

Grazing in Nature's Image, Part 3— Lessons from Nature's Migratory Herbivores

by Jim Howell

In this last article of his series, Jim, looks at the role migrating grazers have played in low-rainfall brittle environments, and at the end suggests how we might use that knowledge when planning livestock grazing. —Editor

I recently heard Bob Budd, manager of the Nature Conservancy's Red Canyon Ranch near Lander, Wyoming, throw out one of his more provocative statements. He said that ecologically, his focus is "managing for chaos." That doesn't mean letting everything fall apart and turn into a disorganized mess. It means creating a diversity of vegetation patches and structures through intentional management practices—patches that lead to a multitude of niches for all the thousands of plants, critters, fungi, and microorganisms living on and in our landscapes. Nature, he insists, abhors monotony.

I never really thought of it that way, but I think he's right. There is nothing monotonous, predictable, or routine about a naturally functioning landscape.

Nature is dynamic, constantly changing, chaotic. Chaos includes disturbance, and disturbance dynamics change across the brittleness scale. In very brittle environments, disturbance is created by large herbivores living in association with their pack hunting predators.

Allan Savory has been saying that for a long time. Herbivores stay bunched and moving as a survival strategy when healthy populations of predators are present, and we strive to imitate this behavior with our domestic livestock. We control such variables as timing, frequency, and intensity of grazing and animal impact. We manipulate stock density, stocking rate, and animal behavior. Those are a lot of dynamics to consider, and "getting it right" from the point of view of the plants, the animals, and the soil surface condition isn't easy. My contention is that naturally functioning herds of herbivores (with their associated predators) still have a lot to teach us in our efforts to "get it right."

Very Brittle, but High or Low Production?

Very brittle environments can range from productive tropical savannas to unproductive semi-desert and temperate latitude steppe environments. The high production, very brittle environments have the capacity to produce a much higher volume of vegetation over the course of a growing season than the low production, but still very brittle, areas, even when ecosystem processes in the latter are

functioning effectively. This variability is primarily the result of precipitation quantity and pattern.

The high production brittle environments are characterized by abundant rainfall over a fairly concise summer growing season, which happens to coincide with high levels of atmospheric humidity and warm temperatures. The result is an explosion of vegetative growth, followed by a long period of dry conditions and plant dormancy.

Low production brittle environments are typified by much lower amounts of annual precipitation. In the tropics it frequently still arrives over the course of a short season in the summer. In the low production steppe environments of the temperate latitudes, little bits of precipitation are possible most any time, but significant moisture

accumulations resulting in new growth are typically few and far between. As a result, plants lie dormant for most of the year and biological decay gives way to oxidation when herbivores are absent. A well-managed high production, very brittle environment in the tropics of Africa might produce on the order of 130 to 180 ADA (Animal



One of the few surviving populations of migratory herbivores still interacting with pack-hunting predators, the wildebeest in the Serengeti number about 15 million.

Days per Acre) per year, while well managed, low production, very brittle environments in the western United States typically produce from 5 to 25 ADA annually.

Megaherbivores

Do disturbance regimes and patterns vary as brittle environments transition between low and high production? My observations and research indicate that they do. Under natural conditions in the high production tropics, very large grazers and browsers (large mammal biologists call them megaherbivores)—those weighing 1,000 kg (2,200 pounds) or more—tend to comprise the majority of the mammalian biomass of a region. These animals include the elephants, rhinos, and hippos. Elephants and rhinos are hind-gut fermenters like a horse, which means they're anatomically designed to consume large volumes of very low quality forage.

Hippos are foregut fermenters, but only have a two-chambered stomach and they don't chew a cud. This makes them similarly adapted to consuming lots of low quality forage. Since these high production brittle environments are characterized by large quantities of lignified, low quality forage for much of the year, it makes sense that nature's model is dominated by these huge vegetation consumers. They perform the bulk of the mineral and nutrient cycling, they create the patchiness and diverse vegetation structure needed by dozens of



Bison were highly migratory on the central North American plains and throughout much of the northwestern cold steppe. This is a family unit in Yellowstone National Park.

other animals and plants, they keep perennial grasses from becoming overrested, and they maintain an open savanna landscape. In combination with all the other smaller herbivores of these regions, a disturbed, patchy environment with healthy ecosystem processes is maintained.

