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Economic and Ecological Benefits of Biodi[...] Ranches in the USA Under Holistic Resource Management

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Abstract

In the USA, farmers often are advised to increase their scale of operation to remain economically viable in the world market. There are many concerns over the social and ecological consequences of this approach, including massive loss of species and genetic biodiversity on large scale industrialized farms. In contrast, a growing alternative approach, Holistic Resource Management (HRM), teaches its students that biodiversity is the foundation of economic wealth. HRM is a process which encourages farmers and ranchers to develop a holistic goal which includes: 1) quality of life values, 2) forms of production to support those values, and 3) resource base and landscape planning, all of which should support fundamental ecosystem processes of succession, energy flow, hydrological and nutrient cycling. For most HRM practitioners this process involves increasing biodiversity on their farms or ranches. In this paper, we present an overview of the HRM model and results of interviews with HRM farmers and ranchers in which relationships between biodiversity and profitability were explored. We found that 95% of the people interviewed reported observing increases in biodiversity (particularly with respect to plants) and 80% reported increase in profits since HRM began influencing their decisions. In addition to increases in biodiversity, the overwhelming majority of the interviewees reported positive changes in ecosystem processes on their farms or ranches. Three of the interviewees who had quantitative data on changes in numbers of plant species and economic indicators are discussed as case studies. We conclude that for farmers and ranchers who consciously work with biodiversity and ecological processes it is possible to have a win-win-win situation between: 1) profitability, 2) environmental protection and 3) quality of life.

1. Introduction

Holistic Resource Management (HRM) is a process of goal setting, decision making and monitoring which integrates social, ecological and economic factors (Savory, 1988). It is being used by farmers, ranchers, communities, government agencies and increasingly, businesses, nationally and internationally (Bingham, 1990; Anon., 1993; Daggart, 1995; Sindelar et al., 1995). The Holistic Resource Management Model evolved out of Savory's concern for the alarming rate of desertification he observed as a wildlife biologist in his native Zimbabwe and many other parts of the world and his desire to do something about it (Savory, 1988). Savory now equates desertification with loss of biodiversity (Savory, 1991;1994) and as a result, biodiversity has become a fundamental concept in HRM. According to Savory (1991; 1994), symptoms and ultimate consequences of biodiversity loss include far-ranging environmental and social effects such as: soil erosion and silting of rivers and dams; increased severity and frequency of floods and droughts; increase in pests and diseases; falling agricultural production and rise in production costs; rural poverty and urban drift; rising crime, violence, social conflict and degeneration; increased bureaucracy; failing economies and cities; and ultimately failing civilizations. "Biodiversity is not about rare and endangered species, it is about human survival" (Savory, 1994). He argues that the typically suggested causes of biodiversity loss such as: overpopulation, overstocking of livestock, communal ownership of land, cultivation of steep slopes, lack of extension services, etc. in Africa, for example, are not correct. Rather, Savory suggests the cause of biodiversity loss is the process of how management decisions are made, fundamentally, and he offers the Holistic Resource Management Model (Fig. 1) as an alternative way of conceptualizing and making decisions (Savory, 1988; 1991; 1994).

The first step in the HRM process is to define the "whole" being managed in terms of people, landbase and money. Once a clear assessment has been made in these terms, the people directly involved (both those who influence the decisions and those who are influenced most by the decisions) should work together to develop a holistic goal which includes their quality of life values, forms of production they must achieve from the land or other resource base to support each of their quality of life values, and a vision of what they wish the land or resource base to look like in the future to sustain their production and that of future generations. In the future landscape description, HRM students are taught to think about and learn to work with four ecological processes as foundation blocks -- community dynamics (which includes ecological succession and human community dynamics), the water cycle, mineral or nutrient cycles, and energy flow (Fig. 1).

