Rangelands in Dry Years

Drought Effects on Range, Cattle, and Management

A Pacific Northwest Cooperative Extension Publication

RANGE-LIVESTOCK operators of the Pacific Northwest, east of the Cascade Mountains, are always suffering from, getting over, or preparing for drought. Dry years are natural to the area where they have chosen to do business. Exceptionally dry years or drought years do occur, but any predictions of when they will occur and how long they will last are merely speculation.

The Society for Range Management has defined drought as "prolonged dry weather, generally when precipitation is less than 75 percent of the average annual." Webster's definition is "dryness; want of rain or water; especially such dryness of weather or climate as affects the earth and prevents the growth of plants." For this publication, drought will be a September through June period in which moisture accumulations are less than 75 percent of normal.

It is important to emphasize that there is nothing definite about the 75 percent level or the September through June time frame. Ample precipitation in December, January, and February or in March, April, and May may result in above-normal plant growth in what could still be defined as a drought year. Examination of Squaw Butte, Oregon, precipitation records revealed that 9 out of the past 40 years may be labeled as drought years if based on this 75 percent figure. This amounts to 1 dry year out of every 4 or 5. Fortunately, there have not been 2 drought years back to back during that period, but there will always be that possibility in the future.

Rangelands dominated by perennial grasses, sometimes mixed with shrubs, have more desirable plant-soil-water relationships than depleted stands with increased soil exposure and often great annual variation in productivity. Good plant cover reduces water runoff and increases infiltration into the soil to provide higher initial soil moisture. The fibrous roots of many perennial grasses penetrate the soil more deeply than do most annuals, permitting water access to deeper soil profiles. Dense stands of some shrub species such as big sagebrush can be excessively competitive and reduce not only forage production but also desirable cover of grasses and forbs. More precipitation interception and evaporation occur in abnormally thick stands of big sagebrush, often decreasing rather than improving watershed values.

A range with healthy native plant communities almost always produces forage of higher productivity and potential for increased animal performance than does a low condition range. Also, forage production is more stable and more dependable from season to season and year to year. Vigorous, desirable plants will have a greater opportunity to recover rapidly from drought as compared to those less vigorous.

Range management principles do not change when drought strikes. The four major grazing

principles still apply: proper stocking rate, correct season of use, optimum livestock distribution, and appropriate kind and/or class of livestock. It is better and less expensive to adjust livestock grazing, even to rebuild a herd, than to rehabilitate a range. Maintaining range in good health must be foremost. But keeping the breeding herd intact also is important. The future of the operation depends on that. Having to reduce productive cow numbers is abhorrent to every livestock producer and must be avoided. How can you work around a reduced range forage supply without damaging the range resource and cutting into the future production and profitability of your base operation?

This publication explains how range plants grow, what happens to them during drought, and some effects of drought on cattle management. It outlines some management adjustments that may be of benefit in the drought year and in the growing season after the drought.

Drought Effects on Range Plants

Forage production

A significant impact of drought on rangelands is a severe reduction in herbage production. Rangelands dominated by annual species, such as cheatgrass, or a shallow-rooted perennial grass, such as Sandberg bluegrass, are most sensitive to drought. In Oregon approximately 10 million acres fall in this category. Some 4 million acres in Idaho and 3.4 million acres in Washington are dominated by annuals. Cheatgrass typically germinates in the fall, puts down roots during winter and spring, and matures seed in spring or early summer before the plant dies. In general, these plants begin growth with the onset of fall rains, and die when the soil surface dries. In an especially dry year cheatgrass seeds may not germinate at all, but remain dormant in the soil until more favorable conditions return.

Data from Oregon State University's Squaw Butte experimental range show cheatgrass produced 258 pounds per acre in 1967, a normal year, and only 15 pounds per acre in 1968, a severe drought year. This represents a 17-fold variation in production, which also would require a 17-fold cut in livestock numbers if the range were stocked to capacity each year. Bluebunch wheatgrass, on the other hand, exhibited only a 6-fold fluctuation in production for the same period—320 pounds per acre in 1967 and 49 pounds in 1968. This variation clearly demonstrates the additional risks involved when depending on annual plants as a source of forage.

