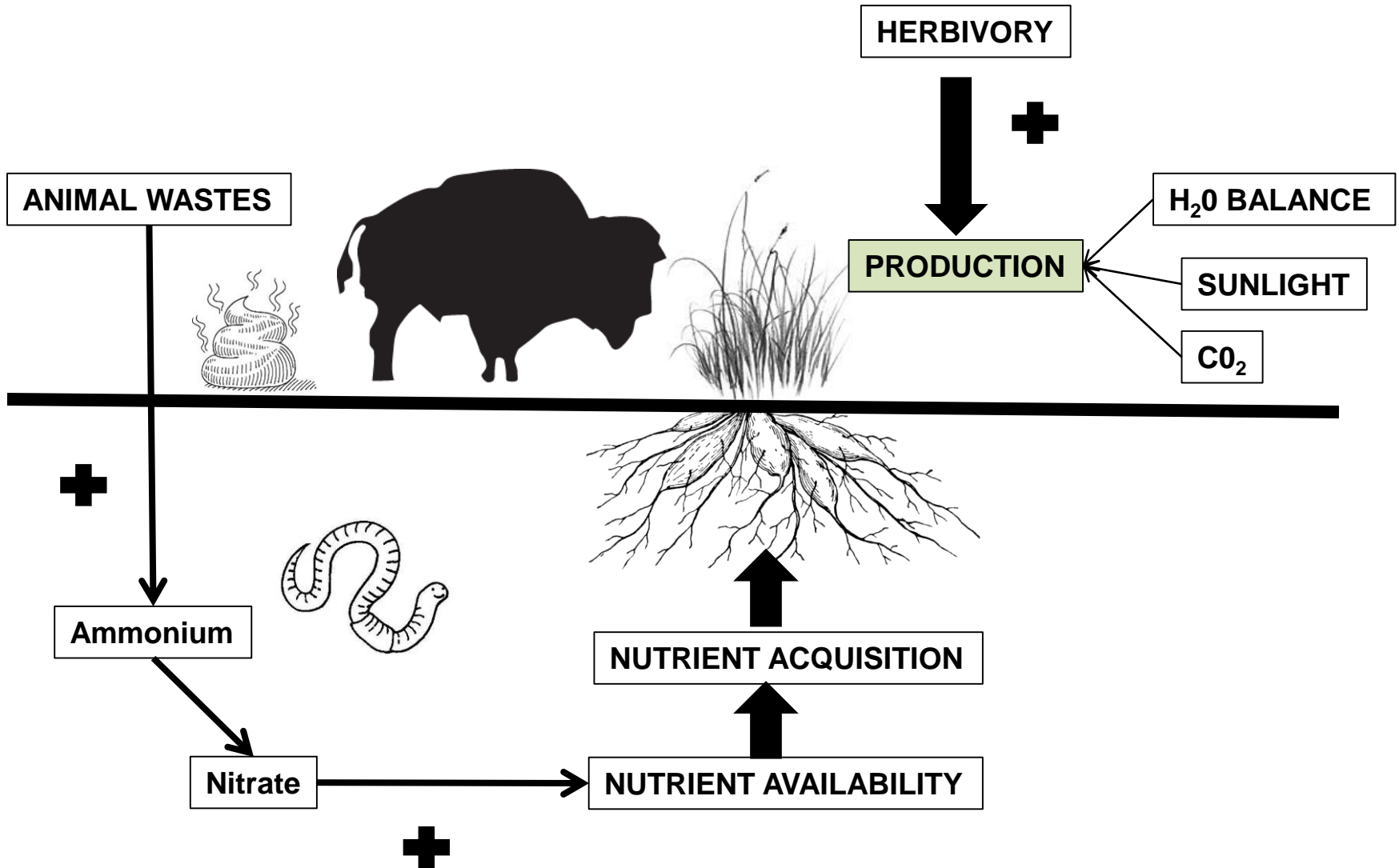
1. THE WEIGHT OF NEW TISSUE MADE BY THE PLANT
2. CARBON DIOXIDE + WATER + SUNLIGHT = **SUGARS** + OXYGEN



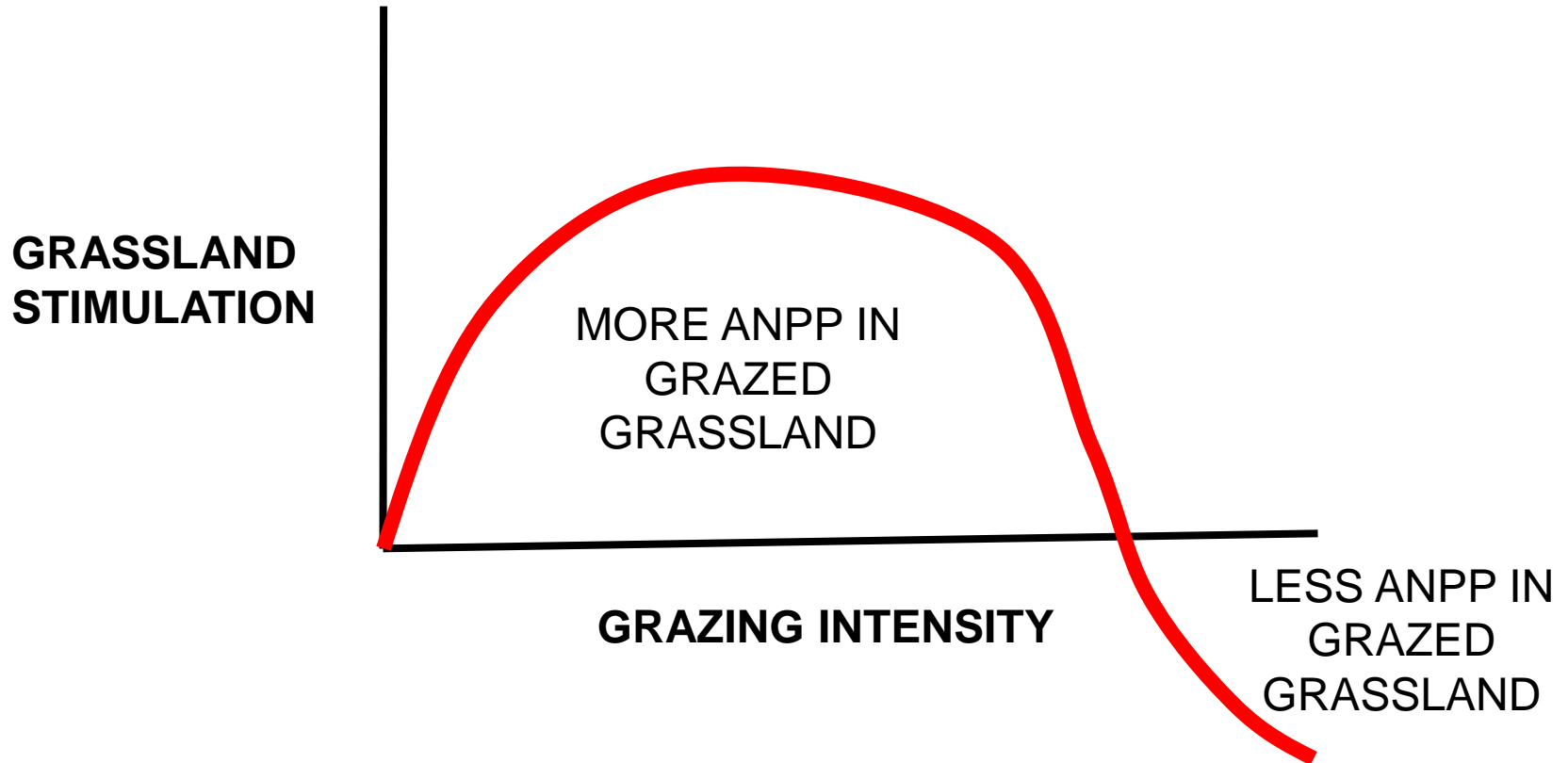
Why is Production (ANPP) IMPORTANT



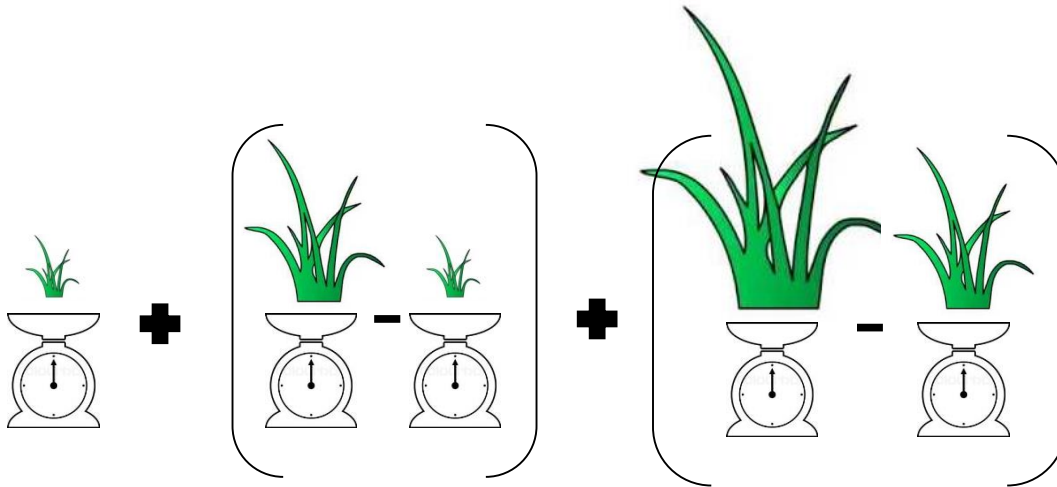
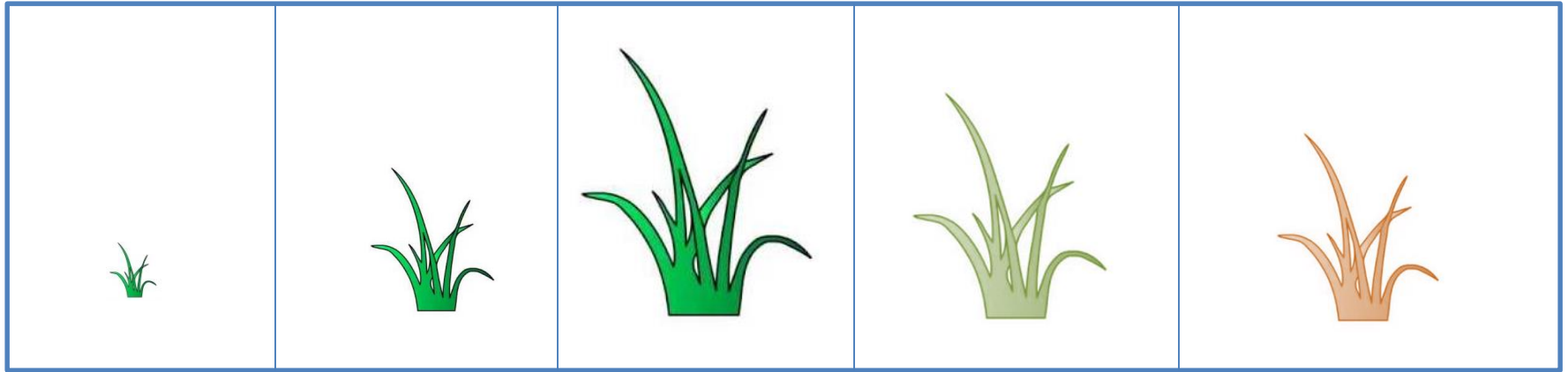
GRAZING IS AN ACTIVE PROCESS: GRAZERS INFLUENCE PLANT GROWTH



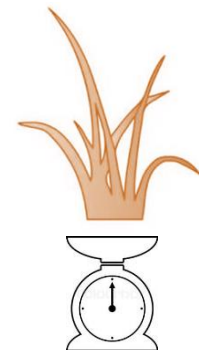
GRAZING OPTIMIZATION



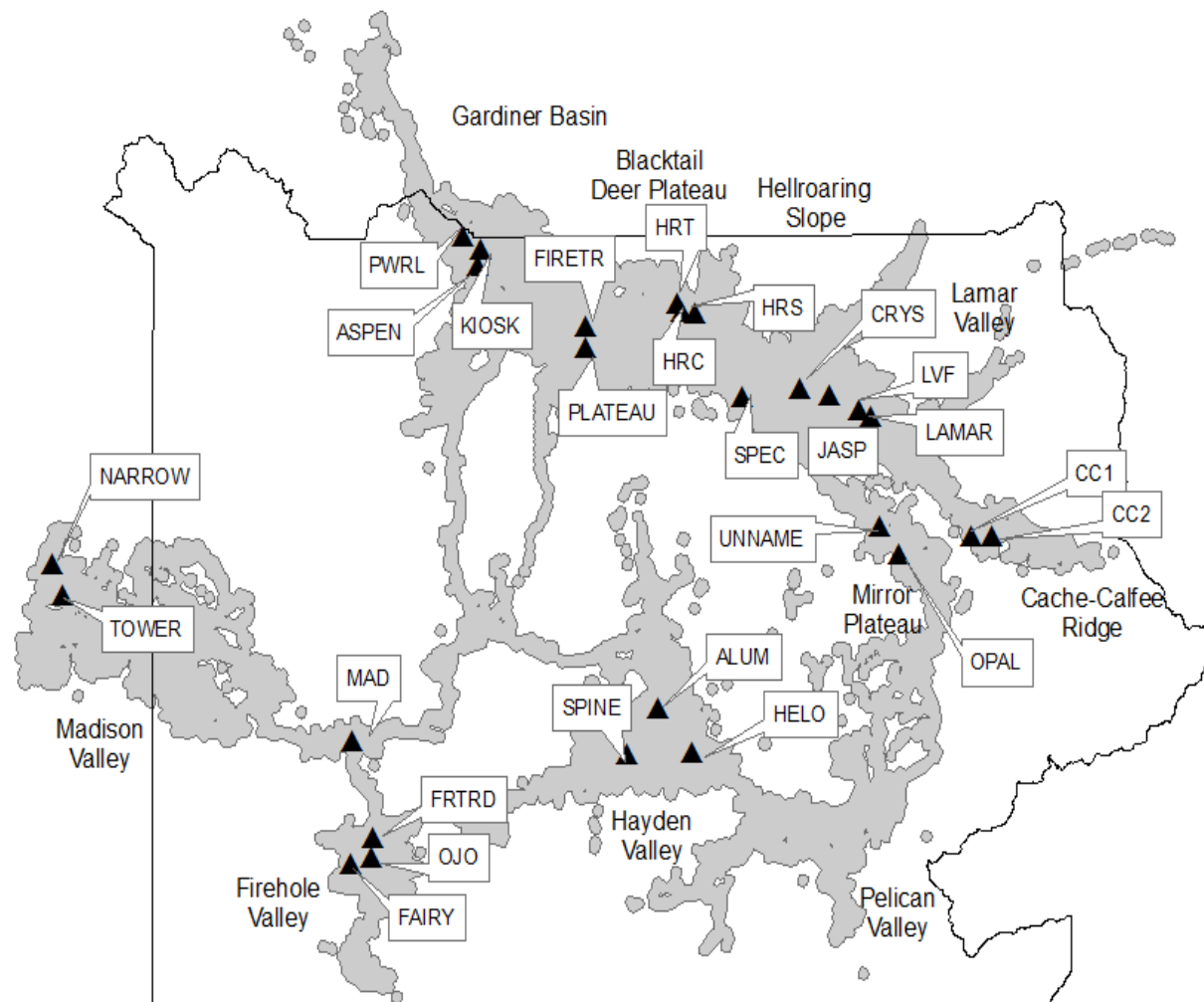
Production (ANPP) is different than Shoot Biomass