Only after this contextual groundwork has been laid do specific tools come into the HRM process. Although most people and especially natural scientists are much more comfortable discussing tools than quality of life values, it is tools that we most often argue about. Laying the context of a farm of ranch first can be a key to building unity in otherwise disparate groups of people in the whole. The tools available to us, according to Savory (1988), include: human creativity, money and labor, rest (e.g., allowing land to lay fallow), fire, grazing, animal impact (effect of short term hoof action and concentrated fertilization when high densities of animals are bunched in a small area for a short period of time, as on the African savannas or the US Great Plains with the American Bison (Bison bison) during annual migrations), living organisms (e. g., using soil micro-organisms to combat crop diseases), and technology (Fig. 1).

Creative brainstorming is encouraged to produce a list of possible solutions to management challenges. These, then, are tested using seven testing guidelines in a pass or fail mode, against the established goal. The first testing guideline, Whole Ecosystem (Fig. 1), asks how the proposed tool or enterprise will affect the four ecosystem processes; will they be enhanced or degraded and will it move these processes towards or away from the future landscape description? In the second testing guideline, Weak Link (Fig. 1), the user determines the weakest link in their operation. Is there a lack of knowledge or information that is holding back progress toward the goal? Is it in personnel or financial problems, inadequate or poor land? Where is the weakest link in the energy conversion chain from sun to plants, to products that can be marketed? Is there a problem organism involved? If so, where is the weakest link in the life cycle of the organism? In the third testing guideline, Cause and Effect (Fig. 1), the user considers whether the proposed action will treat a cause or symptom. The fourth testing guideline, Marginal Reaction (Fig. 1), is one of the economic guidelines and is used only when comparing more than one option. It asks which option will provide the biggest return for the money or time invested in moving the operation towards the goal. The fifth testing guideline, Energy/Wealth - Source and Use (Fig. 1) asks whether the proposed tool will require the use of finite sources of energy and will such use have to be repeated. The fifth testing guideline asks also, what is the source of money required - paper dollars (bank loans), mineral dollars (money from nonrenewable resources) or solar dollars (money generated from renewable sources of energy). The sixth guideline, Society and Culture (Fig. 1), asks how the proposed tool or action will affect the culture and society. Will it help strengthen the community? The seventh and final testing guideline, Gross Margin Analysis (Fig. 1), is another economic test and like Marginal Reaction, compares several options. Using the approach of British economists, Wallace and Burr (1963), in which only variable costs are figured, this guideline helps determine which forms of production are most profitable. If used conscientiously, this process gives the decision maker a consistent and objective evaluation of the soundness of the decision and helps insure that any decision is optimized between environmental, economic and social considerations. It is this optimization process that sets HRM apart from decision making that humans have been using for a very long time, according to Savory (1988; 1991; 1994).

The Management Guidelines part of the model (Fig. 1) deal with specific and more advanced aspects of Holistic Resource Management. See Savory (1988) and Bingham and Savory (1990) for additional information. In the last part of the model - Control, Test - Assume Wrong, Early Warning Criteria, Monitor, etc. (Fig. 1), the user assumes the decision is wrong and watches for the earliest sign of deviation from the plan, be this economically, ecologically or with respect to quality of life. This approach makes it easier to catch deviations from the plan early and correct to produce desired results. The approach stands in contrast to the conventional decision making process which tends to assume that a carefully researched decision is right, and therefore a user is not so apt to see early warning signs of problems (Savory, 1988).

In Holistic Resource Management courses students are taught that biodiversity is the basis of true wealth and sustainable profit from the land, and they are encouraged to think about how to work with the four ecosystem foundation blocks (Fig. 1) and increase biodiversity on their farms or ranches to enhance profit. In Savory's book (1988) and other writings (1994), Savory builds his argument for greater biodiversity in managed ecosystems on the highly debated hypothesis in ecology that stability is positively correlated with diversity in ecosystem function (e.g., Margalef, 1968; Woodwell and Smith, 1969; May, 1973; Van Doblen and Lowe-McConnell, 1975; McNaughton, 1978; and Odum, 1983). McNaughton's (1978) work in old fields and East African grasslands provides support for Savory's contention. The fundamental ecological premise of HRM is that healthy nutrient cycling, hydrology, energy flow and conversion and successional dynamics, with a strong biodiversity base above and below ground (which includes redundancy) buffers the land's response to perturbations (both in terms of resistance and resilience. By learning to work with and improve these fundamental ecological processes on land where previous management has degraded them, farmers and ranchers need less external inputs to sustain production, which allows them to reduce their input costs and thus enhance their profitability.