Research on the U.S. Forest Service Starkey Experimental Forest and Range, in northeastern Oregon, shows that utilization of perennial bunchgrasses increases significantly during drought years. On ranges supporting both annuals and perennials, the bulk of the grazing load must be borne by perennial plants during dry years. As the more reliable forage source, perennials should be maintained to insure stability of the grazing operation.

Perennial plants and carbohydrate reserves

While annual species can escape particularly dry years by simply remaining in the seed stage, perennial bunchgrasses are forced to weather these periods as living, respiring plants, Typically, bunchgrasses in the Pacific Northwest support green top growth for about 4 to 5 months each year. For the remaining 7 to 8 months each plant must continue to support its root system and its meristematic or bud tissue, which will produce next year's growth. To survive during this period, the plant must draw on carbohydrate or food reserves (sugars and starches) that were produced the previous growing season and stored in the roots and crowns. These reserves also furnish the energy necessary to initiate new top growth each spring. For most bunchgrasses, 20 percent or more of the current season's total growth occurs before the plant stops drawing on its energy reserves. Indeed, bluebunch wheatgrass attains about 45 percent of its height before it stops using stored carbohydrates. Studies also indicate that adequate reserves enhance a plant's ability to tolerate extreme temperatures that often accompany drought. Over a year's time in a drought these plants would rely on stored carbohydrates for as long as 9 to 10 months, leaving as little as 2 to 3 months to recharge reserves for the oncoming year.

To date, we have no solid information on carbohydrate accumulations or utilization patterns for plants suffering from drought stress. Information from a variety of sources, however, indicates that range plants should be given every opportunity to attain their maximum growth during a drought year.

The lack of available soil moisture usually reduces the length of the growing season. Thus, range plants have a much abbreviated growing season instead of the usual 4 months. For example, bluebunch wheatgrass begins to recharge its root

reserves just before seedstalks emerge and it has accumulated its full complement of carbohydrates about the time the seed ripens. During drought we would expect plant growth to be arrested before carbohydrates are replaced, or the replenishment period may be shorter than normal. It is possible, however, that drawdown of plant reserves may be less severe than in a normal growing season. Whatever the case, carbohydrates are not fully restored and grasses enter a longer than normal dormant period with less than their full complement of energy. Since heavy grazing, especially during the latter part of the growing season, hinders the accumulation of carbohydrates, we should allow grasses as much opportunity as possible to grow before the full impact of the drought arrives. If, during drought, lower levels of stored energy are used for growth, late spring grazing may have less effect than in a normal year. However, the longer dormant period probably will be harmful, regardless of grazing, and the following growing season will be critical to these plants.

Root growth

A healthy root system is paramount in the growth of any range plant. This is especially true during dry years, when competition for water and nutrients is most severe. The importance of a vigorous root system becomes more apparent when you realize that 50 to 80 percent of the plant exists below the soil surface.

Researchers in the Midwest discovered that plant roots will extend to greater depths as water becomes limited in the topsoil. Roots cannot penetrate dry soil, however, in an attempt to reach moisture—if it were available at lower levels. For this reason, deeply rooted perennial plants have a decided advantage during drought. If water becomes limited in the upper strata, they are in a position to exploit the more dependable deep soil moisture. On the more shallow soils (2 feet or less) this is not true, since most perennial plant roots fully exhaust moisture even in normal years.

Roots of two native bunchgrasses, bluebunch wheatgrass and Idaho fescue, commonly reach depths of 3 to 5 feet if soils are deep enough. Excessive grazing during the growing season, however, causes reductions in both total root material and rooting depths over the years. Clipping studies during the mid-growing season have demonstrated that removing more than 50 percent of a grass's top growth can cause roots to stop growing for more than 2 weeks. A perennial grass that is heavily grazed during its growth period could stop growth altogether. If soil moisture were declining rapidly at the same time, the grazed plant would not have opportunity to recover. But roots can make only minimal growth under dry conditions, so grazing might have less effect than it would under more normal conditions. We believe that grazing in drought years should be as light as possible in order for plants to make maximum use of soil moisture.