Measuring ANPP



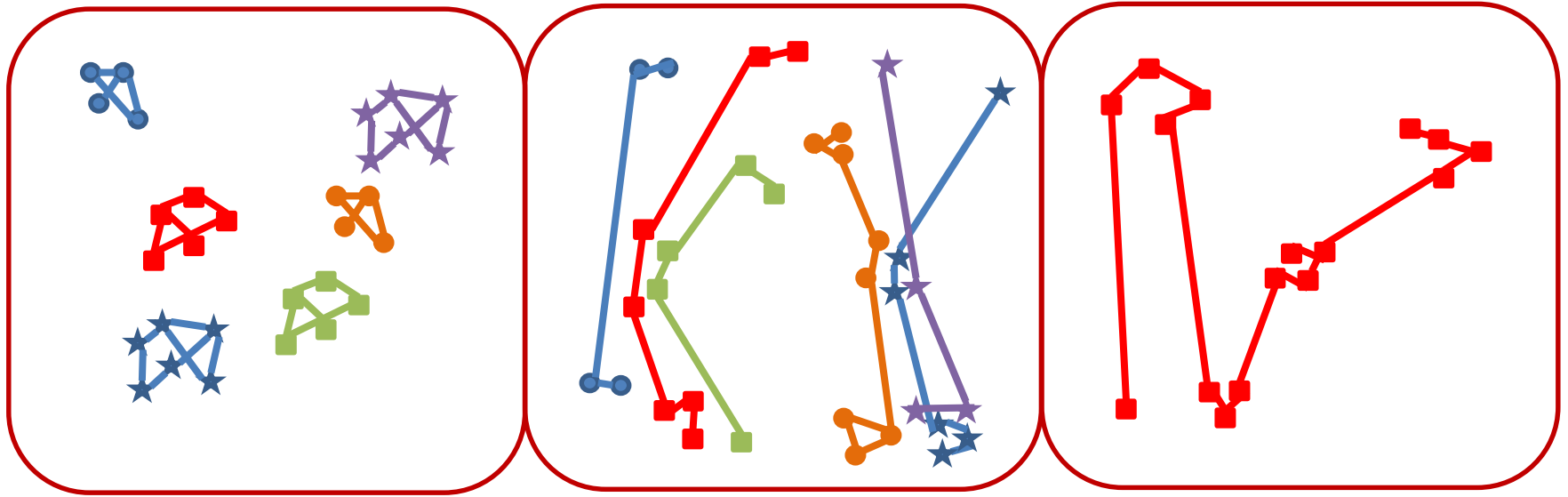
Measuring Shoot Biomass



0 4 8 16 24 32 Kilometers

0 3.75 7.5 15 22.5 30 Miles

BISON MOVEMENTS: WINTER, TRANSITIONAL, and SUMMER RANGES

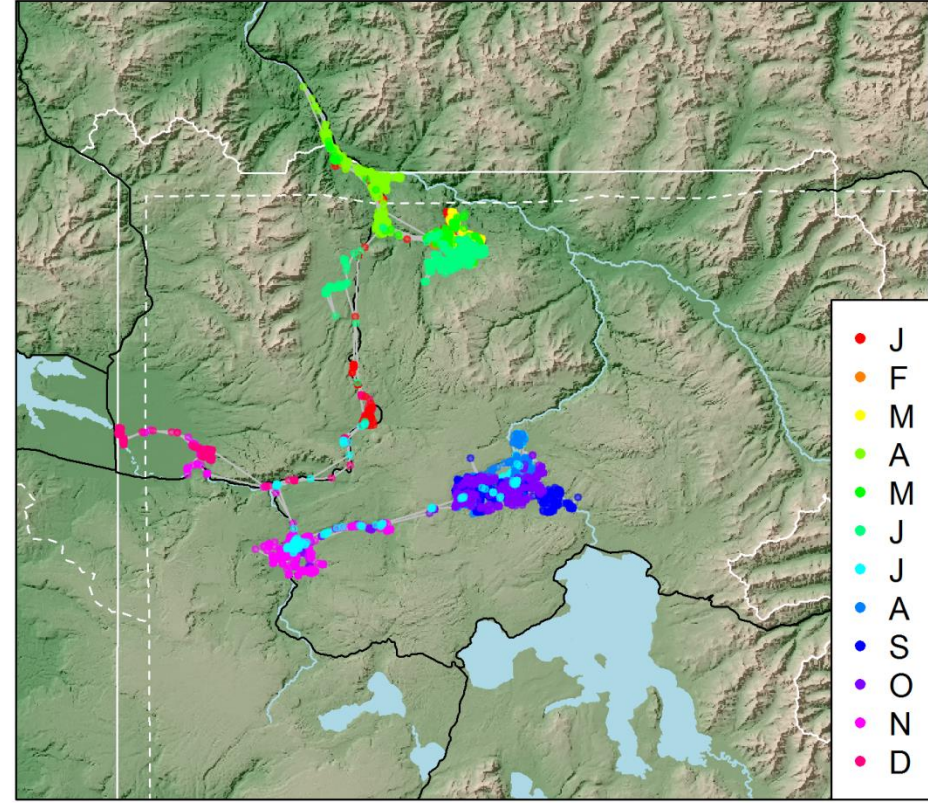
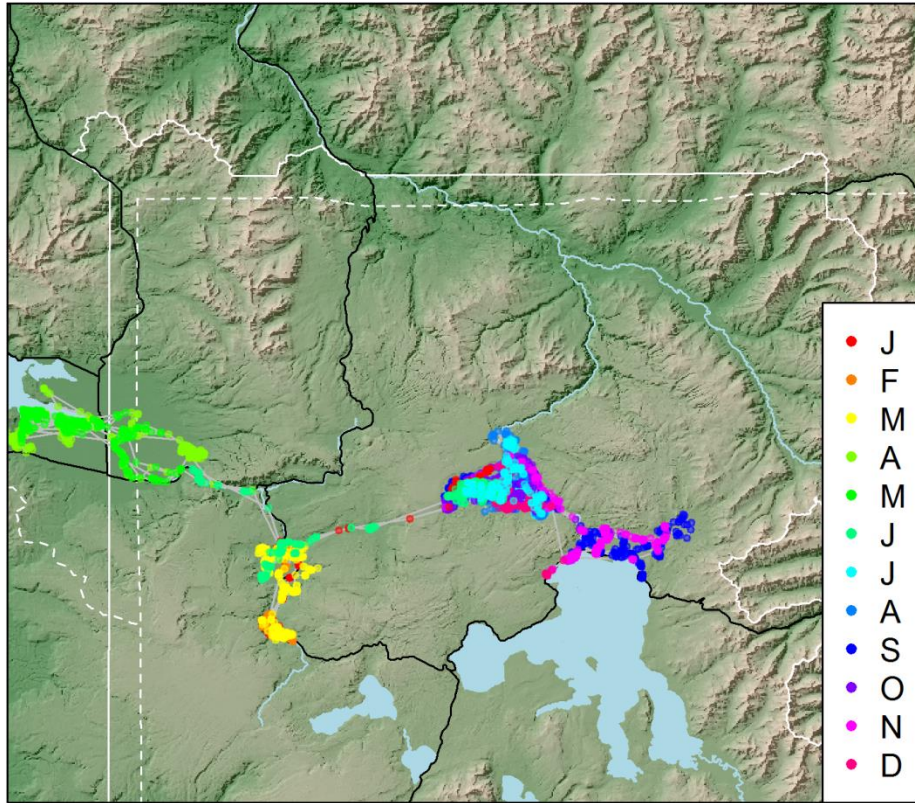


Range Residency

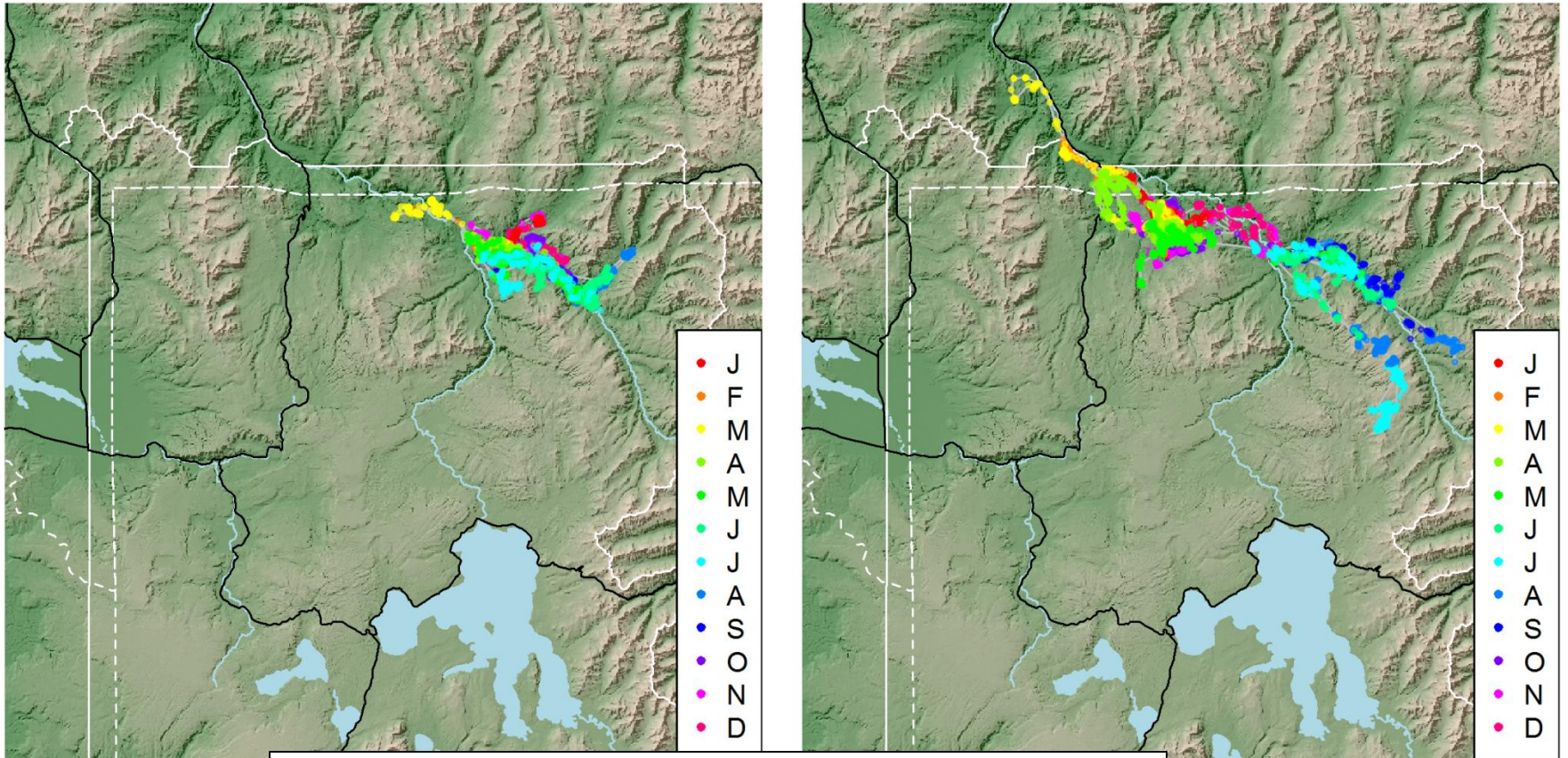
Migration

Nomadic

BISON MOVEMENTS: WINTER, TRANSITIONAL, and SUMMER RANGES



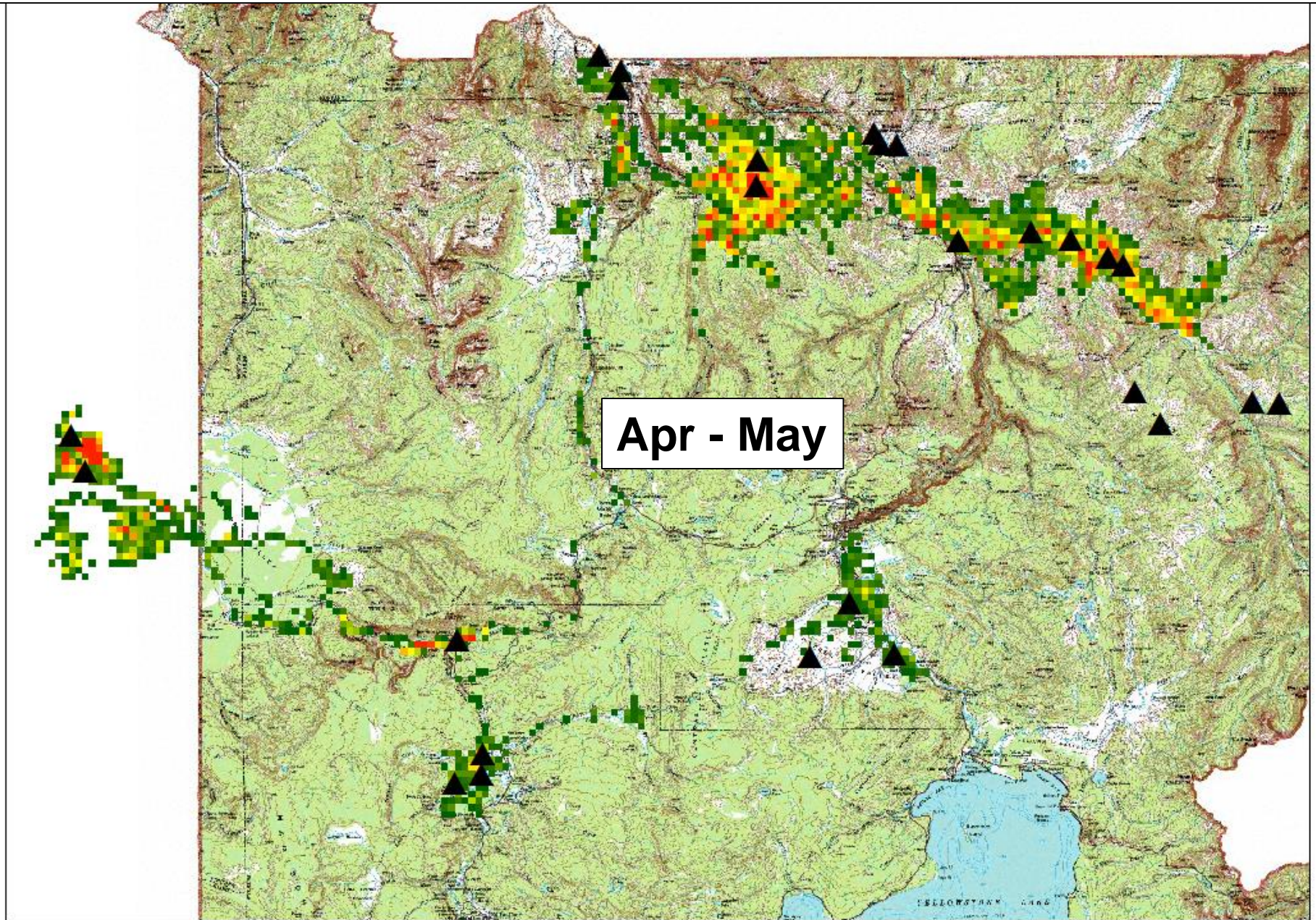
BISON MOVEMENTS: WINTER, TRANSITIONAL, and SUMMER RANGES