This is a fundamentally different paradigm from that which dominates conventional agriculture, in which farmers are being advised to move toward larger scale monocultures of crops or livestock which involve intensive disruption of ecological processes and large amounts of external inputs which must be purchased. The most extreme extension of this approach, which is gaining influence in many rural communities in the USA, is corporate contract farming by transnational companies, in which farmers become employees on their own land with very little input into management decisions (Hamilton, 1994a and 1994b; Hefferman, 1994). The ecological and social consequences of this trend are far-reaching and include many of the symptoms that Savory lists of biodiversity loss, including environmental degradation and dying rural communities (FARE, 1994; Hamilton, 1994a and 1994b; Hefferman, 1994). Evidence that a different approach to agricultural management can enhance not only profit, quality of life for farm or ranch families and rural communities, but also biodiversity and the environment could be used to develop new policies. Butterfield's work (1992) with one HRM practitioner in New Mexico suggested that a positive relationship between biodiversity and profitability existed in this operation. To determine how common and widespread this relationship is among a diversity of HRM practitioners, we interviewed a group of 25 people who practice HRM from across the USA.

2. Methods

We used a participatory ethnographic approach (Spradely, 1980) and qualitative research methods (Lincoln and Guba, 1985; Creswell, 1994; Rubin and Rubin, 1995) in this study. Names and contact of Holistic Research Management practitioners were requested from established certified HRM educators and the Center for Holistic Resource Management in Albuquerque, New Mexico. We wanted to interview a range of HRM practitioners with respect to several parameters: 1) length of time using Holistic Management, 2) different climatic regions or position on the "brittleness scale" (Savory's (1988) description for amount and distribution of moisture for a geographic area on an annual basis), 3) scale of operation and 4) enterprises. A set of questions was agreed upon (Table 1). Potential interviewees were contacted by correspondence and given the opportunity to think about the questions before being called and interviewed. A few of the interviewees chose to respond in written form and four individuals were interviewed in person, but the majority were interviewed by telephone. The interviews took an average of one hour to conduct. Twenty-five practitioners were interviewed from locations shown in Fig. 2.

Biological monitoring is the part of Holistic Resource Management which detects early warning signs of ecological problems. Savory (1988) and Bingham and Savory (1990) present methods in which many attributes concerning plant cover, plant density and soil surface conditions are measured on fixed transects. Instead of direct statistical analysis, the data is related to the HRM model for interpretation (Bingham and Savory, 1990). Figure 3 shows the data forms developed by the Center for Holistic Resource Management for this procedure. In addition to providing information on changes in plant community composition over time, this monitoring offers the manager a relatively simple and inexpensive means (in comparison to research methods) of assessing feedback on parameters associated with all the ecosystem foundation blocks in the model. Random sampling points are determined along fixed starting point transects using a dart thrown over the shoulder. Sampling is to be done at the same time of the year each year by the same person. Less than 5% of the people interviewed were doing the full scale biological monitoring recommended by Savory and co-workers. Although most of them relied on less systematic and time-consuming methods of monitoring their land ecologically, which included walking their land and getting down to ground level and observing soil and plants, many reported that they observe their farm or ranch now in ways they did not before being exposed to HRM.