Forage quality

In addition to reduced forage production accompanying drought, we are also faced with a shorter season of high-quality forage. Typically, in the Pacific Northwest, we have a high-quality green feed from early spring through mid-summer. Crude protein content of bunchgrasses will range up to 20 percent (dry matter basis) in early April and gradually decline to approximately 4 to 5 percent when plants mature in June or July.

With drought, however, the growing season is significantly shortened, and forage quality begins to deteriorate much earlier than is normal. Fortunately, forage cures at a higher nutritive value than in a normal year. Even though less total growth occurs, the forage is of fairly high quality. Thus, cattle gains can equal or exceed those of normal years, if the animals get enough to eat. Light stocking rates would be beneficial to maximize individual animal performance.

Another factor affecting nutritive quality is the amount of standing litter held over from the previous year. Drought in the Pacific Northwest usually means clear skies and a dry winter. Snow cover often is lacking, so some old growth becomes important in insulating plant crowns from cold temperatures. Without winter precipitation, there is little "knock down" or decomposition of last year's standing litter. This material has almost no digestible protein, is lower in digestible energy, and is less desired by livestock. Reduced new growth of drought-stricken plants forces livestock to consume a mixture of poor-quality old growth and good-quality new growth, but often in limited supply. Permitting animals a high degree of selection can help retain acceptable animal performance levels.

Plant mortality and vigor

Research in eastern Oregon following the 1976-77 drought revealed no significant plant mortality of either grazed or protected plants. Plant vigor,

however, was related to past grazing intensity under season-long grazing management. In 1978, lightly grazed ranges produced plants that were heavier and taller than those in long-term exclosures. On moderately grazed ranges, plant height and production differed little from ungrazed plants at the end of the growing season. At the beginning of the growing season, moderately grazed plants were sometimes shorter than long-time protected plants, but by late season this difference disappeared.

Height growth of bluebunch wheatgrass and Idaho fescue under heavy grazing (greater than 70 percent utilization) was reduced more than with moderate grazing, but did catch up by the end of the growing season. Plant weight at the end of the season for heavily grazed Idaho fescue was less than that for protected plants, but this was not so for bluebunch wheatgrass. For a species like Thurber's needlegrass, heavy grazing can have serious effects. This study showed less total leaf growth all season as compared to protected plants, as well as somewhat less yield per plant. The root system also appeared to be affected, since there was enough soil moisture for plants to have made more growth.

Because some bunchgrasses subjected to past heavy, season-long grazing grew more slowly than long-time protected plants, it is probable that these grazed plants started the growing season with reduced root systems and low carbohydrate reserves. Since the research had to be done with plants that were not grazed during the growing season, it is not known whether grazing early in the season would have affected their recovery after drought. The kind of grazing management program imposed following drought may affect plant growth as much as previous grazing. Early season grazing at relatively heavy levels should not be damaging, as long as grazing pressure is removed while there is soil moisture available to allow plants an opportunity to make near normal growth. Conversely, grazing at heavy rates during the mid-growth season would be expected to result in less vigorous and slower-recovering plants.

The effect of drought on range plants is a function of both the intensity and duration of drought and the general health or vigor of the vegetation before the drought. Plants with healthy root systems and adequate carbohydrate reserves will fare much better during and after drought than plants that have been struggling to maintain themselves all along. Researchers working on sagebrush-wheatgrass ranges in southern Idaho observed a 60 percent decrease in ungrazed plant cover during the 1934 drought. Examination of weather data for that period, however, indicated that Idaho had suffered from below-average rainfall for the preceding 12 years. While this is an extreme situation, it clearly demonstrates that range plants are susceptible to long-term drought.

Drought Effects on Cattle

Weaning weights

The amount of nutrients in drought-stressed vegetation may result in reduced weaning weights. There is little information on this subject, but those reports available suggest that weaning weights are typically reduced by 50 to 100 pounds. The probable reason is reduced total intake and not just lower forage quality. Data from the Squaw Butte (Oregon) Agricultural Experiment Station, however, indicate that proper range and stocking management can maintain weaning weights, even during drought years. Stocking rates on the station are adjusted yearly in accordance with forage availability, and weaning weights show only a slight relationship with yearly precipitation on the site.

