United States Department of Agriculture

CEAP Science Note

Natural Resources Conservation Service
Conservation Effects Assessment Project

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Livestock Concentration Areas on Intensively Managed Pastures

Summary of Findings

- Feeding areas (e.g., concentrate, hay, mineral feeders) accounted for the largest amount of pasture area affected by livestock concentration on five farms that were monitored for two years. Farmers should focus management on these sites to reduce potential nutrient loss.
- Livestock concentration areas often had greater accumulation of soil nutrients compared with less disturbed parts of the pasture; however, important exceptions occurred. Sites with significant signs of erosion sometimes had lower soil nutrient concentrations than less disturbed pasture areas.
- Most livestock concentration areas were small, isolated, and often surrounded by vegetation. If these concentration areas are not directly connected to a stream (e.g., channel flow), the surrounding vegetation should behave as a buffer and filter surface water runoff. Proliferation of these areas, however, would increase spatial variation in soil nutrients, provide sites for weed invasion, and encourage soil erosion.

The Conservation Effects Assessment Project (CEAP) Grazing Lands national assessment is designed to quantify the environmental effects of conservation practices on U.S. non-Federal grazing lands. This study, a joint project between private landowners and scientists with the Agricultural Research Service (ARS) in University Park, PA, conducted on-farm research to understand how to best tailor farm and grazing management to minimize the effects of animal concentration areas in pastures.

Background

Grazing animals often congregate around trees for shade, at watering points, and at feeding stations and supplement locations (e.g., hay feeders, salt or mineral licks). The concentration of animals at these sites can result in elevated levels of soil nutrients (e.g., nitrogen, phosphorus), which can contribute to water quality problems. Heavy animal traffic at these sites can also alter soil structure, reduce soil organic matter inputs, and kill vegetation, which results in large areas of bare soil. Once created, the effects from these heavily-trafficked sites may persist for years and create a high degree of variability in pasture health, species composition and/or forage production throughout a pasture. The objective of this study was to determine the extent and spatial distribution of animal concentration areas on selected grazing farms.

Basic Study Design

Research was conducted on two farms in Pennsylvania, two farms in New York, and one farm in Maryland — all of which use grazed pastures as an integral part of the farm system. During a 2-year period, researchers located, measured, and geo-referenced all concentration areas in all pastures on the farms in spring, summer, and fall. Selected areas where livestock had congregated (e.g., gate corners, shade trees, waterers, mineral feeders, grain troughs, and hay feeders; total of 39 paired sites) were soil sampled to quantify animal congregation effects on soil test phosphorus (via the Mehlich III extractant).

Plots for simulated rain application were placed at three landscape positions in each of two pastures on one of the Pennsylvania farms: (1) at the heavily affected and denuded part of the concentration area, (2) at the transition from bare soil to vegetation, and (3) in a densely vegetated area with little or no obvious signs of animal trampling. At each of the six runoff sites, two plots (2.5 feet by 6.5 feet) were isolated by steel frames. A portable rainfall simulator was used to generate runoff, which was collected at the downslope edge of the plot.

Figure 1 shows the total number and size of animal concentration areas on the five farms varied greatly between seasons and years. Three farms had nearly 2.5 acres of concentration areas in April of year 1.

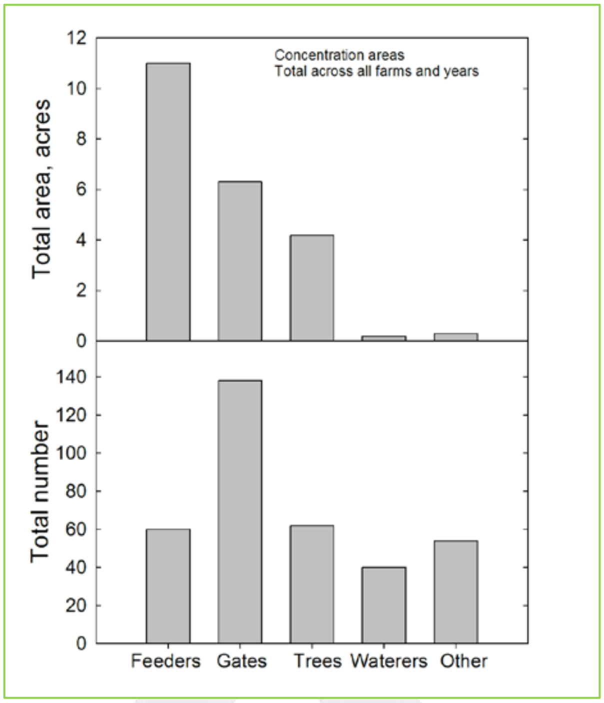

Figure 1. Cumulative number and size of concentration areas by type. Totaled across all farms and years.