Information from all the interviews is summarized and presented in Table 2 according to methods in Miles and Huberman (1994). This is followed by much more detailed information developed as case studies (Stake, 1995) for three of the interviewees who had quantitative data. These three case studies cross an environmental range in brittleness, a factor of interest because Savory (1988) stresses that brittle environments respond differently to management tools than non-brittle environments. In Table 2, changes in biodiversity are based on interviewees' observations of changes in species numbers (particularly plants) over the time they have been practicing Holistic Resource Management. For changes in profit, percentages are presented where that information was shared, otherwise we show reported positive, negative or zero trends. For information on the ecosystem processes, changes in biodiversity were taken as an indication of changes in community dynamics or succession. Observations of faster decomposition of manure piles, more earthworms and other soil macro-fauna, and changes in organic matter or soil tilth, for example, were viewed as indications of changes in nutrient cycles. Many interviewees reported observing significant changes in soil erosion and hydrological cycles, such as springs and streams running where none had run for many years and clear instead of murky water in ponds. Another indication used for changes in the water cycle was both resistance and resilience to drought. These observations are the basis of presented changes in the water cycle in Table 2. Finally, for changes in energy flow, we used reported increases in plant biomass and increase in stocking rates of livestock. Stocking rates of livestock on a unit of land was a parameter reported by numerous interviewees and was viewed as a direct indicator of profitability (although price fluctuations confound this) in addition to an indirect indicator of energy flow. Stocking rates are the amount of land required to support one animal for a specified period of time, usually a year (see Bingham and Savory, 1990 for further discussion of stocking rates).

3. Results

3.1 Summary of all interviews

The scale of operations ranged from 7.3 - 90,000 Ha and the time practicing HRM 1.5 - 17 years with an average of 5.6 years (Table 2). Interviewees typically defined biodiversity as all the different species of plants and animals, including micro-organisms in the soil, and their quantities as biomass or numbers. In addition, habitat diversity and genetic diversity within agricultural species were often mentioned. One interviewee included diversity of human ideas in his definition of biodiversity. Nine percent of the interviewees thought about biodiversity in context of their operations before being exposed to HRM. Now, 100% of them think biodiversity is important to the ecological and economic well-being of their farms or ranches. "Biodiversity is the true wealth to sustain the world. It is the only true source of capital for enterprises. I was not aware of biodiversity before HRM", said one of the interviewees in response to question 6 (Table 1). All but one interviewee reported observing increases in biodiversity since they began using HRM. With respect to changes in profit, 80% reported increase in profits since HRM began influencing their decisions. Of these, 40% provided actual percentage increases which ranged from 60 - 1400% and averaged 383% (median was %). Reduced input costs seem to be the major reason for better profitability in this group, which gave them a wider profit margin. Sixteen percent reported no or little increase in profits yet, but were optimistic about future increased profitability.

In addition to increased biodiversity on their farms and ranches and concomitant increases in profitability, almost all of the interviewees reported observing improvements in ecosystem processes since they began using HRM (Table 2). For example, a farmer/rancher in North Dakota with 11 years experience practicing HRM, related increases in soil permeability and infiltration from 5 cm to 50 cm. All of the ranchers west of the Mississippi River reported changes in plant species composition to a greater frequency of perennials and return of many native tall and short grass prairie species. On the human community side, most of the interviewees relayed that they were considered odd by their immediate neighbors, but many of them are sought after speakers for national meetings and even internationally. Networks with other HRM practitioners were considered critical to the success of most of the interviewees.

3.2 Detailed case studies of three farms/ranches

These three operations offer a range along Savory's brittleness scale, with the farm in West Virginia in the humid southeastern part of the USA (#4, Fig. 2) being in the least brittle environment , followed by the Oklahoma Coffey Ranch (#19, Fig. 2), and the New Mexico ranch in the arid southwestern part of the USA in the most brittle environment (#23, Fig. 2).