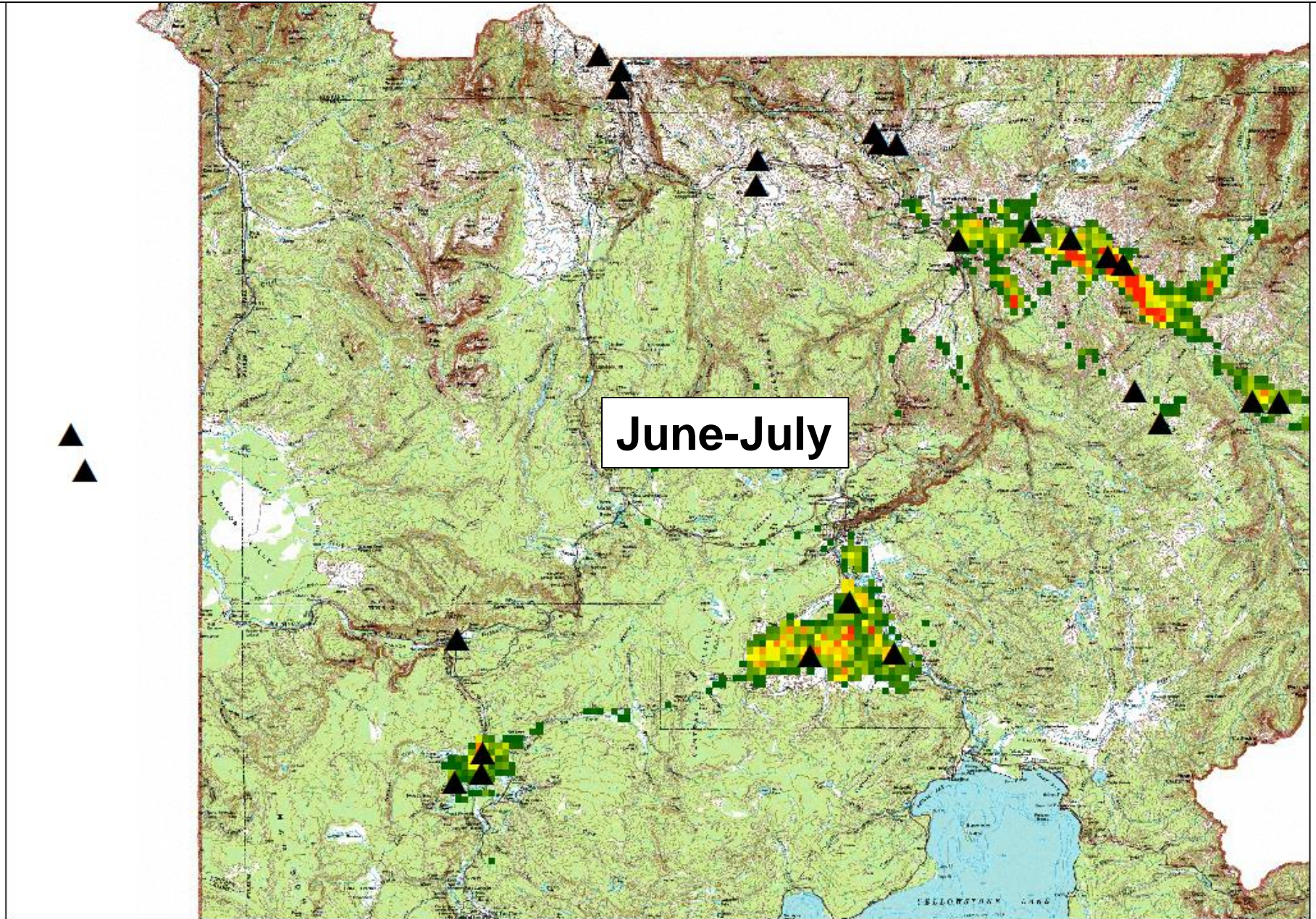
FULL NORTHERN MIGRATION ROUTE (70 km)

- 97% of northern herd animals used full route at least once
- 84% used the partial route at least once

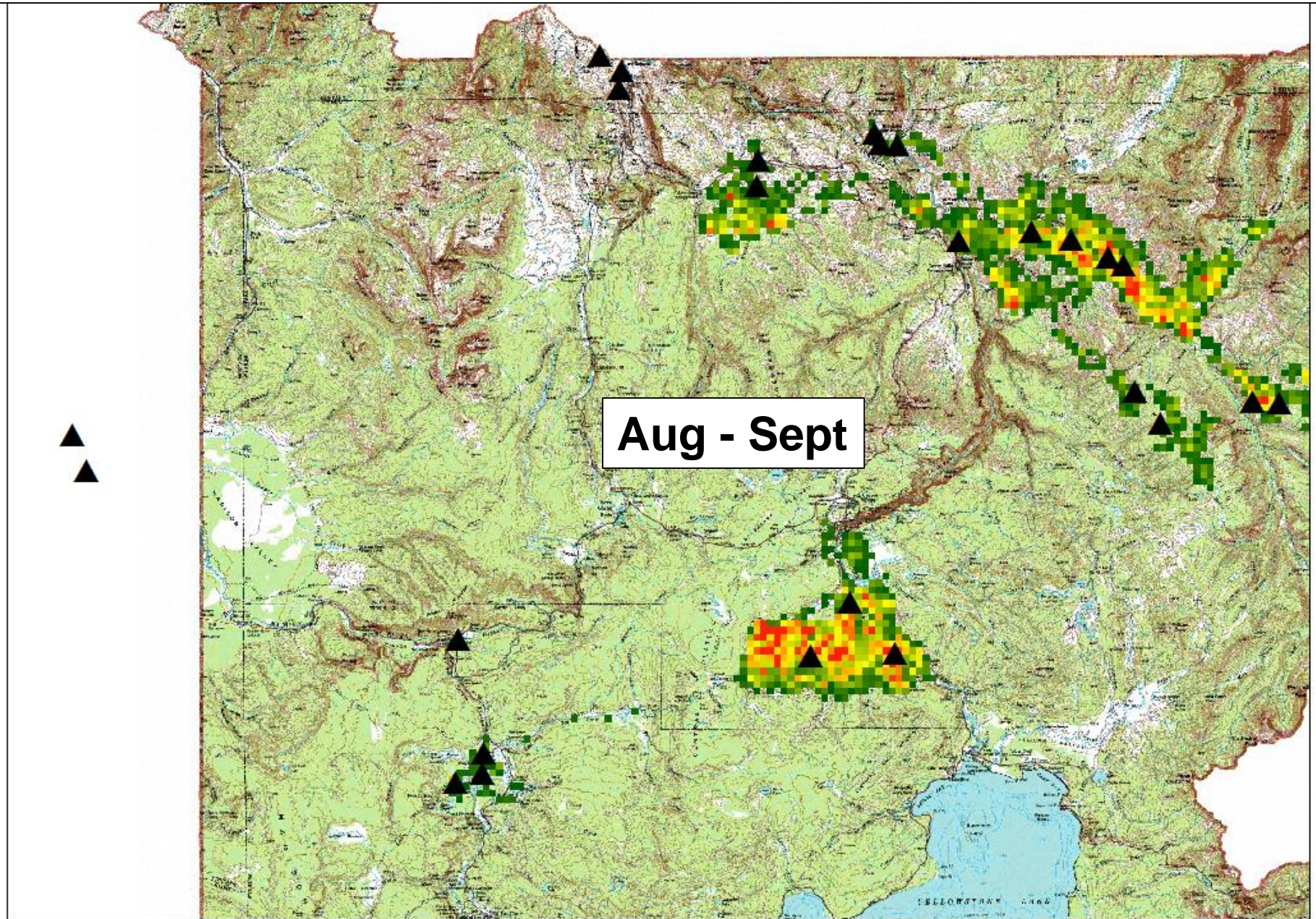
BISON MOVEMENTS: WINTER, TRANSITIONAL, and SUMMER RANGES



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BISON MOVEMENTS: WINTER, TRANSITIONAL, and SUMMER RANGES





Production

Consumption

Shoot Biomass

Soil Nitrogen Availability

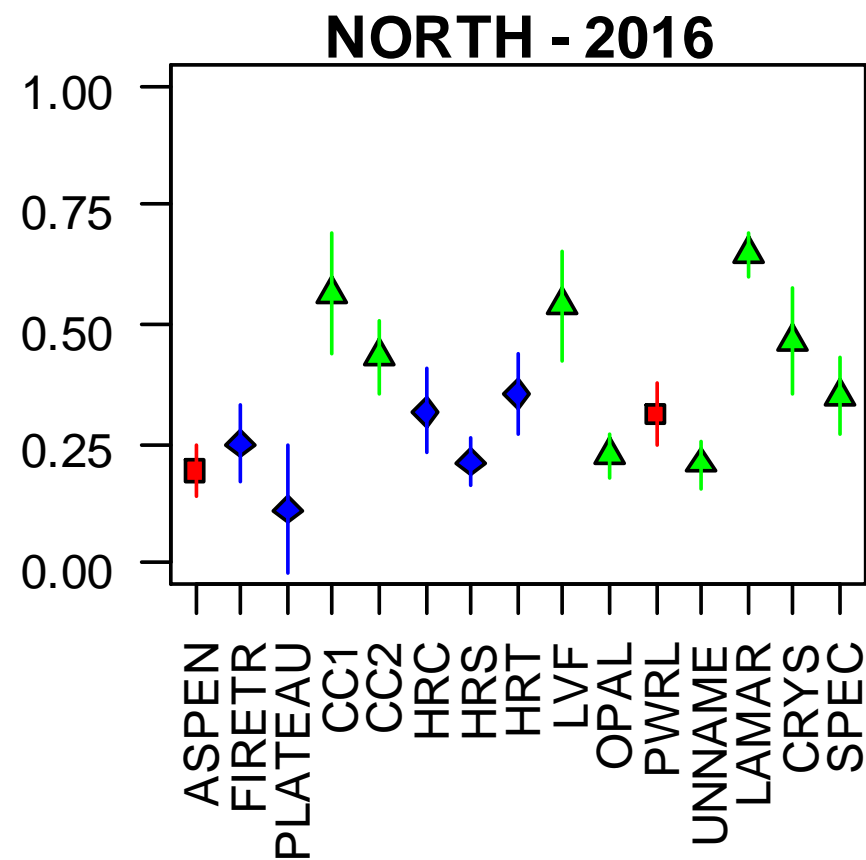
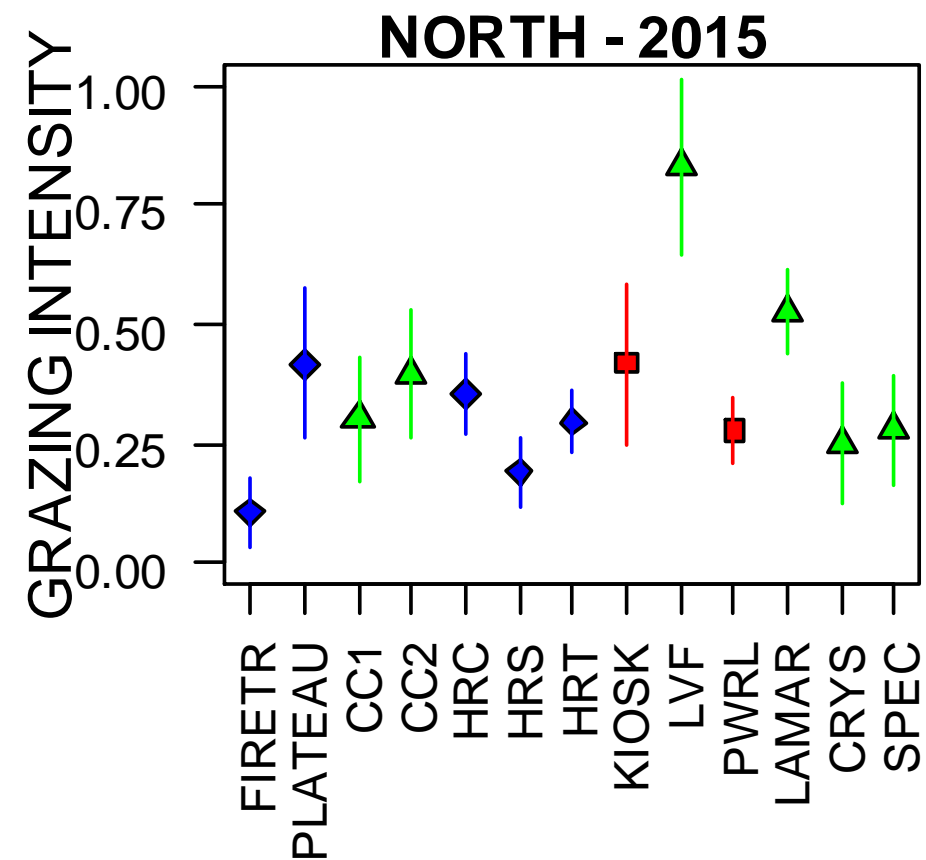
Leaf /Composite Nitrogen

Leaf Digestibility

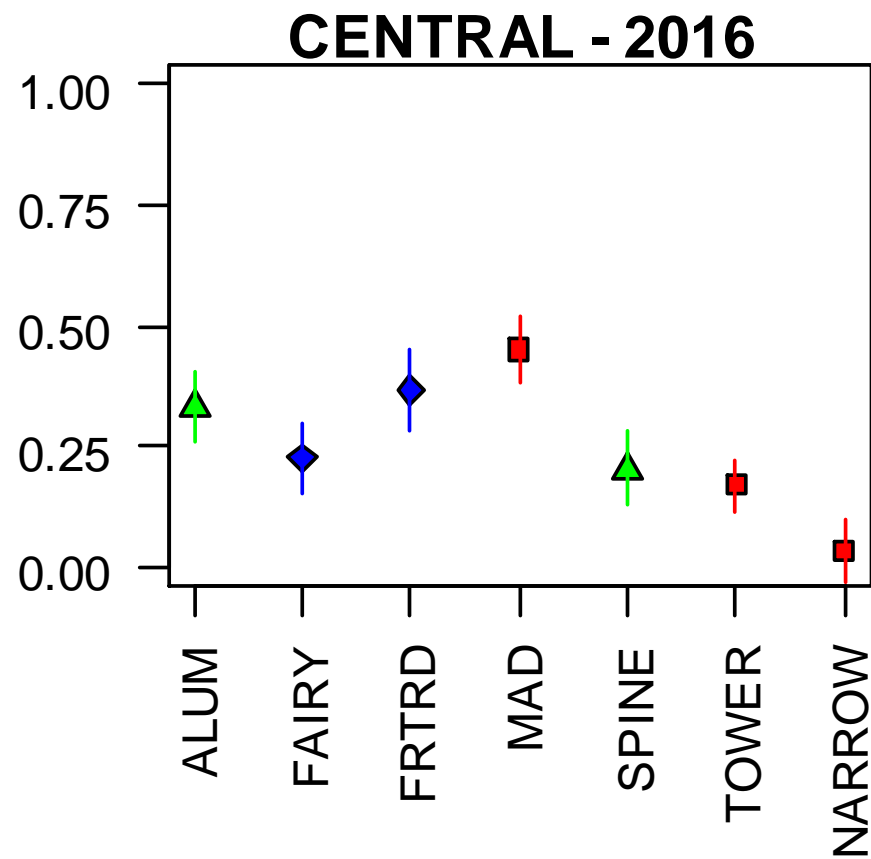
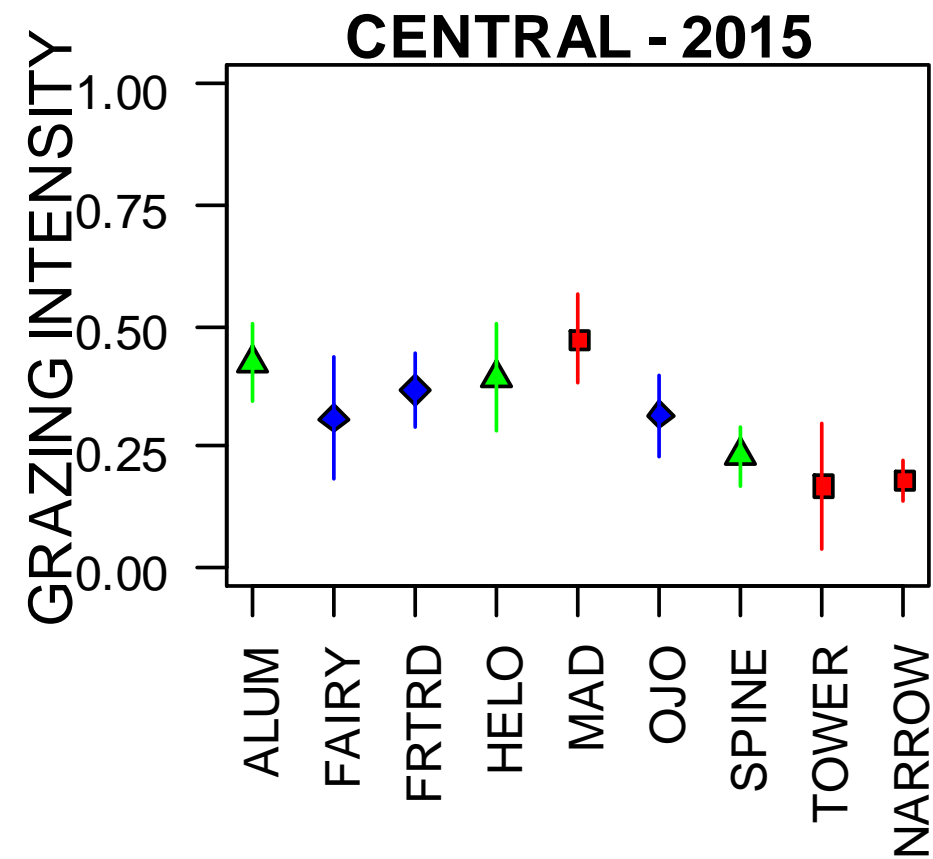
Visitation



