Interactions of Prairie Dogs and Vegetation

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On the prairie dog distribution maps that you saw earlier today you noticed that prairie dogs occupy most of the central grasslands of North America with the exception of the tall grass prairie. What I am going to tell you about today are the results of some of the research that my students, colleagues and I have been conducting for quite a period of time. Particularly in the grasslands of southwestern South Dakota, Wind Cave National Park, a little bit on the Badlands National Park of South Dakota and then out on the Pawnee Grasslands in Colorado.

The Wind Cave National Park is an example of mixed grass prairie, one of the main prairie types that prairie dogs are found in. The prairie dogs of course, as you are all aware, live in colonies where they dig burrows. Their burrows are quite evident by the piling up the soil and they also have significant effects on other aspects of the vegetation.

When prairie dogs enter a grassland area (which has not been supporting the prairie dog population within a year or less), you can see a distinct shortening of the vegetation because they [prairie dogs] feed preferentially on grasses. If prairie dogs remain in an area for some extended period of time, lets say 7 to 20 years or so, by preferentially eating on those grasses the grasses begin to die out and become replaced by forbs and what I'll refer to as dwarf shrubs (things like fringed sage and broom snake weed). A prairie dog colony looks like this with an area in the center that has been more heavily impacted for a longer period of time outside of which is a young-colony. This

inner area, which I have labeled an old-colony, is the one that is made up of the forbs and the dwarf shrubs. The younger colony is still dominated mostly by grasses and this edge of the colony is the advancing front as that population of prairie dogs is migrating out. Beyond that we have the uncolonized area of the off-colony area. I'll be referring to an old-colony, young-colony, the edge, and the uncolonized grasslands so kind of keep those areas in mind.

First of all, how much are they reducing the height of the canopy in the uncolonized grasslands? At Wind Cave by about a third. The height of the canopy is about a third the height of the canopy of an area that is not colonized by grasslands. Bison, and some pronghorn occupy the uncolonized area, but grazing intensity is very light.

In order to quantify the effects that these animals are having on the biomass in the amount of forage there is we've gone out and clipped a number of plots, dried and weighed the vegetation. Soil cores were taken from which we have extracted root samples to get an estimate of both the aboveground and belowground biomass on those four different kinds or lengths of colonization of prairie dog towns. If you look down this series of graphs starting from the top we have an uncolonized grassland, a young prairie dog colony, where grasses are still dominating, and an old prairie dog colony where the grasses have been replaced by dwarf shrubs. What we have got on the bottom axis here is time during the growing season from April through September and the biomass of plant material. So you can see that there is a reduction of maybe 1/3 to a 1/2 of the total biomass of plant material that is occurring there. Another thing that you will see is that there is quite a bit of dead standing biomass off the prairie dog colonies, not nearly as

much dead biomass on the prairie dog colonies. Of course the prairie dogs have been eating all of the biomass that didn't have a chance to die, at least not as standing vegetation, it died in the guts of the prairie dogs.

The low ground is also affected, as we go from uncolonized-grassland and edge, to young-colony, to the old-colony, there is a distinct decline in the root biomass. In part this decline is due to the fact that the aboveground biomass has been clipped off, there is a reduction in the photosynthetic leaf area, there is less photosynthate being translocated to build the root system belowground. In part this is also probably a function of the fact that some forbs have come in that don't have as extensive root systems as many of those grasses. In order to further quantify some of the effects that they're having we have done a number of studies looking at plant cover. Again going through a colonized-grassland from young to old-colony we can see the plant cover in general decreases and that the litter and bare ground increases over a period of time.

Furthermore what you see here is that there is initially a decrease in some of the cool-season grasses, followed by a total decrease in grass cover by the time you get to an old-colony, most of the total cover you see is in forbs and dwarf shrubs.

Now, another question that comes to mind is how much are the prairie dogs actually consuming of this vegetation. To address this question we've utilized a series of moveable cages, which we move around, and we have a large number of the cages out on the grasslands. On uncolonized grasslands 20% to 40% of the aboveground biomass is being grazed by the native grazers in the area, these being predominately bison in the areas where we were doing our study in Wind Cave. Somewhere around 60-80% of the total biomass on the prairie dog towns was being consumed. So it looks like that 60%

maybe 70% on the average is what we were finding as a consumption rate by prairie dogs on the prairie dog towns. Another thing that we noticed fairly early on was that bison were feeding preferentially on prairie dog colonies. In fact as a result of a number of surveys that we did we found that although the grassland areas of Wind Cave occupied an area of only about 8% of the total grassland portion of the park that bison fed on, they average almost 40% of the time on that 8% of the area.

This caused us to wonder if there was something about the vegetation on those prairie dog towns that was causing the bison to feed there preferentially. So again we did a number of additional studies where we clipped the vegetation, took it in to the laboratory and analyzed it. One thing that we looked at was the nitrogen content in vegetation from off the prairie dog towns, compared to the nitrogen content in the vegetation of the same species growing on prairie dog towns. The reason that we were interested in nitrogen is that it is an indication of what the crude protein content of the vegetation is. In essence what we found was that there was a significantly greater amount of nitrogen and hence crude protein in the foliage of the vegetation of plants growing on prairie dog towns as in the foliage of the same species of plants growing off prairie dog towns.