Migratory Herbivores

How does this change as we move into the lower production tropical savannas and temperate steppe environments? In these areas, migratory herbivores tend to comprise the bulk of the mammalian biomass. The megaherbivores can still be present, but their contribution to the total mass of mammals becomes progressively less significant as environments become less productive.

Because of the lower total rainfall, and more fertile soils (due to less leaching), the vegetation in these regions, particularly the perennial grasses, tends to be much lower in lignin and therefore much higher in digestible energy than in the high production brittle environments. As a result, ruminants, which require a higher quality diet than the hind-gut fermenters, are more adapted to the plant communities of these environments. Most of the migratory herds, in fact, are comprised of ruminants.

In their native condition, the numbers of large migratory herbivores in these low production environments greatly outnumber all other herbivore species combined, in some instances by an order of magnitude (i.e., ten times as many). In other words, low production brittle environments typically support many more migratory herbivores than resident or sedentary herbivores. Their role in creating disturbance and maintaining healthy ecosystem processes is therefore huge.

These herds still exist, or until the mid-90s did exist, in a few isolated corners of the globe. They include the wildebeest, zebra, and Thompson's gazelle of the Serengeti/Mara region in Tanzania and Kenya; the white-eared kob antelope and kopi antelope of Sudan; the caribou all across the arctic tundra; the saiga antelope of southern Russia and Kazakhstan; the chiru antelope of the Tibetan Plateau; the Mongolian gazelle; and the dorcas gazelle on the edges of the Sahara Desert. Until the end of the 19th century, bison and elk on the Great Plains, pronghorn west of the Rockies, the springbok of South Africa,

and the guanaco of Patagonia (southern Argentina and Chile) constituted some other great populations of migratory ungulates. Remnants of formerly large migratory populations still survive in many other areas, but due to overhunting, habitat fragmentation, and a lack of predators, they no longer interact with their environment as nature intended.

With the exception of the caribou in the arctic, all of these migratory herbivores are found in very brittle environments, most of which are low production. The northern range of the Serengeti is high production, but that's where the elephants live, and they, rather than the wildebeest, cycle most of the vegetation. Toward the southern end of the Serengeti, where the wildebeest tend to spend a majority of the year, annual rainfall falls off to 15 inches (330 mm), with a consequent drop in vegetation production.

The high latitude arctic lies in the middle of the brittleness scale. Due to extremely cold temperatures throughout most of the year, very little biological decay takes place outside of the wet summer growing season. Because this growing season is so short and nighttime temperatures remain cold, annual production of new vegetation is low. So they may not be very brittle, but they are low production environments with plant growth characteristics similar to cold steppe environments.

This means the plants need long recovery periods to regrow leaf material and root mass.

Migration 101

Now, what exactly did nature intend? How do these migratory behavior patterns impact the plants and the soil surfaces of these



The first Europeans in western South Africa described single herds of migratory springbok numbering over a million animals.

low production brittle areas? What makes them migrate in the first place? What does all this have to do with "managing for chaos" or even Holistic Management? First let's try to answer why they even migrate in the first place. Scientists have been asking themselves this for a long time. The answers are many and varied.

For example, the migrations might enable the animals to utilize seasonally abundant ranges more efficiently, or they may revolve around seasonal supplies of surface water. Commonly, however, the migrations don't seem to have any nutritional motivation at all, especially the spring migrations. The wildebeest of the Serengeti migrate much farther than necessary to partake of the higher quality short grasses during the summer rainy season, as do the white-eared kob of southern Sudan. The chiru migrate to calving grounds in the more northerly, drier, and colder part of their range, just when their wintering grounds are finally greening up in the spring. They actually migrate to poorer nutritional conditions right when their physiological status would indicate a need for a rising plane of nutrition. The

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caribou do the same thing in the arctic, moving north ahead of the spring green-up.