GRAZING INTENSITY – NORTHERN YELLOWSTONE

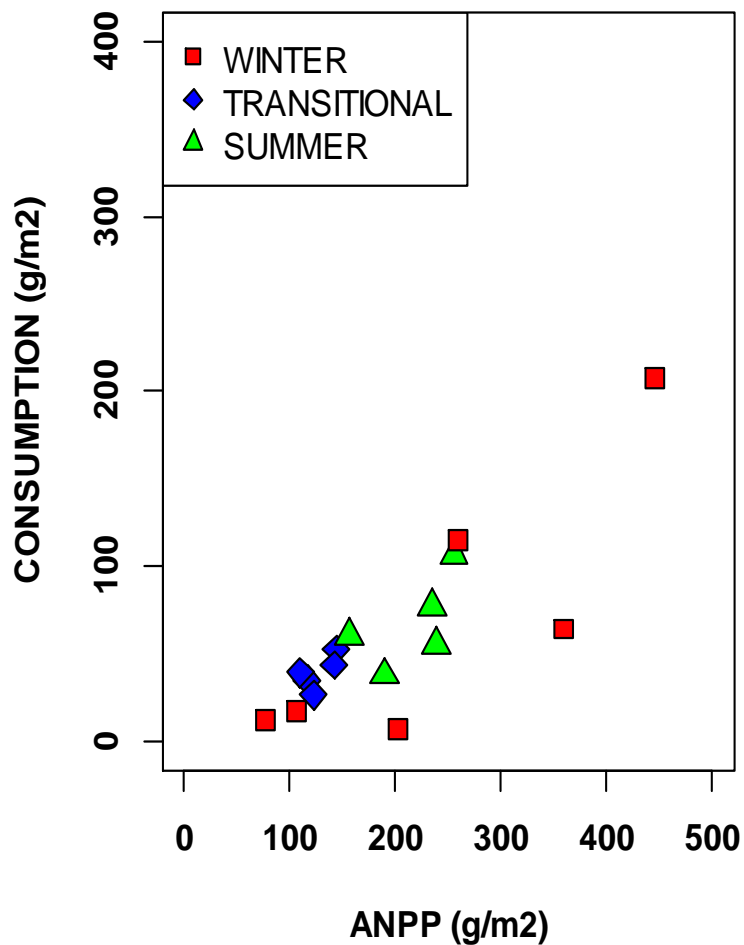


GRAZING INTENSITY – CENTRAL YELLOWSTONE

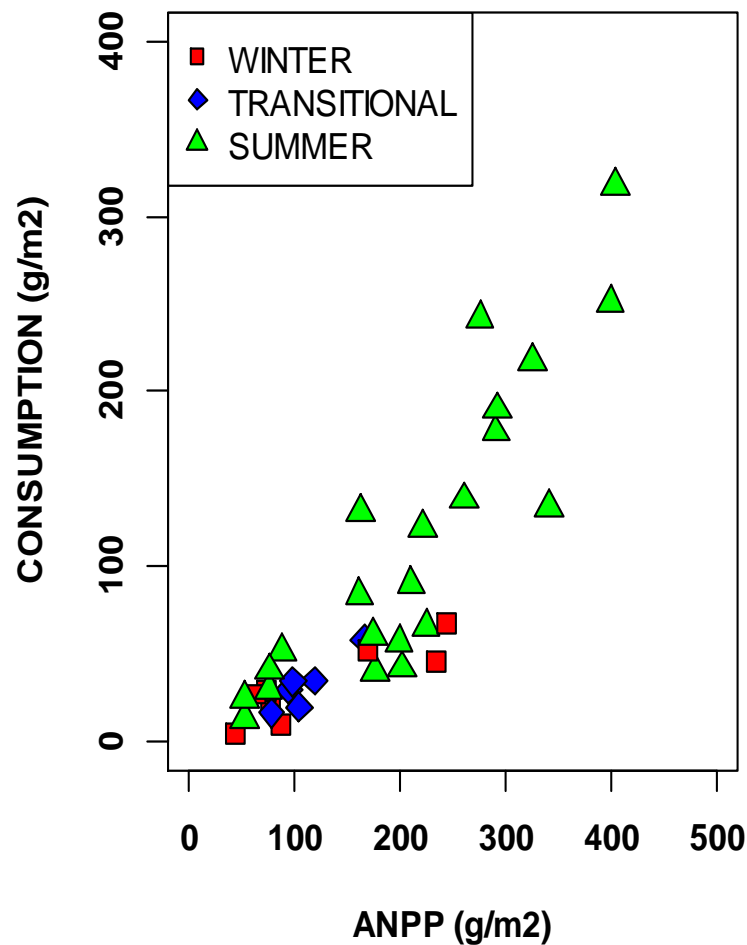


BISON NEED PRODUCTIVE AREAS

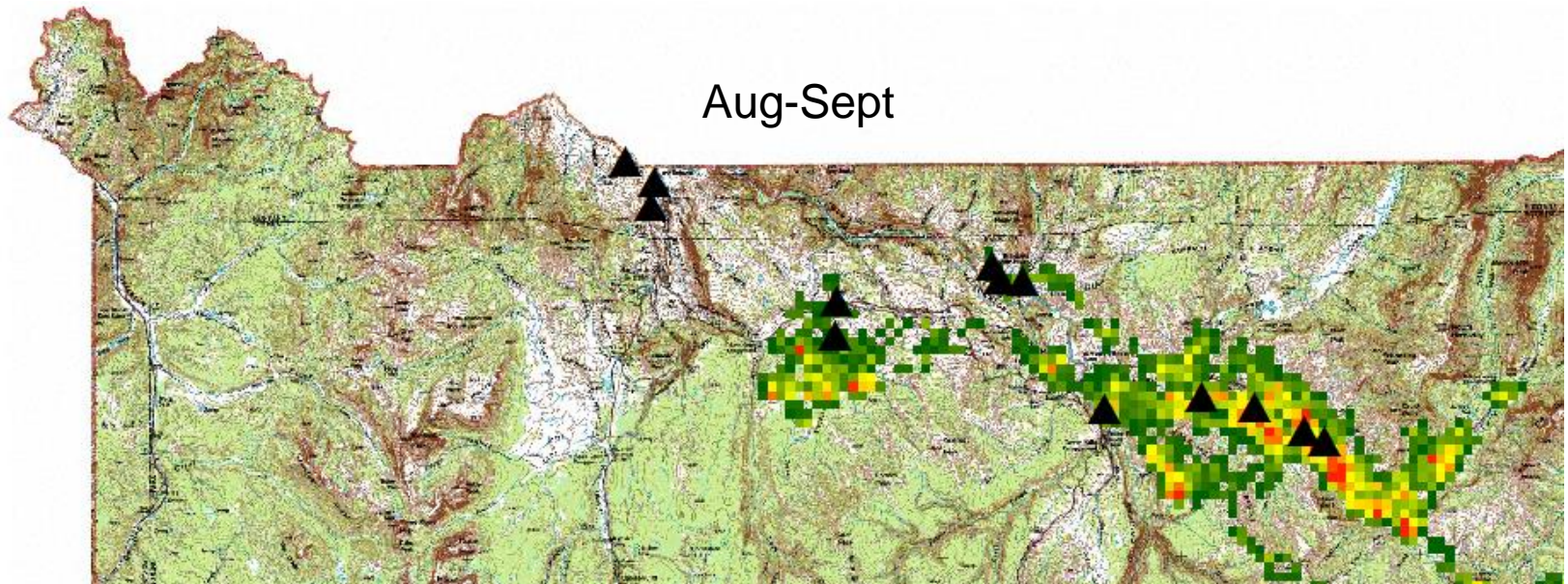
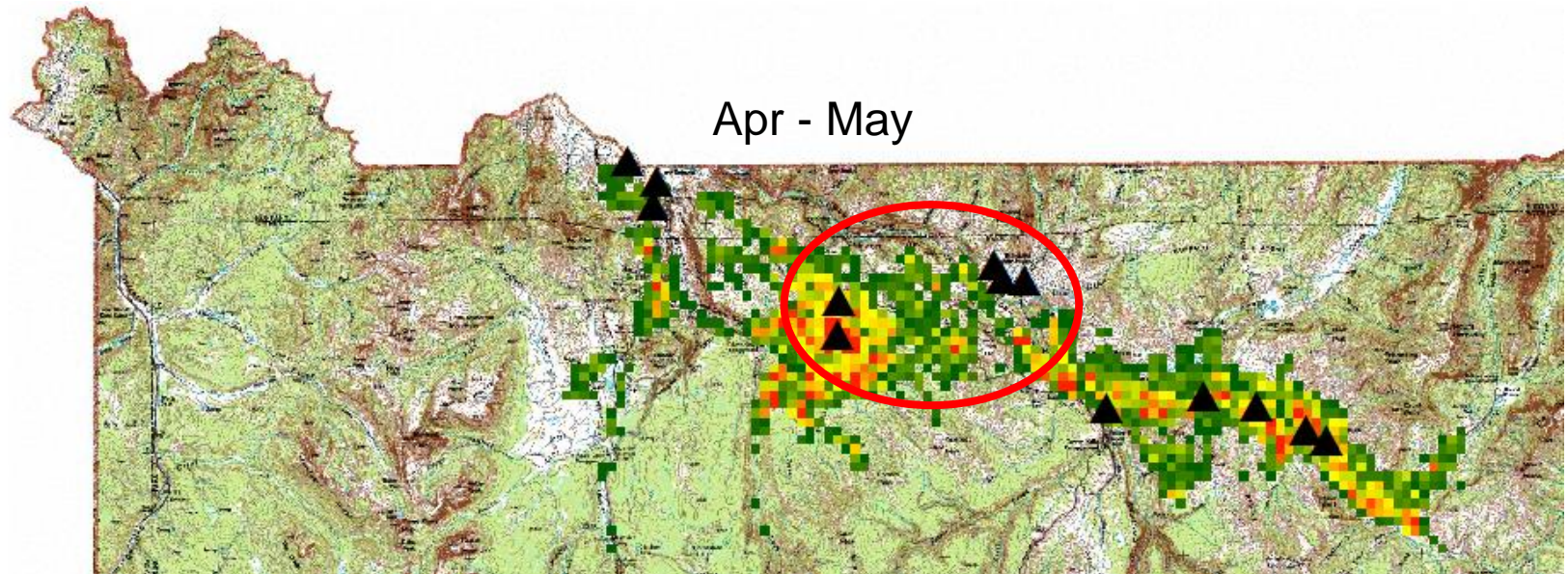
CENTRAL