These were dominated by one or two large "sacrifice" feeding areas on each farm. Totaled across farms and years, bare concentration areas occurred most frequently at paddock gates; however, feeding areas (mineral and hay feeders, sacrifice feeding paddocks) accounted for the most area affected (fig. 1).

In aggregate, the size of concentration areas generally decreased from spring to fall (fig. 2). This varied with the type of concentration area with large decreases in size occurring for feeding sites, whereas the number and size of concentration areas associated with trees peaked in summer.

Averaged across 39 sites sampled on the five farms, soil nutrient levels were usually higher in the livestock concentration areas than in the unaffected part of the pasture (fig. 3). However, there was considerable variation in soil nutrient levels among sites. Soil phosphorus (P) levels were very

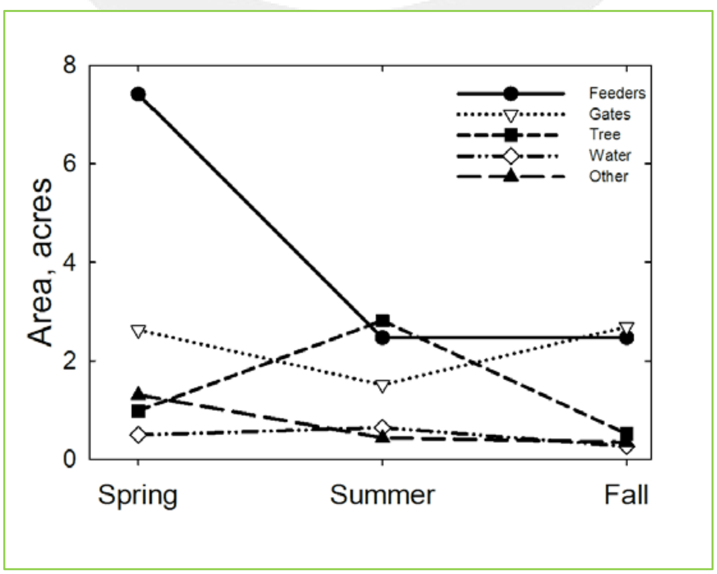

Figure 2. Size of concentration areas by type and season, average of 2005 and 2006 data.

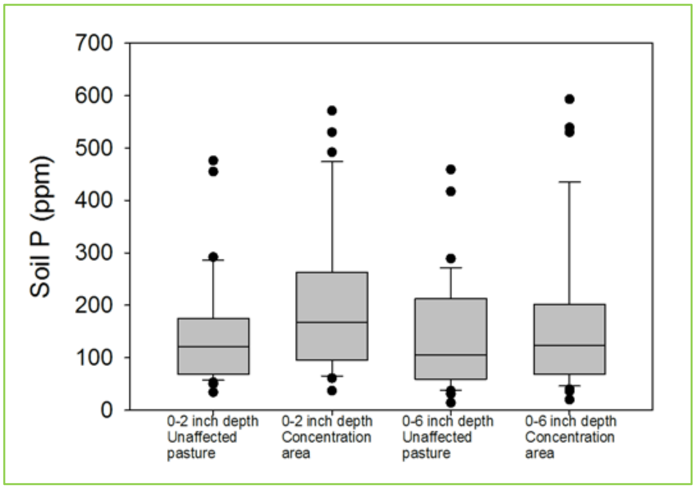

Figure 3. Soil test phosphorus (Mehlich III extractant) at a 0 to 2-inch or 0 to 6-inch depth for livestock concentration areas and unaffected areas in pastures. Data is from five farms on which concentration areas were monitored. Box plots show the median value (line inside the box), 25th and 75th percentiles (box outline), 5th and 95th percentiles (whiskers), and outliers (individual points).

high (> 400 ppm) at some feeding sites and gates. The feeding site with the highest soil P was a paddock used for feeding and wintering beef cows on one of the Pennsylvania farms. Soil P was also relatively high in the unaffected area of this paddock, which along with its nearly direct hydrologic connection to an ephemeral waterway, indicates that this site was a high risk for P contamination of surface water.

Soil test P between the livestock concentration area and the unaffected area for three of the feeding sites differed by 200 to 400 ppm. Soil test P at most feeding and watering sites, however, differed only slightly or not at all between the livestock concentration area and the unaffected part of the pasture. In fact, on some sites the concentration area had lower soil test P levels than the unaffected site. At gates and trees, soil test P in the animal concentration area generally was higher than in the unaffected part of the pasture.