Breeding cycles

Nutritional status of range livestock plays an important role in reproductive performance. Cows need roughly two times as much crude protein and 60 percent more total digestible nutrients during early lactation than when dry. They must be ready to breed back within 80 days to calve at the same time the following year. Under normal good management conditions cows will be cycling 60 days post calving. In drought situations if management has not accounted for reduced forage supply, the cows often cannot both suckle a calf and return reproductive organs to normal within 60 days. The cows' normal reaction, therefore, is to miss heat periods (not ovulate).

Drought Effects on Management

Adjusting breeding schedule

During the 1976-77 drought it was not unusual for many cows to delay breeding until late summer or fall, which resulted in either totally reduced 1978 calf crops or a greatly spread out calving season. Late calves never gain as well as do early calves, since there is a shorter green-feed period for the lactating mothers. Thus, not only

can a drought year cause fewer calves the following year, but those that are born later than desired will gain less weight and wean off lighter.

One year of drought-caused calving delay can cause serious upsets in an operation. After a cow once calves late, it is difficult to get her back on schedule in her productive lifetime without skipping a year. Cows have the capability to rebreed within 60 days of calving, which advances the next year's calving by about 3 weeks. Excellent nutrition and management are necessary for this to occur with regularity. Drought can easily cause conception delays of 3 months or longer. Some 4 to 5 years would be needed to get a cow back on schedule, even with excellent management. On the basis of weaning weight or loss of production from late calving, skipping a year to get back on schedule should be considered for cows with at least 4 more years of productive life.

Stock water

The onset of drought is typically accompanied by reduced stock water supplies. This is especially true in areas where surface runoff is expected to recharge impoundments. The premature drying of water holes and reservoirs, coupled with deterioration of water quality in these facilities, leads to both inadequate animal distribution and poor livestock performance and condition.

Poor livestock distribution will leave considerable forage unused in the farthest reaches of a range unit. This is especially critical when forage is in short supply and you are attempting to maintain the maximum number of animals. Elevated temperatures and the concentration of animals in and about available water can quickly lead to fouling of the supply. This may result in reduced forage intake and poor animal performance.

Management Options in a Dry Year

A clear picture of all available resources is necessary in order to make correct management decisions. Consider the current inventories of feed on hand, range condition in each unit, and range feed alternatives, along with current animal numbers and each animal's productivity. Give attention to production per animal—past, present, and future.

With less available range forage, some downward adjustment in cattle numbers usually is needed. Insure that only healthy, producing, middle-aged cows remain in the herd. Adequate records are necessary at all times, but when unusual reductions may be called for, they are even more important. You may be able to afford heavier culling of late calving cows and keeping fewer replacements without too seriously affecting at least short-term production, and still be able to weather the problem.

Most operators do not keep the extra haystacks that were so often seen in years past. Those who do should not be as seriously affected, since they could use hay for all of the herd for part of the grazing season or for part of the herd for all of the grazing season.

Rangelands that have adequate developments to permit good livestock control have inherent management flexibility, whether in drought or not. Subdivision of large grazing units into smaller ones containing well-distributed livestock watering locations permits planned livestock movement from unit to unit, if desired. Surplus forage in one or more units often will be available for use. Range developments allow improved grazing management to take place, regardless of the program or operational scheme.

Since many native rangelands are grazed throughout the season, the following management suggestions are based upon that premise. The options assume that stocking rates will be adjusted as necessary.

Moderate grazing use history

As long as stocking levels during the drought year will be moderate—that is, matched to forage available and animal needs—no special grazing program is necessary to insure plant survival and health.

Heavy grazing use history—alternate feed available

Defer grazing until plants are as near maturity as possible. Plants that have experienced heavy use, perhaps above 60 percent over a period of time, probably have reduced root systems. Permitting these plants the maximum opportunity for growth should significantly help them maintain vigor even under very dry soil conditions. To accomplish deferment, consider these practices:

- Closely graze annual plant areas without impairing animal performance. Although less forage production will occur with annuals in a drought year, these species can be grazed heavily without seriously affecting their next year's growth. There is almost always enough residual material and feed left to provide plants and forage the next year unless a series of dry years occurs.