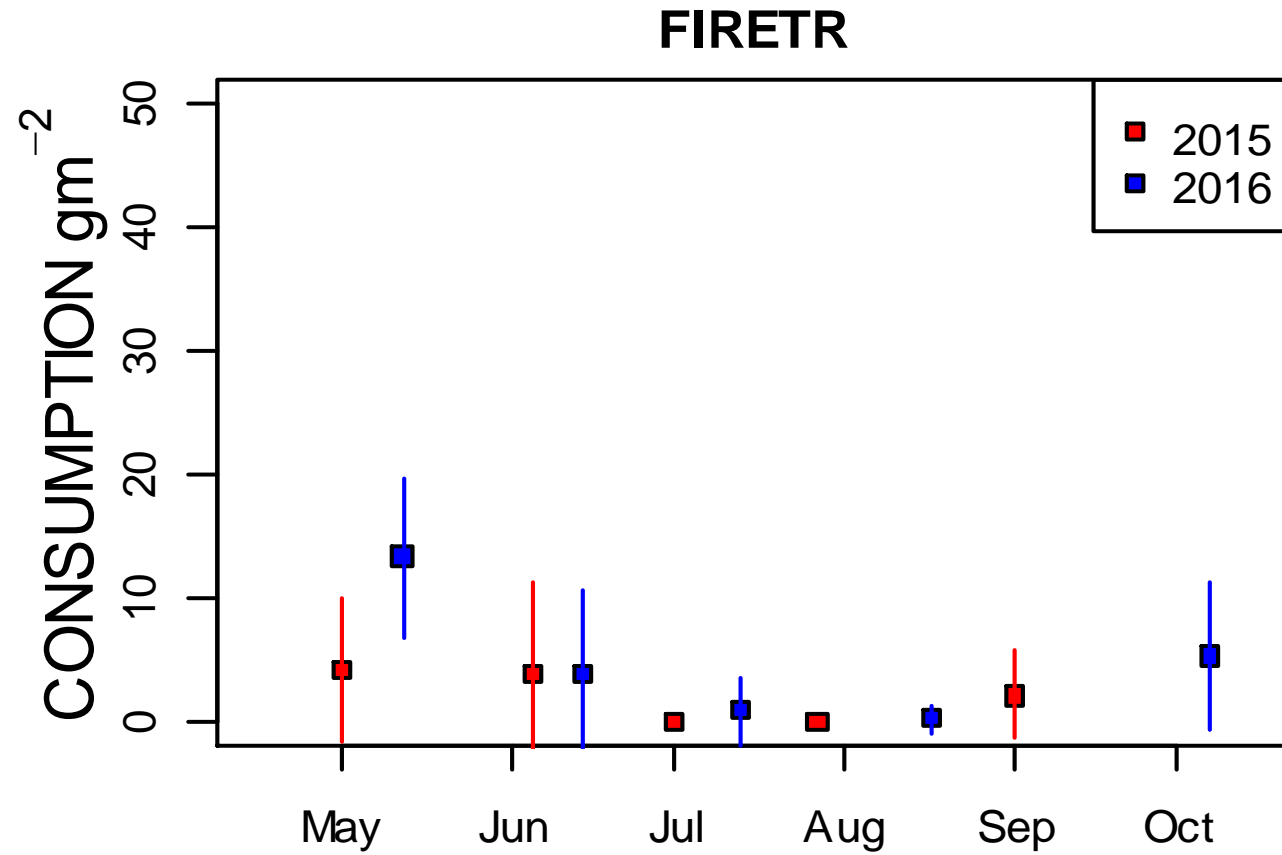
NORTHERN



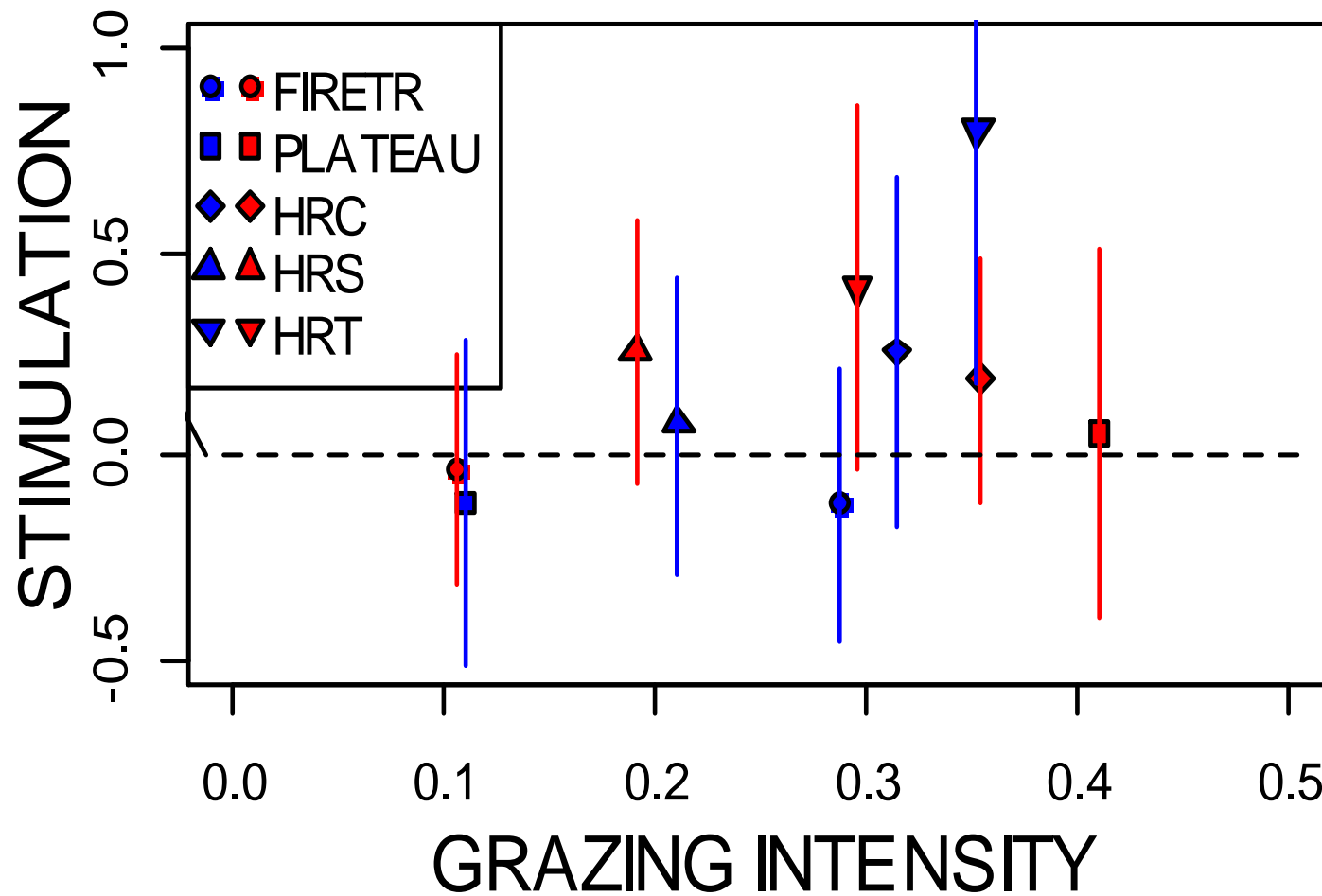
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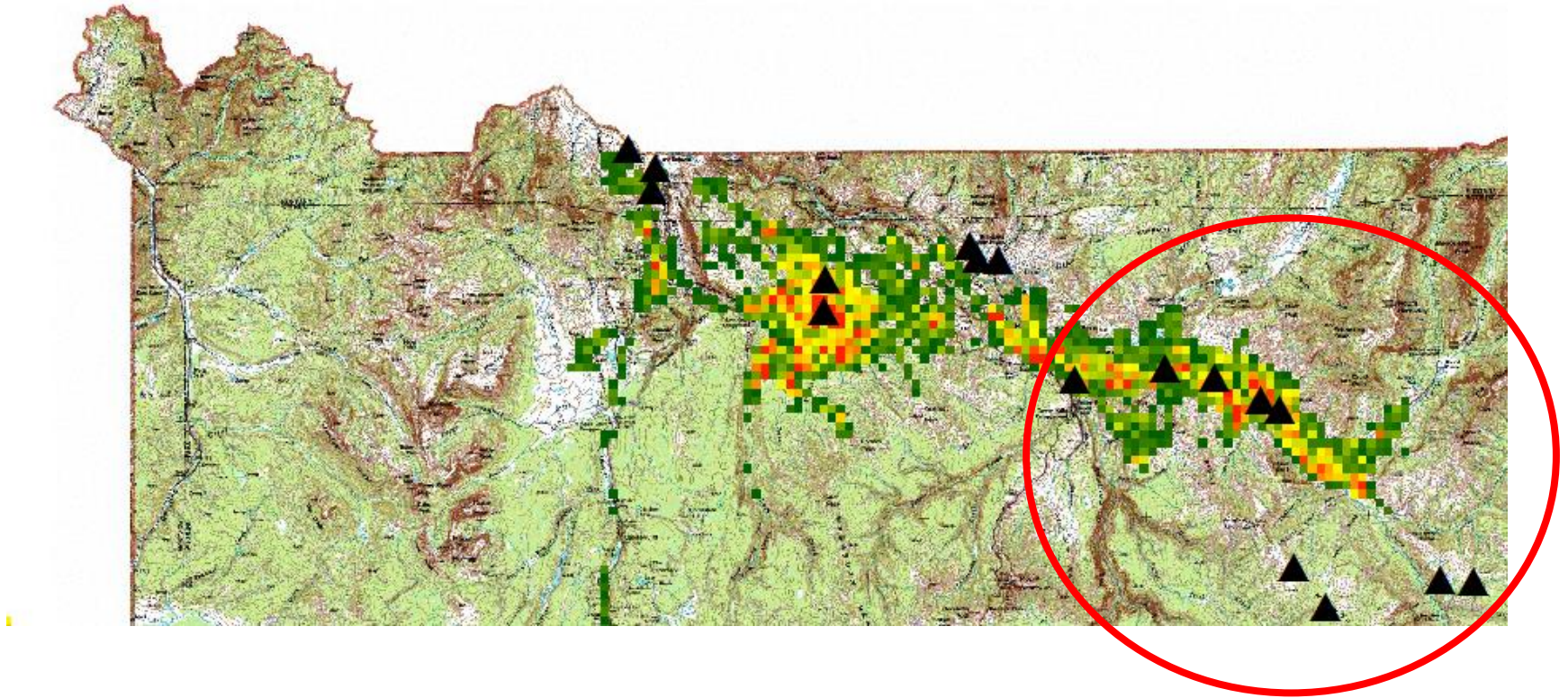


GRAZING INTENSITY – NORTHERN YELLOWSTONE



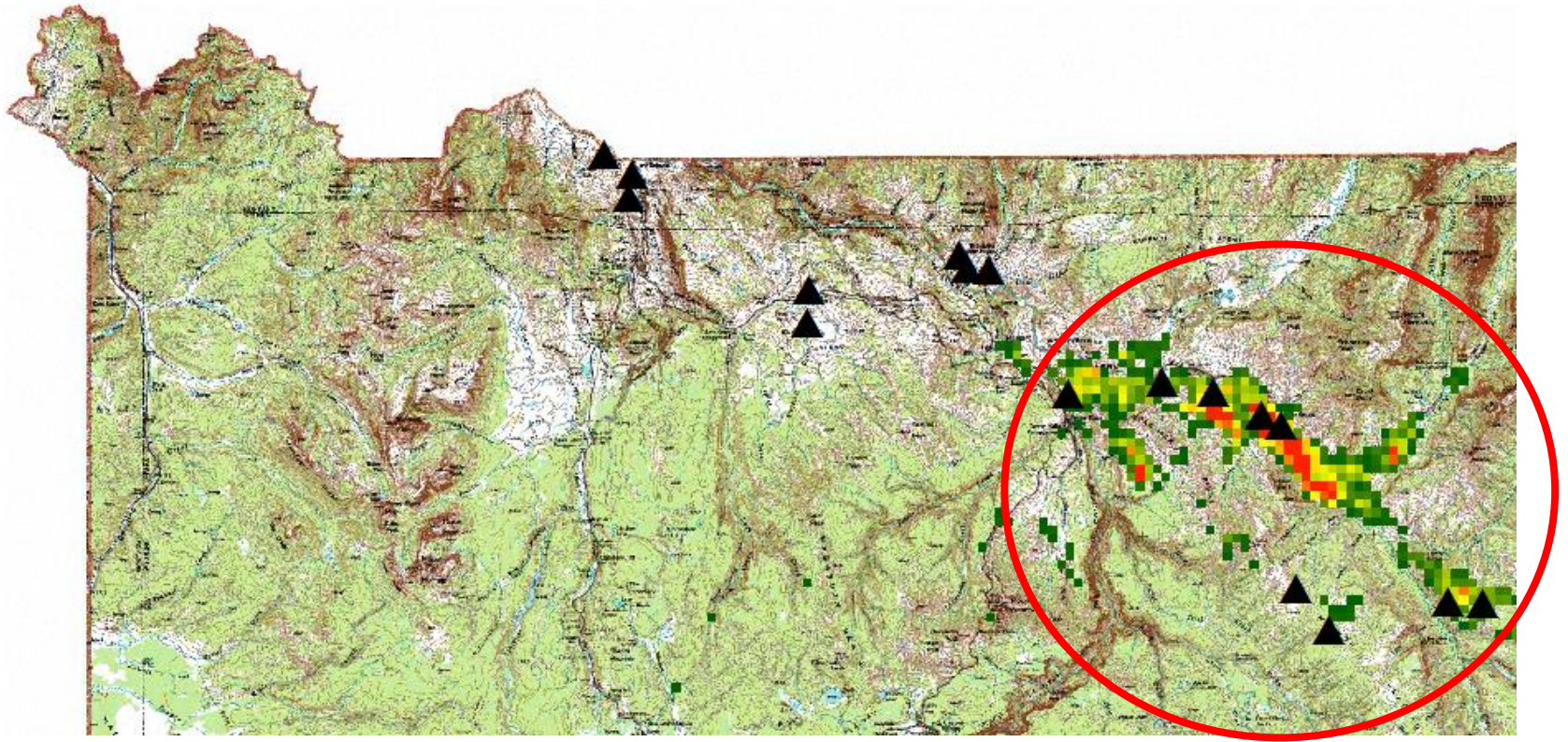
GRAZING INTENSITY – NORTHERN YELLOWSTONE

Apr - May



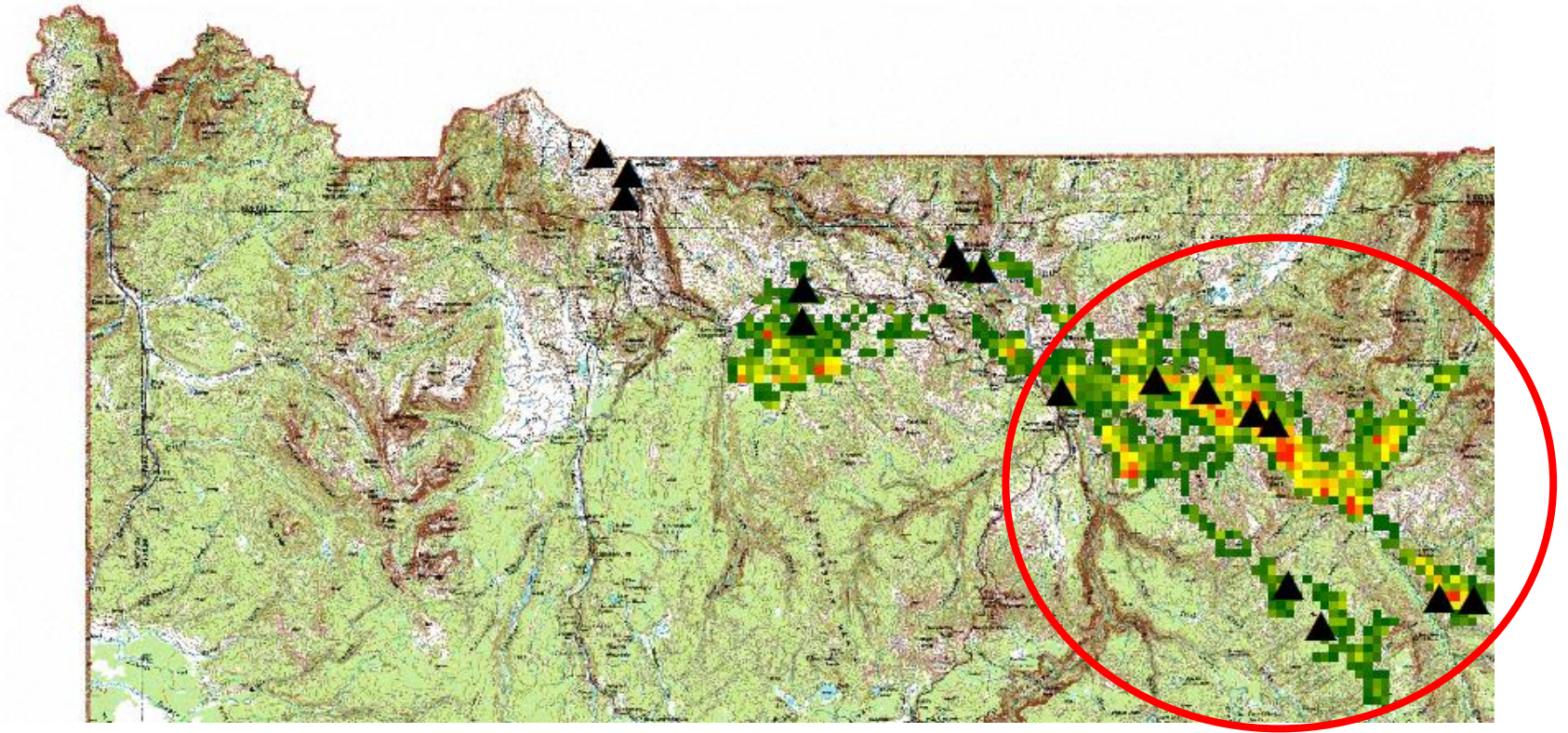
GRAZING INTENSITY – NORTHERN YELLOWSTONE