So, we did an additional study to see if this might be of some nutritional benefit to the animals and to do so we collected rumen fluid from cattle, brought vegetation samples into the laboratory and digested those samples in the rumen fluid from the cattle that we had used here. The amount of vegetation that you put into these ingestion tubes is measured out very carefully so you know exactly how much vegetation you put in and after a period of about 4 days you can measure what percentage of it has been digested.

Just as we saw with the nitrogen content the digestibility of plants was lower if those plants were collected off of prairie dog towns than if it had been collected on the prairie dog towns. So in other words there is something about the vegetation (the high nitrogen content perhaps being part of it) that makes it more digestible for ruminant animals.

I get asked a lot of questions about cattle and I've only worked with bison. So recently we have begun some studies on the short grass prairie in eastern Colorado on the Pawnee Grasslands. Looking to see whether first of all the prairie dogs are having similar effects on the vegetation and secondarily whether cattle in fact, at least on the short grass steppe, are preferentially utilizing these prairie dog towns. We have several years of data now on average grass biomass on a prairie dog town and off a prairie dog town. In 1999 there was plague on some of the prairie dog towns and the vegetation recovered fairly quickly following the dying off of those prairie dogs.

Looking at vegetation height on the short grass prairie I didn't draw your attention to how tall the vegetation was. On the mixed grass prairie, about 8 cm; and averaging about 7 cm in height on a prairie dog town. Proportionately it is not as big a decrease in height as we saw on the mixed grass prairie in South Dakota. But again the same trends for different grassland communities within the Pawnee Grasslands.

So, we did some driving surveys, actually we didn't, one of my graduate students did some driving surveys, throughout the summer and looked at whether or not cattle were grazing on prairie dog towns and she developed what she has called here a standardized selection ratio, all you need to know about this graph is this .5 line right here. If these bars come across above that .5 level, what that means is that cattle are using that particular prairie dog town more frequently than random chance alone. That is

if the prairie dog town occupied 2% of the pasture maybe this year they were almost using it twice that much. They claim that if a bar is below this .5 level what it means is they are avoiding that prairie dog town; they are not using it as much as one would expect by random chance alone. The [conclusion] is this: along several different statistical analyses, we found that cattle neither preferred nor avoided, statistically speaking, the use of prairie dog towns on the short grass steppe. The cattle weren't doing the same thing on the short grass steppe as we found that bison were on the mixed grass prairie. The cattle were using it randomly. When the cattle were using it they were really using it, they were out there and they were really grazing it. The students counted how many bites the cattle took per minute and how many bites they took per step. The cattle were using the prairie dog towns exactly the same as they would use an uncolonized area but they weren't feeding preferentially there.

More recently than that we have begun another study in which we have been looking at these soil mounds themselves as small natural disturbances in the landscape. Our hypothesis initially was that there were certain plant species whose abundance was at least locally very rare that might be found in much higher proportion on these disturbances and perhaps these actual disturbances by prairie dogs were creating refugia in which plants that were otherwise rare could live and coexist here with the prairie dogs. One such plant that seems to be at least possibly associated with these soil mounds is scarlet globe mallow as shown here. I don't think I have the time, I don't have the data with me as I didn't think that I would have the time to talk about it so I won't present the results beyond that. So, that's a real quick thumbnail sketch of the last 20-25 years of my

career which has been looking at prairie dogs and prairie dog-plant interactions and some of the effects that they have on vegetation. Thank you.

Questions & Answers

Question: How did you measure soil nitrogen on these towns?

Answer: Yes we did in South Dakota , and no we haven't yet on the Pawnee Grasslands. What we did specifically in South Dakota was to measure the rate of mineralization with the greatest inversion of organic forms of nitrogen in organicology of the soil into forms of nitrogen such as nitrate that is utilizable by the plant. What we found was that the soil nitrogen mineralization rates were higher in the soils of the prairie dog towns than off the prairie dog towns.

Question: Where do prairie dogs poop?

Answer: Where do they poop? I don't know where all they poop, but they poop around the perimeter of the mound. They don't have latrines in their burrows.

Question: Did we have a different proportion of leaf blades in one site than in another site?

Answer: We corrected only in that we collected the same plant parts which was the leaf. What we didn't do in that particular study was to look at the proportion of leaves of other parts and what turned out was that the plants on the prairie dog towns were shorter and a lot less stemmy than the plants off the prairie dog towns.

Question: What effect does fire have on the distribution of livestock and hail on livestock?

Answer: I can't answer about the hailstones but we did look at fire effect on bison in Wind Cave National Park. We did have one 75-acre fire and we had someone in the fire tower all year recording where the bison were and then the following year where they were after there had been a burn. The bison of course really key in on those burned areas. We have done several other studies that show that bison preferentially graze on recently burned areas. So what that means is that it relieves grazing pressure on the prairie dog towns and the bison will graze in the valleys that have been recently burned. That effect apparently only lasts for about a year.