Windy Slope Farm, Leon, West Virginia

John and Carolyn Fichtner and their three children moved to this 32 Ha (8 Ha pasture and 24 Ha woodlands) hillside farm (# 4, Fig. 2) in 1981. At that time, the farm was almost overrun with multiflora rose (Rosa multiflora Thumb) and its soils (Gilpin, Muskingham and Uptsure) were classified as severely eroded and very severely eroded. It had been plowed for maize production in the 1930's and then put into sod in the 1940's or 1950's and the land supported a few horses and beef cattle since the 1950's. Before European settlement, the farm was fire- maintained savanna grazed by the Eastern Woodland Bison (Bison sp) according to ref (). The Fichtners began intensive grazing in 1989 and discovered HRM at an intensive grazing conference. The husband and wife took their first HRM classes in 1990 and 1991 respectively. Both had off farm jobs at that time. They developed their Three Part Goal:

"Quality of life: A lifestyle that requires minimal material goods and allows for plenty of time to enjoy life with family and friends. A lifestyle that is in harmony with nature and contributes to the community, and one in which the children can grow, learn, develop and be happy productive individuals.

Forms of Production: Many different species of:

A) Livestock and poultry to harvest forage produced by the sun's energy.

B) A form of production that is sustainable and relies little on external inputs.

C) A form of production that poses little health risk and lots of enjoyment to all involved with the operation.

D) A diversity of enterprises is desirable. In addition to livestock, we would make use of the forests, wood products, raise fruits, nuts, and vegetables.

E) Forms of production that would allow our children to earn a livelihood for them and their children, if so desired.

Future Landscape: A landscape with character. Lush green fertile pastures free of erosion bordered by woodlands that are rich in diversity of healthy plant and animal species, both wild and domestic. Clean water sources that can be used for production purposes as well as recreation and wildlife habitat."

With their goal and the principles and tools of Holistic Management they began to reclaim their land.

A great diversity of animals (Saaenen dairy goats, Suffolk, Suffolk X, Cheviot, Romney x Liecester, Perendale X sheep, Scottish Highlander cattle, Jersey dairy heifers, donkeys, hogs, chickens, quineas, geese, Muscovy ducks and turkeys) are used as tools, each with their own role. For example, the hogs break up and compost manure in the barn and the Muscovy ducks control flies. The Scottish Highlander cattle are very rugged and excellent browsers, clearing brush efficiently. The donkeys keep coyotes (Canis latrans) at bay. The cattle graze after the sheep, helping to break the parasitic cycle, as well as harvest the plants their predecessors passed over. Lambs are pasture born in the spring. The Fichtners began controlled grazing in 1990 on a small scale with 7 paddocks, a few sheep and electric net on a 0.2 Ha field. Now they have one 12 Ha cell with 12 permanent paddocks, which they further subdivide into 40 or 50 or even more depending on the conditions (Massey, 1993 and interview). In this time, because of quality of life concerns and profits have risen, Carolyn has quit her off-farm job. The family's short-term goal is to have a seasonal dairy in 2 years and they have 20 Jersey heifers as a foundation of their future dairy herd, a clear statement of the pasture improvements that have been made on this farm. Concomitantly with these changes, the Fichtners have monitored improvements in the organic matter, with more humus and tilth of their soils and dramatic increases in plant biodiversity in their pastures.

A summary of changes in stocking rates, number of plant species and net profit/Ha from 1990 to 1995 on the Fichtner farm are shown in Table 3. Stocking rate, number of plant species in pastures and net profit/Ha have increased fivefold in that 5 years. Improvements in the ecosystem foundation blocks are integral to this increase in profit. The increased plant diversity was in the direction of higher successional species (annuals versus perennials), indicating changes in community dynamics. Higher stocking rates indicate more efficient solar energy conversion with its resulting increased carrying capacity. More ground cover has reduced erosion and the Fichtners report more earthworms and other soil macrofauna involved in nutrient cycling and faster decomposition of manure piles. The shorter and denser forage species present now grow longer and better in hot dry weather now than those present in 1990, so that the growing season has been extended. Also, they are able to get more grazing rotations on a particular paddock per year now (3-6) than in 1990 (1-2).