• Graze crested wheatgrass if available. Crested wheatgrass provides excellent spring forage and seeding ranges to this species has long been recommended. Not only is crested wheatgrass more productive than native perennial bunchgrasses early in the growing season, but it can be more heavily grazed even under drought conditions. Crested wheatgrass is difficult to kill and tolerant to grazing and can be relied upon much more than many people have realized. If you have the option of heavily grazing either crested wheatgrass or native bunchgrass, graze the crested wheatgrass heavily.

• Keep cattle on hay meadows longer. Weigh this option against the expected hay production without extended grazing. Often potential supplies of irrigation water will be more important than anything else. If water supplies are fairly certain, you could graze meadows in April and May, with the main impact being delay of hay harvest. If irrigation water is not available, this could force a decision to keep cows off the meadows, trying for a small hay crop, or permitting grazing during and/or just before the breeding season. If possible, concentrate water use on areas most potentially valuable for hay, and graze the remainder.

• Feed the cows crop aftermath or byproducts, if available. Take advantage of locally available byproducts and save the normal hay supply to feed after calving.

• Feed hay longer than normal. Substituting hay for range forage during spring may pay dividends in getting cows to rebreed, as well as allowing range plants full opportunity to grow. The winter and spring probably will have been dry and open with less weather stress on livestock, and thus could result in hay savings. In such cases, some of the normal hay could be available without need for buying it.

Heavy grazing history—alternate feed not available

• Spread grazing load uniformly. Spreading the grazing load as uniformly as possible and practicable is desirable for native bunchgrass. This decreases the possibility of each plant being fully and repeatedly defoliated. An exception to the maximum dispersion principle might be made later in the grazing season after plants are dormant. Heavier grazing at that time could be desirable.

Undependable stock water often limits optimum distribution during a drought year. Graze the areas first where stock water supplies may fail later in the season. Salt distribution and riding the range are effective in dispersing grazing loads when adequate stock water exists. Water can be provided by hauling, but local conditions will dictate the economics of this. One Lake County (southern Oregon) rancher reported that water hauling in 1977 cost $10 per animal unit month (AUM), and he felt that he was doing an efficient job. Alternative feed sources could have been provided for less than $10 per AUM, and the operator certainly would have used another feed source if he had known his costs in advance.

Research at Squaw Butte Agricultural Experiment Station shows that cattle can drink only every second day without seriously impairing performance. But lactating cows on short water rations produce less milk, causing suckling calves to gain poorly. Since drought often is coupled with higher than normal temperatures, water restriction could reduce daily gains unduly when those conditions occur. This would mean that water would need to be provided more often in very hot weather.

• Supplement low-quality feed. Seldom is range forage so lacking in *amount* that feed supplements are economical. However, low forage *quality* can be corrected effectively, and often economically, with certain feed supplements. Do not allow animal performance to serve as an index of range utilization. Performance may remain stable or even improve during supplementation, but a range could be too heavily used. Thus, range use must be monitored carefully, along with animal performance.

• Develop a stock water system. More range is underutilized for lack of available stock water than for any other single reason. Livestock are creatures of habit and do not venture far from customary water locations. Several techniques for water development offer promise. Locating one good water source and piping water is often the most economical method when terrain is not too dissected and the line can be kept on the contour. Digging out small springs and seeps, boxing in with culvert sections standing upright, and piping to troughs can be equally effective and economical. The time-honored stock pond can be built in many locations with good results, but often is less dependable over the long run than developing springs. Horizontal wells offer promise, but are not

widely used yet in the Northwest. Deep wells often are the most dependable under desert conditions, but cost and the type of power supply often limit their use. Hauling water, as mentioned earlier, may be necessary in the short run, but the costs must be evaluated carefully in relation to the advantages.

• Wean calves early. Research at the Squaw Butte Agricultural Experiment Station and elsewhere in the West clearly shows advantages of weaning calves from sagebrush-grass range after forage matures and loses its high quality. Lactation declines in relation to available high-quality forage supply. Since drought-stressed plants accelerate maturity, weaning even earlier than current research results indicate may be desirable. This would not be necessary if cured forage was of sufficient nutrient content to permit normal growth.