The answer seems to be tied to predation. Because most predators are obliged to be fairly sedentary due to the long period of dependency of their young and the necessity of remaining in the relative vicinity of their dens, predators typically are unable to follow the herbivores over their vast migratory routes. Predators consequently tend to congregate in areas with abundant resident herbivores and year-round supplies of surface water. The migratory herbivores have evolved behavior patterns of traveling over vast distances to remote calving grounds, seemingly for the sole purpose of avoiding areas of high predator density during their brief birthing seasons.

Scientists believe that this single factor is why populations of migratory herbivores tend to be so much more abundant than resident herbivores. The migratory population numbers are not limited by predation, but by the quantity of forage that grows on their dry season range. The resident species, on the other hand, are totally regulated by predation.

Migratory Variations

So now we think we know why they migrate. But, how do these migrations vary from year to year? It turns out that most migratory



Elephants are one of nature's most effective carbon cyclers and agents of disturbance in high production very brittle environments. At one time they or their close relatives have occupied every habitable continent except Australia where the same niche was filled by a huge rhino-sized marsupial.

patterns tend to be predictable on a broad scale, but very unpredictable on a more local scale. The less productive the environment, the less predictable the migratory behavior. For example, the wildebeest of the Serengeti (which are in an environment ranging from fairly low annual production in the south to fairly high production in the north) can always be expected to be in the northern woodlands during the middle of the dry season and in the southern plains during the middle of the wet season. The timing of their migrations north and south, however, can vary by one or two months. The actual migration routes can also vary from year to year,



Bighorn sheep may once have been migratory. In 1776, journal writers in the Dominguez Escalante Expedition didn't mention seeing any sheep until they reached the Four Corners Area (where Arizona, Colorado, New Mexico and Utah meet) near Lake Po well. According to one journal entry, "Wild sheep breed hereabouts in such abundance that the tracks look like those of great droves of game."

as can the time spent on a given seasonal range. Over a 12-year study from 1961 to 1972, the wildebeest spent between 5 and 32 percent of each year in the northern woodland savanna, 12 to 40 percent in the western mixed savanna, 7 to 15 percent in the central mixed savanna, and 22 to 60 percent in the open southern plains savanna.

Other observations of these populations tend to paint a similar picture. Scientists studying the chiru of the Tibetan Plateau were unable to predict their seasonal migration routes. After setting up their observation camps on the route the chiru took the previous year, these scientists were frequently disappointed to realize that the migration was passing dozens of miles away. The same occurs when trying to predict the exact migration routes of the caribou.

Variable migration routes then tend to lead to different areas of summer or winter ranges being used from one year to the next. The 800,000 head George River caribou herd of northern Canada was observed to use the same summer range only once every six years. Depending on when the large lakes freeze over (enabling the caribou to cross rather than travel around them), the migrations may end up in totally different winter range from one year to the next. Migrations of saiga antelope in Kazakhstan and Mongolian gazelles in eastern Mongolia are reportedly very erratic. Depending on snow and drought conditions, migration routes to and from calving grounds and seasonal use areas are highly variable. In the extremely harsh steppe-desert on the edge of the Sahara, the behavior of the surviving migratory dorcas gazelle is described as nomadic. There is no pattern to annual movements at all. Their grazing patterns are totally dictated by ephemeral rains that create the odd green spot in their austere landscape. As a result, they might not return to the same area for years.

Management Implications of Migratory Behavior

All of these populations seem to be strong adherents to chaos theory. The lower the potential productive capacity of a brittle environment, the more erratic and seemingly chaotic the migratory movements of the associated herbivores seem to be. What does that mean for the plants and the soil surface condition? In practical terms, how does the erratic migratory behavior of huge herds of herbivores affect the timing, frequency, and intensity of plant defoliation and soil

surface disturbance? We know that wherever and whenever a migration travels, the animals will be grazing, trampling, defecating, urinating, rubbing, and scratching.

Because the commencement of a migration might vary by up to two months from year to year, the timing of all this grazing and disturbance in a certain area may also be variable. Also, a specific site might fall in the path of the spring migration this year, but next time the animals come through that spot it may be the next year on their fall return to winter range. Again, the result is variable *timing* of grazing. Because migration routes and specific localities of seasonal use change from year to year, *frequency* between defoliations might stretch out to several years. The lower the productive potential of an environment, the less frequent grazing periods tend to be. Because length of occupancy on specific ranges tends to vary from year to year, the degree of utilization, or *intensity* of overall plant defoliation, will also vary on an annual basis. What's the result of all this variation? The incredible chaos of nature.