<u>Noble Foundation / D. Joyce Coffey Resource Management and Demonstration Ranch, Marietta, Oklahoma</u>

This 1053 Ha ranch (#19, Fig. 2) was a privately owned and operated ranch until 1981, when its owner died and willed its management to the Noble Foundation to be operated as a model ranch. Historically, this ranch was similar to much of southern Okalahoma, with crops planted on open land and livestock continuously grazed on rough and wooded land. The Coffey family moved to the ranch in 1949 and focused on cattle and forages, establishing improved grasses in some areas in the 1960's and 70's (Altom, 1992). Today, the ranch contains 506 hectares of open herbaceous plant community and the remaining streams and wooded vegetation (Griffith and Stevens, 1992). Major soils on the ranch are: Breaks--alluvial land, Denton, Durant, Gowen, Labette, Lincoln, Lula, Minco, Norwood, Rocky broken land, Stephenville, Shidler-Steedman Complex, Tarrant, Teller, and Windthorst. Some of the upland soils are slightly to severely eroded (Altom, 1992). Currently, the ranch is managed by a team of specialists in crops and forages, economics, livestock, soils and soil fertility, and wildlife and fisheries plus the ranch manager. This management team initiated Holistic Resource Management on the ranch in 1987. We interviewed Charles Griffith, the forage specialist and in addition to the interview material, he provided us with written research and field day reports. This operation had the most complete quantitative data on changes in plant biodiversity of our interviewee group. The annual stocking rate had decreased from 300 to 67 animal units per year, with a mixture of 60% low seral species, 12% mid seral species and 22% high seral species on the degraded rangeland when HRM began being applied (Griffith and Stevens, 1992).

The goal statement developed by the management team for the Coffey Ranch is shown in Table 4. In general, the landscape goal was to reverse the successional trend back to a mixture of low, medium and high seral species, with high seral species occupying as much as 50% of the plant communities and to stop all forms of soil erosion. It was determined that this landscape could support the production goal of high profitability in livestock and lease hunting (Griffith and Stevens, 1992). Management tools used to realize the landscape goal included: grazing, based on time control, stock density and proper plant rest periods; fire and animal impact. Herbaceous plant composition was monitored annually on five random transects. Annual fixed point photographs were used to monitor soil erosion and wildlife populations were monitored with spotlight surveys, harvest records and incidental sightings (Griffith and Stevens, 1992).

Monitored changes in plant communities and annual stocking rates from 1987 to 1991 and then to 1994 are shown in Table 5. From 1987 to 1991, there was no change in frequency rate of high seral species at 5%, but low seral species declined from 60% to 32% frequency rate and mid seral species increased from 12% to 43% as a result of grazing management, with an concomitant increase in annual stocking rate of 30% (Table 5). Exposed soils containing varying degrees of erosion were completely covered with growing plants and the white-tailed deer (Odocoileus virginianus) had increased 100% (Griffith and Stevens, 1992). By 1994, high seral species had risen to 25%, low seral species had declined further to 25%, mid seral species had dropped back down to 27%, and stocking rates had increased 100%, from 110 animal units per annum in 1987 to 200 (Table 5, Newport, 1995). In addition, changes in song bird populations have been observed as have the common bobwhite (Colinus virginianus), wild turkeys (Meleagris gallopavo), and some predators, including golden eagles (Aquila chrysaetos).

Other ecosystem processes besides succession have changed on the Coffey Ranch since implementation of Holistic Resource Management also. In the interview, Griffith reported that improvements in the water cycle were the first changes observed with respect to erosion. Ponds which had high turbidity now have low turbidity and two springs which had dried up now run in the spring of the year. Nutrient cycles have changed resulting in much faster decomposition of manure piles from 2-3 years in 1987 to 5 days now, according to Griffith. Greater percent ground cover and more higher successional plant species are indications of improved energy flow and conversion on the land. Labor is another factor that has been dramatically altered on the Coffey Ranch by HRM according to Griffith in the interview. In 1987 it took four people and two horses all day to gather the cattle, now, because of planned grazing and the cattle being trained to that, it takes one person and no horses five minutes to move the animals. Animal sales doubled since 1987 after a 3 year threshold was crossed. However, "if our knowledge had been there, the increases could have come almost immediately" Griffith said in retrospect in the interview.