The practice of early weaning has not been studied thoroughly, but may have merit under severe drought conditions. If kept on range with their mothers, young calves surely will perform poorly. Their mothers will also. On the other hand, weaning early and feeding an adequate ration should permit normal gains. Calves can perform well at young ages, as widely observed with dairy calves, and early weaning should help the dry cow maintain herself on range and enter the coming winter in better condition.

Management Options Following a Dry Year

Research shows it is nearly impossible, under natural field conditions, to separate the real effects of drought from those of grazing. Observations and research in central and eastern Oregon during the growing season following the 1976-77 drought clearly showed that past light and moderate use on bluebunch wheatgrass, Idaho fescue, and crested wheatgrass did not affect overall production or growth rate of the forage. Past heavy use did have some depressing effect, however, especially on Thurber's needlegrass. Since 1978 was an exceptionally good growing season, plant growth in a more normal growing season would be less, but the relative responses by the species due to past grazing should not be different.

Since you probably will reduce livestock numbers due to drought, the temptation is great to increase them when better feed conditions occur. Any increase in grazing pressure planned after drought obviously should be in relation to the projected recovery you expect. Rapid restocking must be balanced against probable effects. Probably the single best indicator of the native range potential will be its range condition or ecological health. Those ranges in good to excellent condition probably will not be affected greatly by a single year of drought. Ranges in fair condition (unless in a strongly improving trend just before the drought) could be affected seriously. Ranges in poor condition probably will produce very little desirable forage during drought and usually much less than good-condition ranges afterwards.

Proper range management following drought is really common-sense management, which many operators and managers follow regardless of drought status. Although livestock condition can be an indicator of range health, the degree of forage species selectivity that livestock practice often masks the real effects of grazing. This is the main reason that close attention to range management detail has proved beneficial—not only to the grazing livestock, but for wildlife and other multiple uses also.

Moderate grazing history

Observations suggest that light and moderate use in the past do not seriously affect a plant's ability to grow and produce normally following drought. Therefore, no out-of-the-ordinary management precautions should be necessary.

Heavy grazing history

If at all possible, defer grazing until the major species mature. Observations show that early season growth of past heavily used species can be depressed seriously, as compared to ungrazed plants. For some species, total production can be reduced significantly. How can an operator accomplish deferment?

• Use annual species ahead of perennials. The drought year acts as fallow, in that above-normal levels of plant nutrients often are available to plants that can take advantage of them. Since annuals are on poor-to-fair-condition range, and often are the only available forage, taking advantage of their relative abundance will help livestock performance as well as allow delayed turnout on the better native bunchgrasses.

• Graze crested wheatgrass. Graze even if heavily used during the drought year. Ultimately, some provision must be made for crested wheatgrass recovery, but this species can take grazing pressure that few others can tolerate without mortality.

• Keep cattle on irrigated hay meadows longer than normal. This may have some merit for delaying turnout if crested wheatgrass or annual pasture is not available. Better water supplies after drought should insure a good potential hay supply, especially if combined with above average fertilization.

• Graze areas scheduled for range seeding that year. Plants would be killed in seedbed preparation anyway.

If grazing cannot be deferred, several alternatives do exist.

• Graze areas first that were not grazed during the drought year due to lack of stock water or to deferment.

• Graze areas that were more lightly used before grazing more heavily used ones. Proper grazing will not damage, and may in fact enhance, grass growth.

• Strive for maximum animal dispersion early in the season, and rotate livestock from unit to unit if several pastures can be made available. Both will place a lighter grazing load on individual plants and give them a chance to catch up during the growing season. Salting away from water, with more salting locations than normal, will aid distribution. Breaking up congregations of cattle through riding may be necessary, also.

Drought Management Planning

Since drought years occur 20 to 25 percent of the time, management plans that do not consider drought impacts are incomplete. Explore each alternative that is employed during a normal season to determine whether any parts of it could apply during drought. Since stock water often is the most critical factor during drought, maintain all watering facilities and develop additional ones as a part of each range program. Contingency plans such as keeping a reserve feed available are a must.

Identify animals that could be sold, if necessary. Keep the records current. Do not be put into a forced sale position. Keep all equipment in order. Have an updated range inventory. Keep in touch with your Extension office to learn of new programs.

Better coping with drought can be accomplished when you have planned for it.

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