June-July



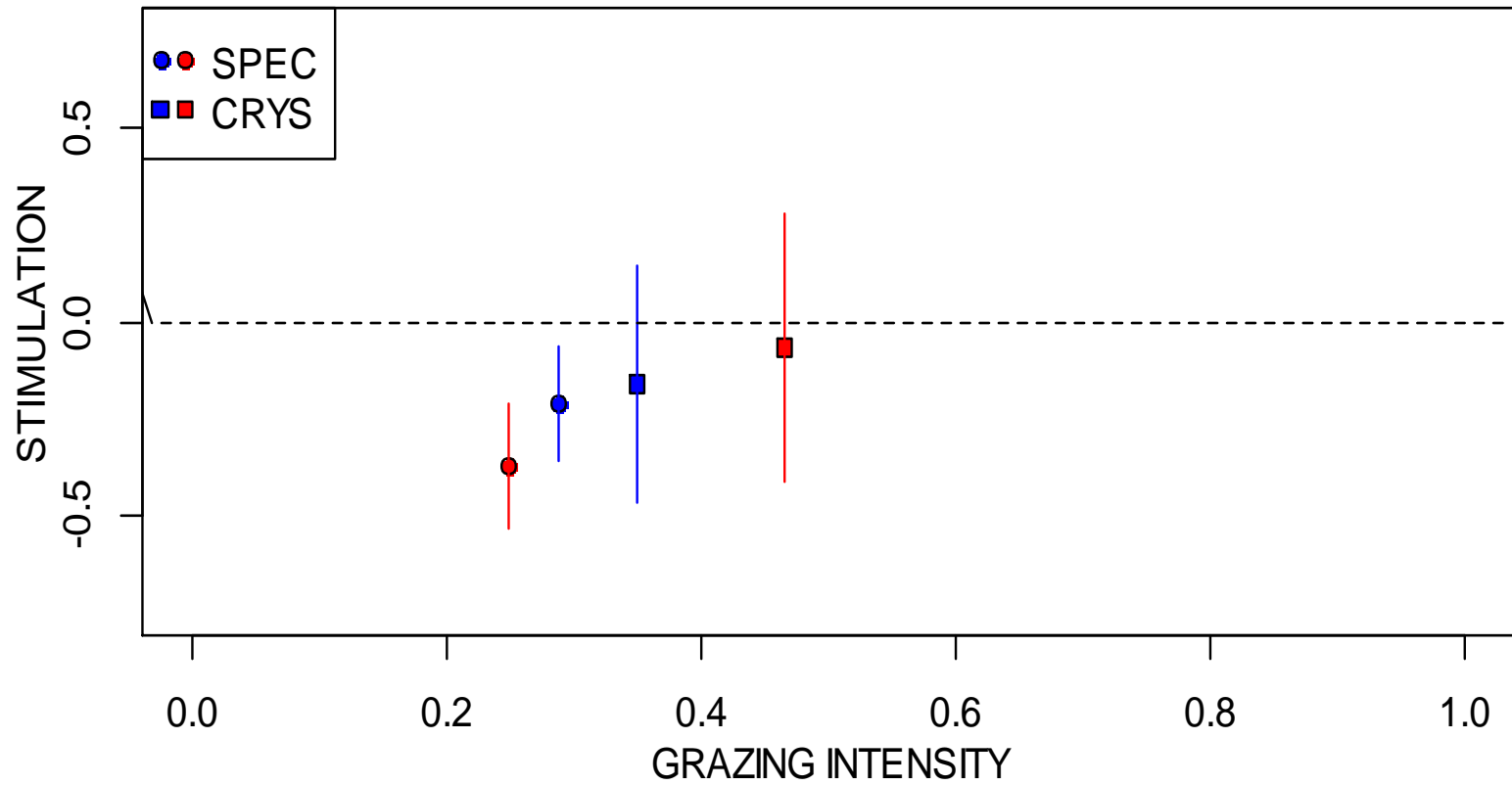
GRAZING INTENSITY – NORTHERN YELLOWSTONE

Aug - Sept



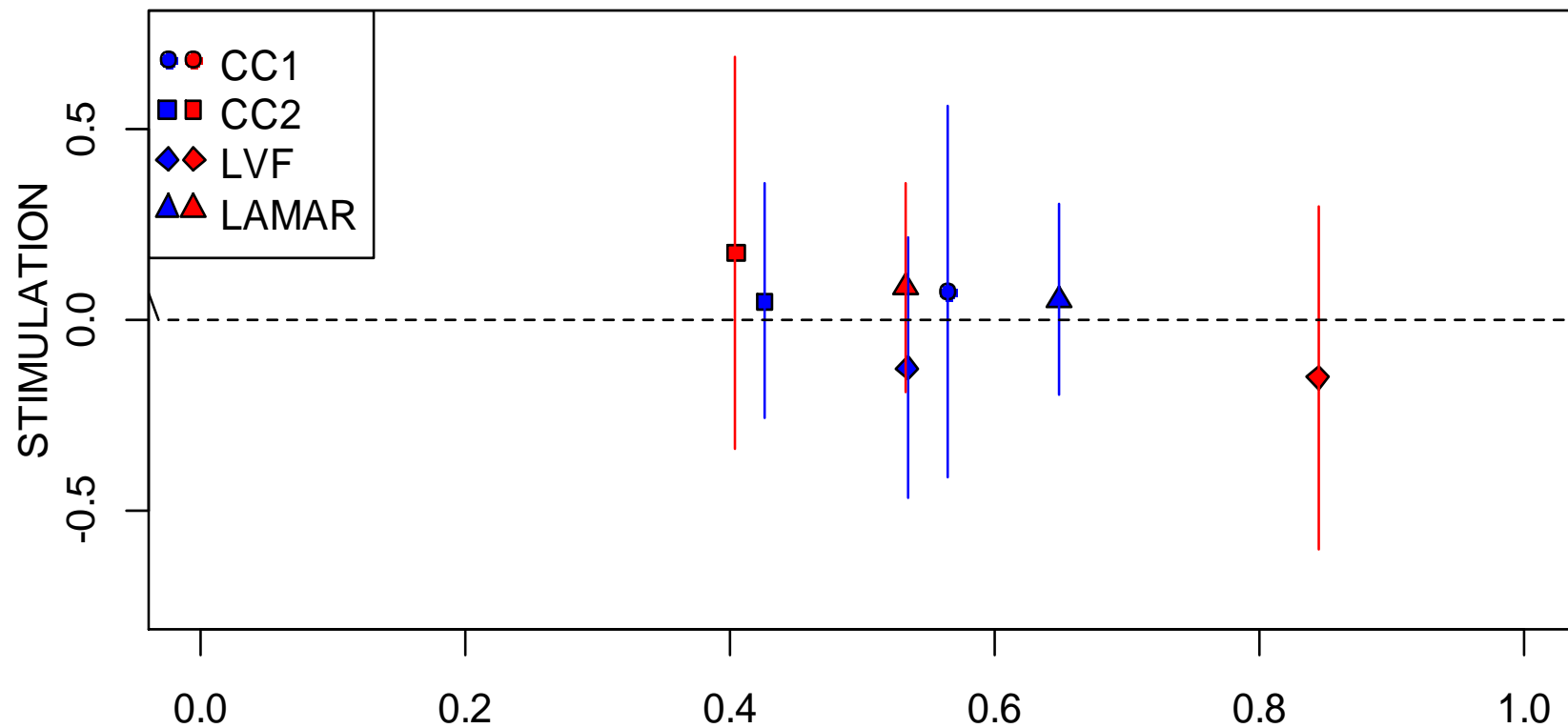
GRAZING INTENSITY – NORTHERN YELLOWSTONE