How do we translate these lessons to a domestic scenario and manage for chaos? Luckily, we as land managers have lots of control over these three critical variables of timing, frequency, and intensity. However, because most of us like routines, we tend to vary them only a little. We always turn out in the same pasture at the same time of year with the same number of animals and leave them there for the same amount of time. That's not chaos, that's an entrenched pattern and it's not natural. Allan Savory developed holistic planned grazing for the very purpose of handling these multiple variables and to keep land managers from falling into damaging, thoughtless routines.

In most situations, our herds are small and/or our stock density is extremely low, which results in very uneven grazing and little soil surface disturbance. But the massive migrating herds don't always bunch up in tight herds. In fact, they often are distributed fairly thinly. The white-eared kob antelope seldom reach densities over 1,000 head per square kilometer, which works out to only four head to the acre. But because the herds are so huge (especially relative to our domestic herds), by the time thousands of animals traveling in cohesive family groups pass a given area, the result is an extremely well-distributed pattern of grazing and animal impact. Depending on how fast the herd is moving, the intensity of defoliation may be light, moderate, or heavy, but whatever the case, it will tend to be uniform over the landscape the herd is traveling through.

By increasing stock density, through herding, fencing, and herd amalgamation to achieve large enough herds, we have the ability to mimic this even level of impact and grazing severity with our domestic herbivores. By controlling the time of our grazing periods, it is therefore easy to vary intensity. On my family's ranch, we typically will have 400 yearlings grazing about 40-acre temporary pastures. A one-day grazing period will result in an even but light intensity of grazing and impact, two days a moderate level, and three days a heavy level of grazing and trampling.

From year to year, we can intentionally vary this level of utilization, or grazing intensity, by changing our pasture ratings in the Holistic Management grazing planning procedure. If we want to graze a pasture lightly one year, we'll rate it low, which will result in a shorter planned grazing period, and vice versa if a pasture needs a heavy grazing. Because we can control exactly where we want the animals to be from the beginning to the end of the grazing season,



Uniformity of grazing intensity is easy to control with high stock density. On the left 400 yearling steers grazed a 40-acre temporary paddock for 3 days. Temporary wire has just been rolled up and animals have moved themselves onto new grass at right. The foreground is close to a riparian area, which is the reason for the close plant spacing and relatively high production.

we also have total control over the timing of grazing. In other words, we can always be sure to graze a certain area at a different time in successive years.

We also have complete control over the frequency of grazing. In our situation, we'll seldom have a grazing period last longer than a week, so plants have little chance of suffering a second bite on regrowth. We can also plan to ensure plants are not regrazed in a subsequent grazing period until those plants are fully recovered from the previous defoliation. The migratory herbivores often stay out of areas for up to several years at a time, allowing for very long recovery periods and abundant vegetation accumulation. We've allowed for these long recovery periods (two full growing seasons) on some experimental plots, the results of which have convinced us that a periodic extended recovery period is vital to accumulating a source of older material to serve as a source of vital soil-covering litter. This seems especially critical the lower the inherent productive capacity of a range, such as the steppe environments of the western United States.

So, to summarize, we can deliberately vary the timing, the intensity, and the frequency of grazing on any given piece of ground. We can create the sort of chaotic conditions that nature would have produced with migratory herbivores. For example, one year we might plan to graze a pasture lightly in the spring, then heavily during the next year's summer, then give it the following year completely off. With the Holistic Management® grazing planning procedure, it's easy to plan all of these various treatments while still minimizing overgrazing of individual plants. At the end of the season, the completed plan serves as a fantastic record of past events.

This record is critical to sound future planning. The management decisions we make for each pasture should be aligned with our holistic goal, and the results of these decisions have to be carefully monitored. The importance of assuming we're wrong when attempting to mimic the chaos of nature can't be overemphasized. Do the planning, do the monitoring, adapt as needed, and be prosperous.