Several studies indicate that soil nutrient concentrations are highest near shades, waterers, and feeders. Our data show, however, that this does not always hold true. Other factors, such as soil erosion, landscape position, or pasture management can alter this relationship. The bare soil at these areas would also allow weed invasion and be susceptible to erosion.

Some soil effects at gates and waterers are inevitable with grazing animals, but our data suggest that these effects can be minimized with attention and management. One of the Pennsylvania farms maintained a winter sacrifice feeding paddock that was often nearly all bare soil in the spring, had very high soil test P levels (> 400 ppm), and a direct connection to a stream. Thus, even though vegetation recovered somewhat on this site, the practice of overwintering created a nutrient runoff hazard.

Runoff occurred more quickly and with greater volume at the center of the livestock concentration area and in the transition from bare soil and vegetation than at 295 feet away where vegetation was dense with less livestock trampling. The concentrations and amounts of total phosphorus were greater in runoff water from the center of the concentration area than at 295 feet away in a densely vegetated part of the pasture (fig. 4).

Management Implications

The use of movable shades and watering sources along with rotational stocking and hay removal are recommendations to reduce the heterogeneity of soil nutrients in pastures. Our data on the number and location of concentration areas, however, indicate that managing feeding areas and sacrifice paddocks may be more important. Even with rotational stocking the farms had many concentration areas distributed around the landscape.

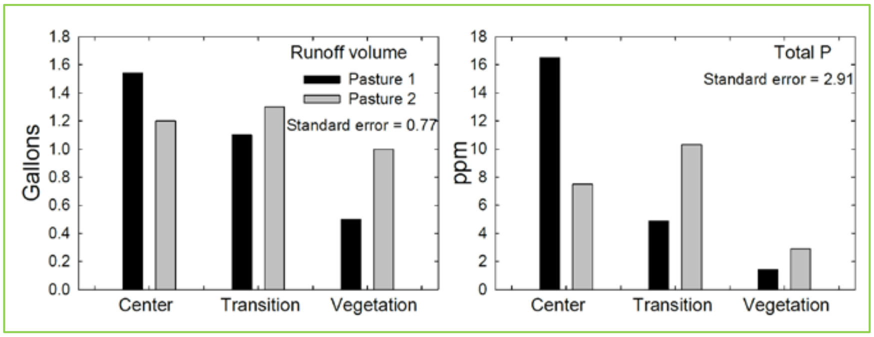

Figure 4. Runoff volume and total P concentration in runoff at three positions (center of concentration area, transition between bare soil, and vegetation, and densely vegetated area) of two livestock concentration areas.

Simply moving shades, feeders, and waterers may reduce the extremes in soil nutrient buildup at these areas, but it will probably increase spatial variability in soil nutrients. Use of NRCS Conservation Practices such as Access Control (472), Heavy Use Area Protection (562), Prescribed Grazing (528), Nutrient Management (590), and others may provide for improved water and soil quality.

Reference

Sanderson, M.A., C. Feldmann, J. Schmidt, A. Herrmann, and F. Taube. 2010. Spatial distribution of livestock concentration areas and soil nutrients in Pastures. J. Soil Water Conserv. 65:180-189.

The Conservation Effects Assessment Project (CEAP) is a multi-agency effort to build the science base for conservation policy and program development, and help farmers and ranchers make more informed conservation choices.

The CEAP Grazing Lands national assessment is designed to quantify the environmental effects of conservation practices on U.S. non-Federal grazing lands. The 584 million acres of non-Federal grazing lands in the contiguous 48 states are composed of 409 million acres of rangeland, 119 million acres of pastureland, and 56 million acres of grazed forest land.

Development of CEAP Grazing Lands processes and findings must address a number of unique challenges that are typically not present on croplands at management scales. Grazing lands typically have more diversity in climate (especially precipitation), soils, and topography than does cropland. Management practices and their effects are less precise and less well-defined, making the results of specific studies more difficult to extrapolate. There are three scales of investigation for CEAP Grazing Lands. Ecological sites will be used to stratify assessments at all three levels for the rangeland portion.

This Science Note was developed by Dr. Matt Sanderson and Dr. Sarah Goslee, USDA-ARS Northern Great Plains Research Laboratory, Mandan, ND; and the Pasture Systems and Watershed Management Research Unit, University Park, PA, respectively.

For more information:
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/ceap/?cid=nrcs143_014159