DRY

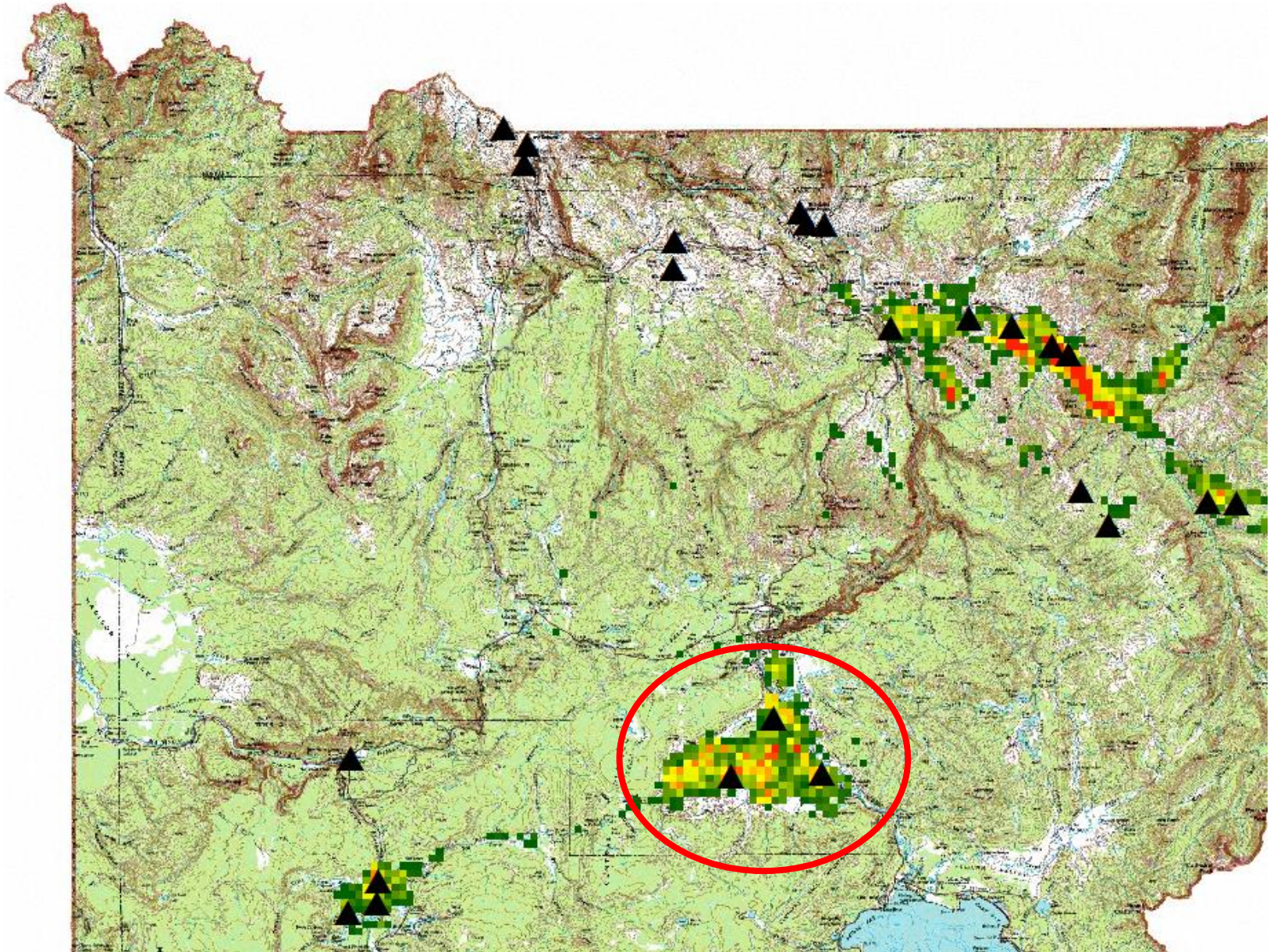


GRAZING INTENSITY – NORTHERN YELLOWSTONE

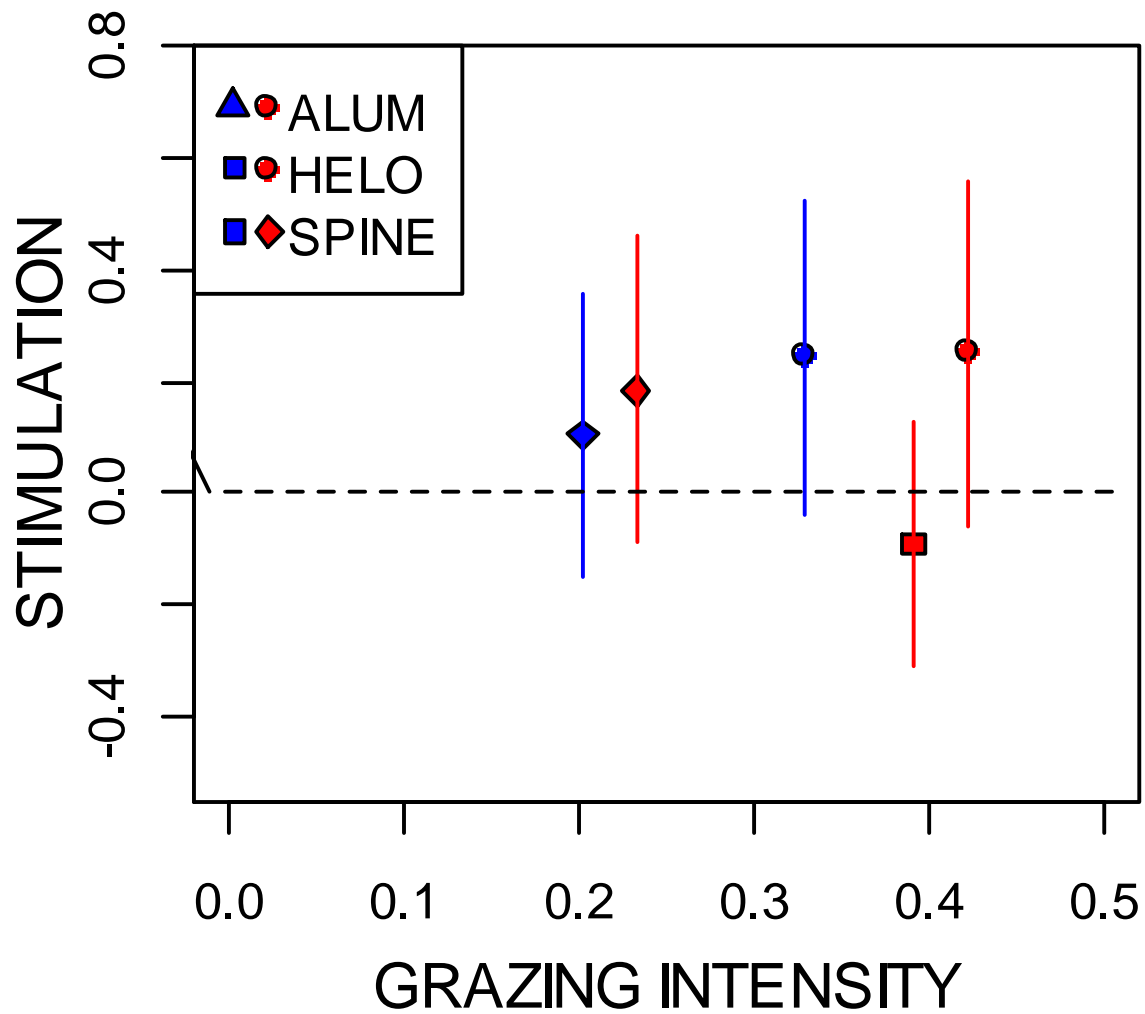
MESIC



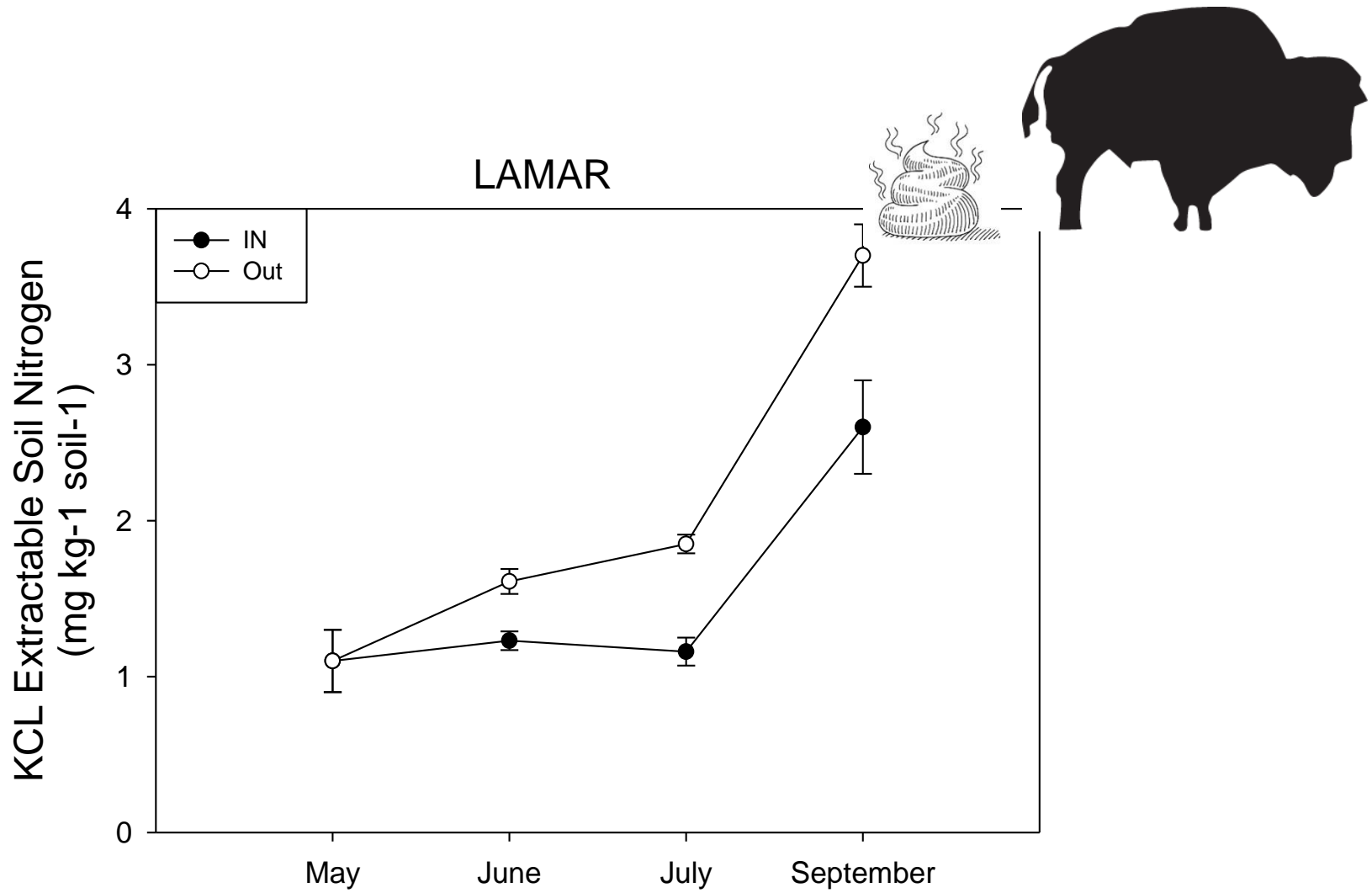
GRAZING INTENSITY – CENTRAL YELLOWSTONE



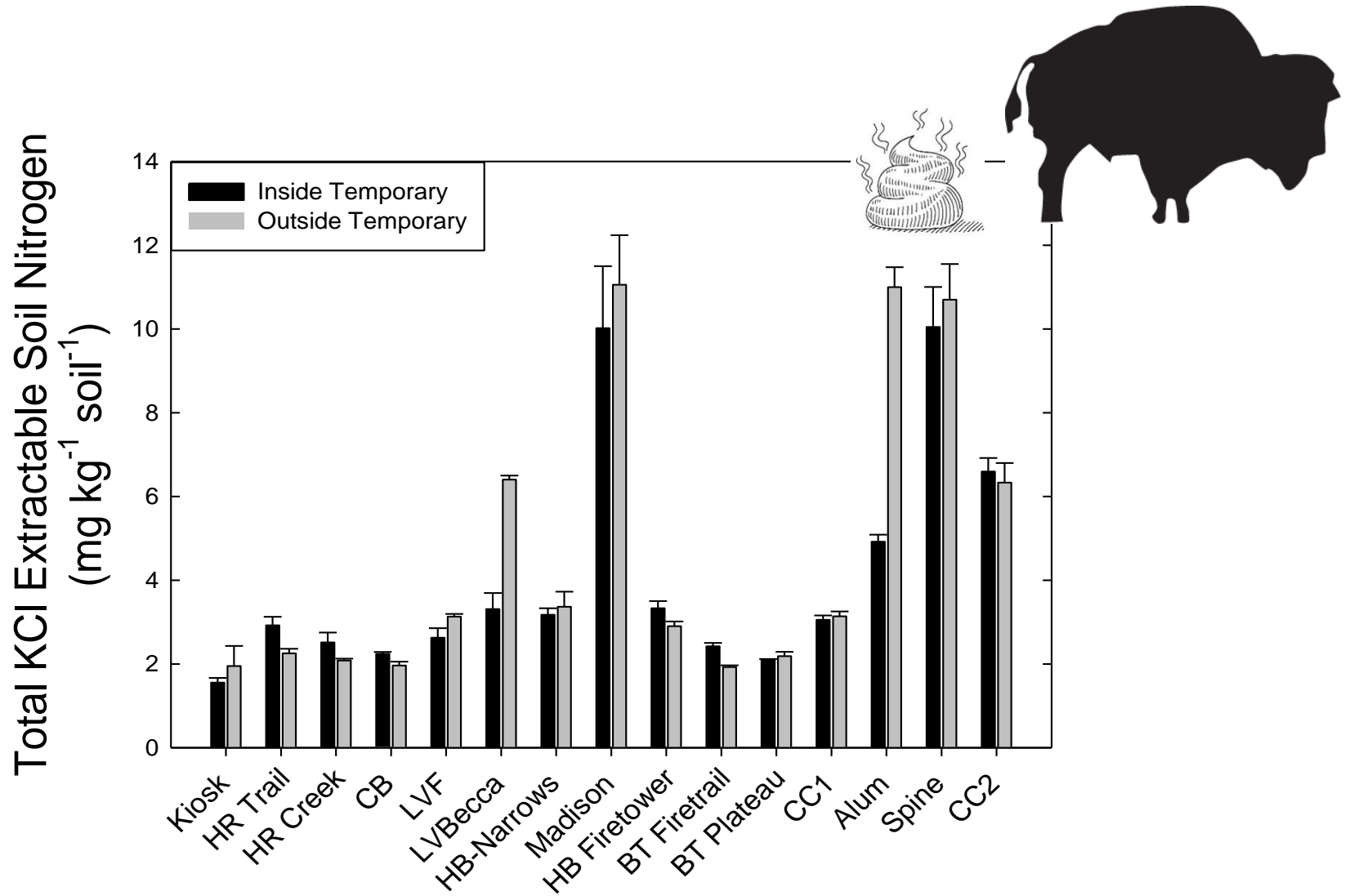
GRAZING INTENSITY – CENTRAL YELLOWSTONE



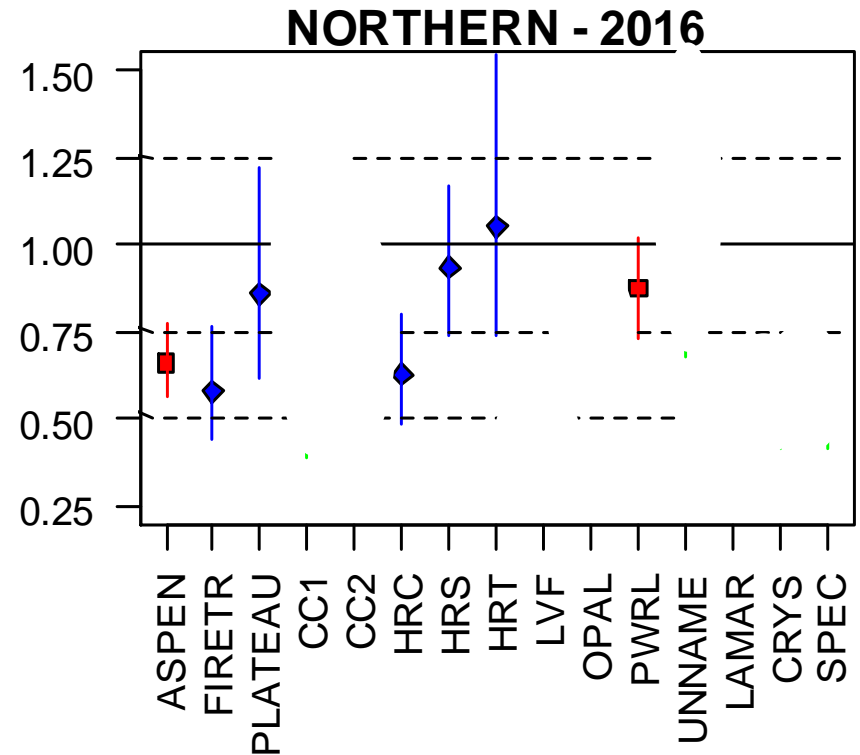
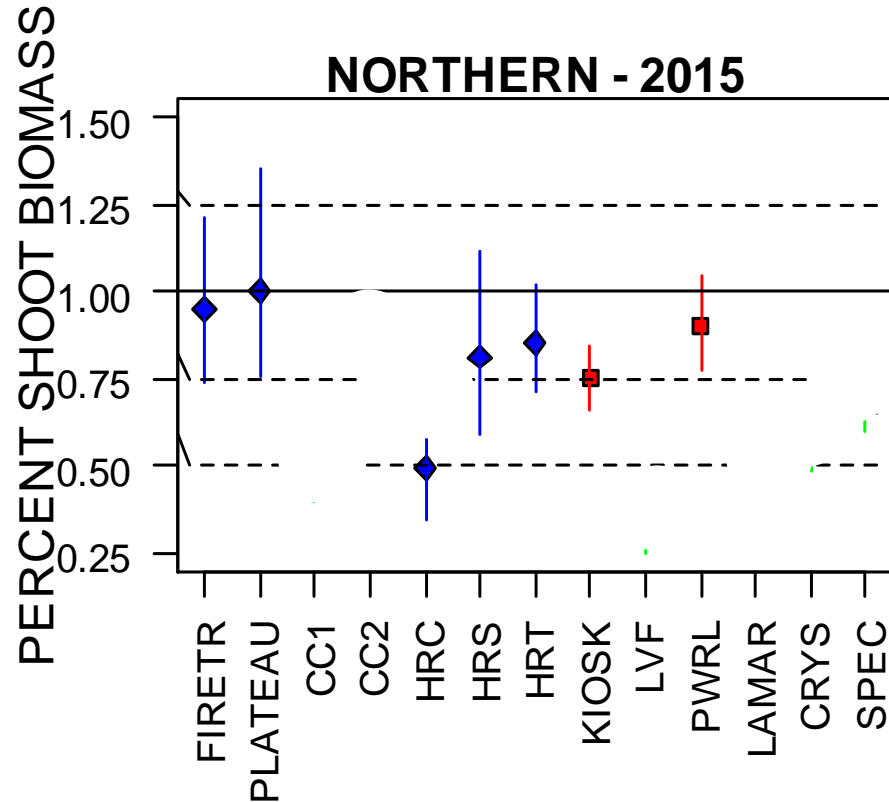
NITROGEN CYCLING: A POSITIVE FEEDBACK ON PRODUCTION



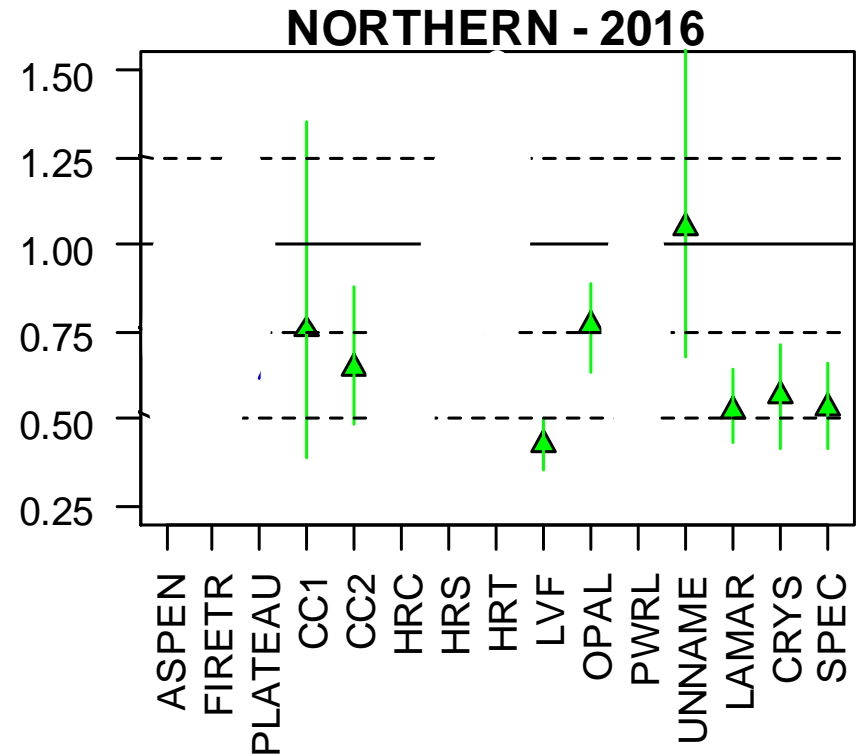
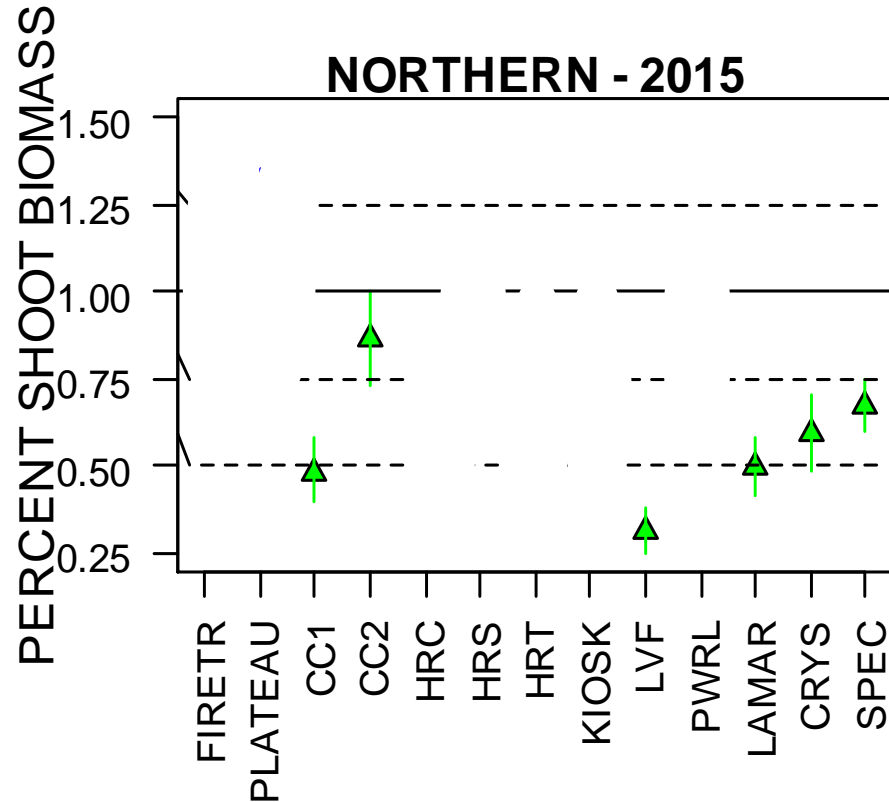
NITROGEN CYCLING: A POSITIVE FEEDBACK ON PRODUCTION



BISON GRAZING: IMPROVED FOOD QUALITY UNDER INTENSIVE GRAZING

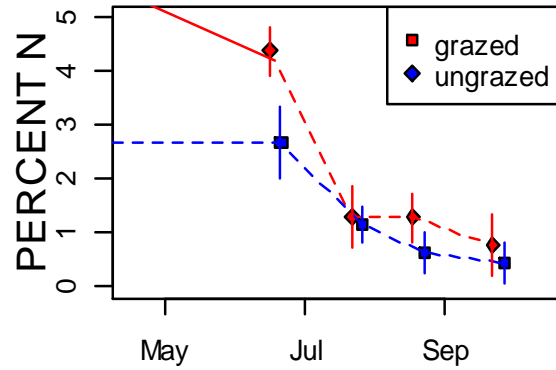


BISON GRAZING: IMPROVED FOOD QUALITY UNDER INTENSIVE GRAZING

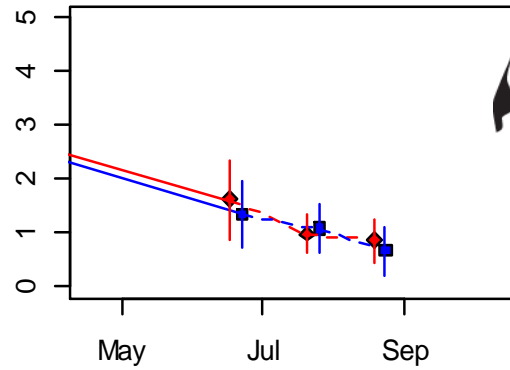


BISON GRAZING: IMPROVED FOOD QUALITY UNDER INTENSIVE GRAZING

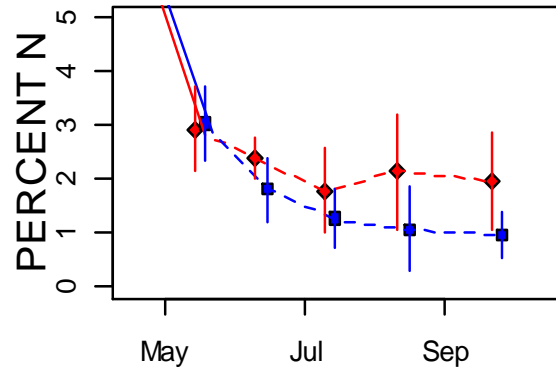
CC1



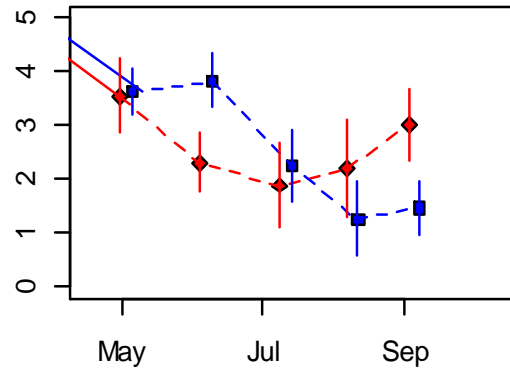
CC2



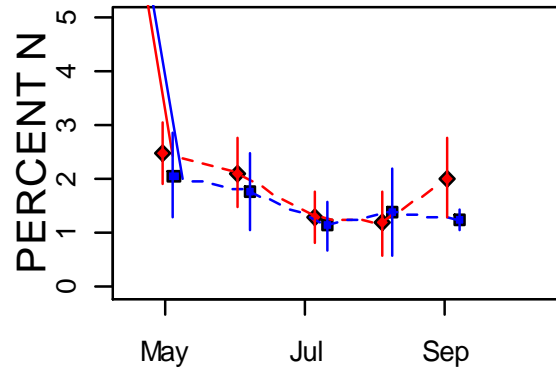
LVF



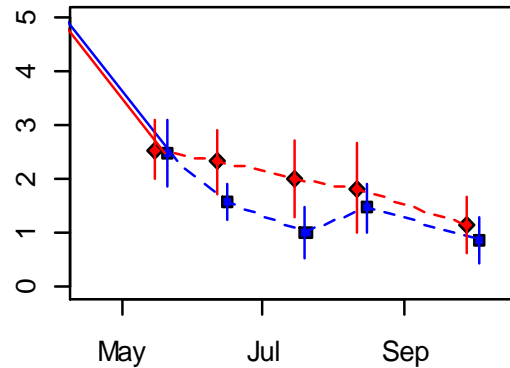
LAMAR



CRYS



SPEC



KEY POINTS:

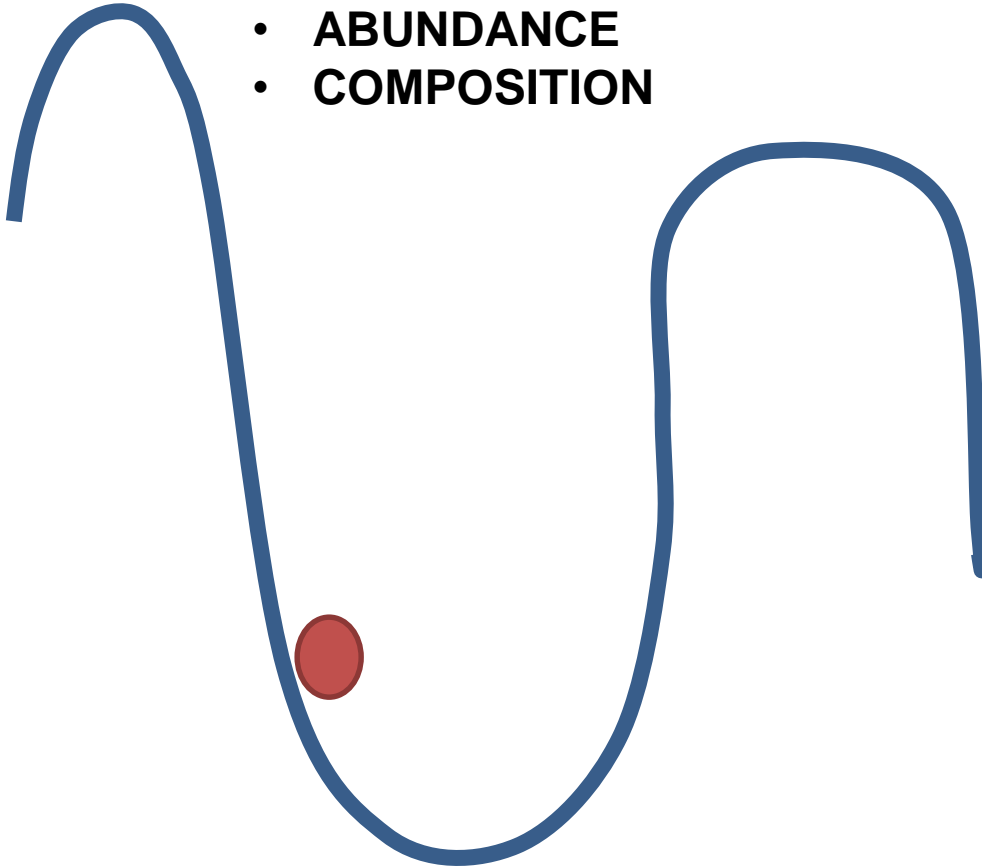
- Production is the amount of new plant tissue made during a growing season. Production is a key indicator of ecosystem health, because it is the basic component of food for all higher organisms in the ecosystem
- We found that grazing increased production on wintering and transitional areas used by bison in northern Yellowstone. With 4,000 bison in northern Yellowstone, grazing intensities were moderate 10-40% with a period of the growing season where no grazing occurred
- Bunchgrass-shrubland communities on summering areas in northern Yellowstone that were grazed were less productive than ungrazed areas. Grazing intensities were 20-50%, but areas were used by bison throughout the growing season. We suspect continued use and the effects of trampling and wallowing reduced productivity. These areas provide some indication that grazing at similar intensity for long periods of time may not be sustainable.

KEY POINTS:

- Production was maintained under high grazing (50-70%) in sod-forming, wet vegetation communities with 4,000 bison in northern Yellowstone. These areas were repeatedly grazed throughout summer and shoot biomass at the end of the growing season averaged 50% of ungrazed areas.
- Grazing had positive feedbacks on production and food quality. Grazing improved N-availability which likely contributed to sustaining/enhancing ANPP under grazing. Grazing improved food quality by reducing shoot biomass, increasing crude protein, and in some cases, lowering the amount of indigestible material in plant tissue.

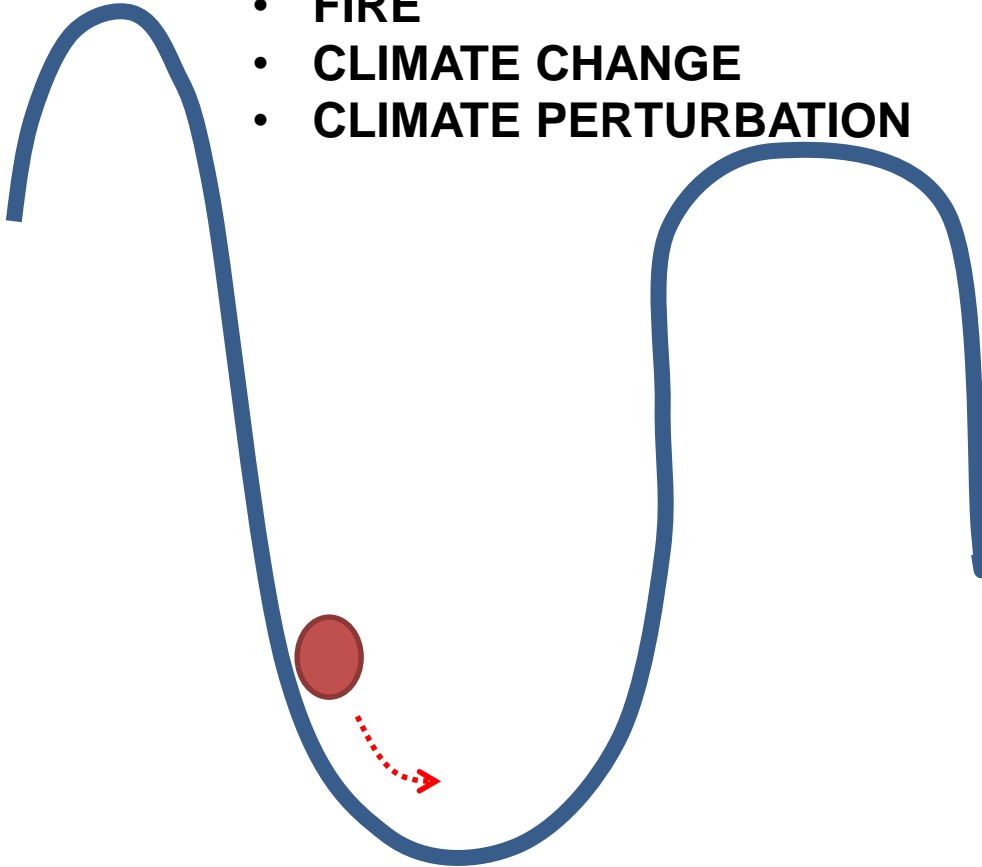
ECOSYSTEM SERVICES

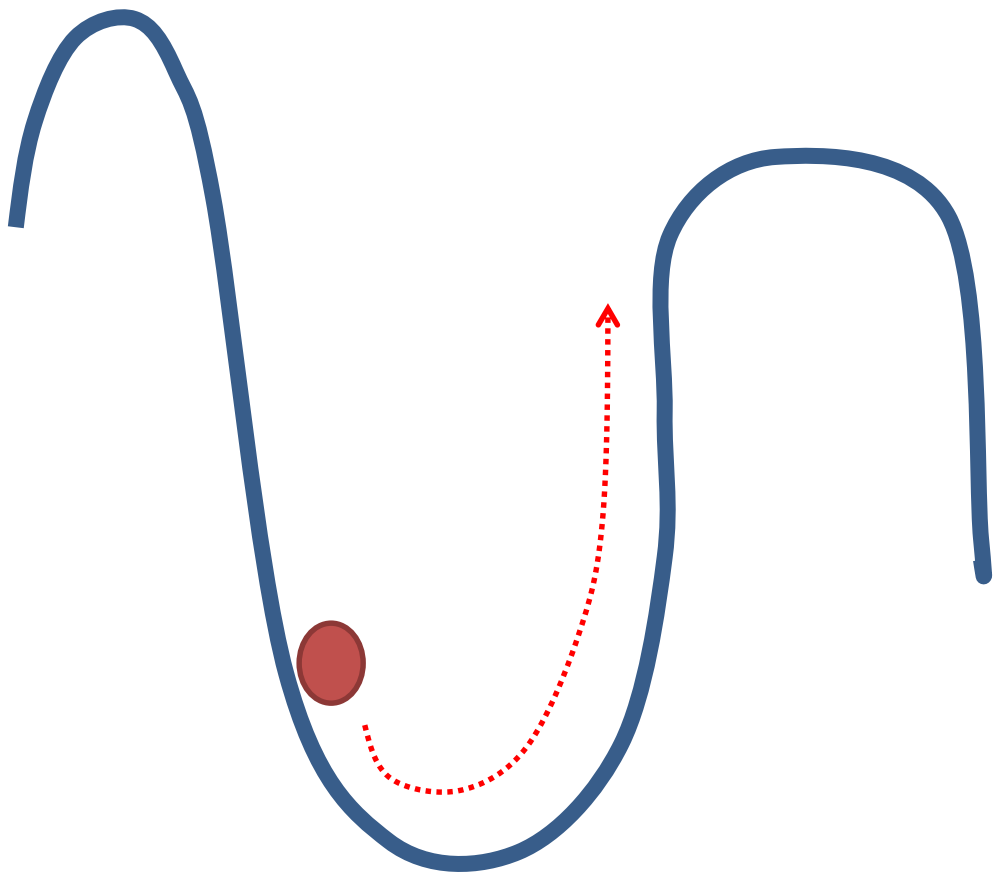
- ANPP
- ABUNDANCE
- COMPOSITION

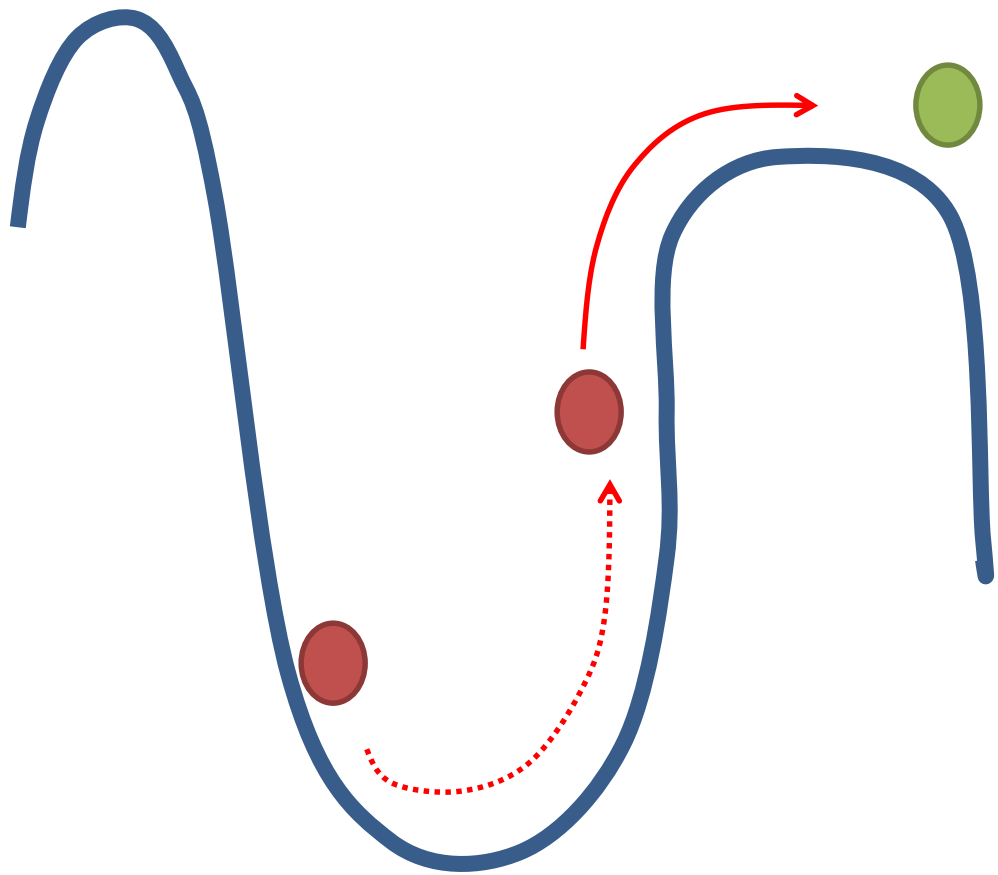


DISTURBANCE:

- **GRAZING**
- **FIRE**
- **CLIMATE CHANGE**
- **CLIMATE PERTURBATION**







NEXT STEPS:

- IDENTIFY CONDITIONS THAT ARE UNSUSTAINABLE FOR KEY VEGETATION COMMUNITIES
- PERFORM GREENHOUSE AND FIELD MANIPULATION EXPERIMENTS THAT SIMULATE DISTURBANCE
- EXPAND MONITORING TO INCLUDE ANPP, CONSUMPTION, ABUNDANCE, AND COMPOSITION
- ASSESS HOW MUCH SITES ARE MOVING TOWARDS UNSUSTAINABLE CONDITIONS