Rafter F Ranch, San Jon, New Mexico

This 4800 Ha ranch in northeastern New Mexico (#23, Fig. 2) is in the most brittle environment of our three case studies with an average of 40.6 cm of rainfall a year, 70% of which comes in the summer months. However, 1994 and 1995 have been exceptionally dry with 12.7 cm and 17.8 cm, respectively. The ranch was first homesteaded in the early 1900's by the current owner's parents. In the interview, Roger Bowe said that the land was originally farmed and "blew away in the 1930's" (soil erosion via wind). Rolling hills with sandy loam soils and sod-bound grama grass (Bouteloua spp.) and valleys with clay flats, tobosa grass (Hilaria mutica) and gradual encroachment of mesquite trees (Prosopis glandulosa) characterized the land (Bowe, 1987; Butterfield, 1992). It is all range land. Roger and his parents were motivated to take their first HRM course in 1983 to halt their ranch's falling productivity. They admit that they many mistakes the first couple of years, in particular because they spent more time and energy on fencing, land and biological planning than on goal setting (interview and Bowe, 1987). A second HRM course in 1986 was critical in helping them with that their goal and they began to move forward (interview and Bowe, 1987). The parents have since retired, but Roger and his wife, Debby have been joined by his brother and his family. In brief, their goal is:

Quality of life A long-term business that is prosperous and stable and can provide for two families without anyone having to work away from the business, closer family ties, time for leisure, time for working in a strong community, school and church, and a good education for the children.

Forms of Production Profits from livestock and wildlife.

Future Resource Base Higher successional grassland with scattered brush, increased biodiversity in both livestock and plants, a watershed that is no longer eroding and high water quality.

They used three tools, primarily, to reach their goal: grazing, animal impact and technology in the form of fencing. Several days of planning is required each year to establish the grazing plan for the following year, both in checking on forage quality to determine how much will be needed to feed one cow one day in all 56 paddocks, and in computer and evaluation time. Biological monitoring is done on five transects once a year after the growing season when the plants have seed heads for ease in identification (Butterfield, 1992). Results of this monitoring are shown in Table 6. From 1984 to 1991, the number of perennial species of grasses tripled and ground cover increased. Concomitantly, from 1984 to 1991 the stocking rate of beef almost tripled and the cost of production dropped by one half (Table 6). Bowe reported that net returns per acre tripled over this period (Butterfield, 1992). One weed, snakeweed (Gutierrezia sarothrae.), which covered 11% of one grazing cell in 1986 and that the Bowes had failed to eradicate with chemicals, was reduced to 1% cover by 1990 and nine new species of perennial species were recorded with grazing and animal impact (Butterfield, 1992). In the interview, Roger discussed the presence of two new plant species, indiangrass (Sorghastrum nutans, which the cattle love) and Canadian wildrye (Elymus canadensis) which normally occur at much higher altitudes than his land. In addition to increased plant biodiversity, the Bowe reported increases in earthworms (Bowe, 1987) and wildlife.

Like most of the interviewees, the Bowes have observed numerous improvements in other ecological processes besides succession. Bowe reported that his water table has risen three meters (which he thinks may explain the presence of the above rare species for his area). An old dry well now has 3 meters of water in it. Springs have appeared. He told the story of an archaeological site on his land where there were signs of a Native American settlement in the form of tipi rings which could not be explained because there was no water nearby. However, after the water table began rising, they discovered a spring near the site. There is much less erosion now than before, a function of the greater number of perennial grass species. However, Bowe feels there is potential for a lot more biodiversity on their ranch. "When I see a new grass species, clear water in my stock ponds, minerals cycling through living organisms and by banker becoming a stranger, that's my (positive) feedback" (Butterfield, 1992).

Discussion

Many of the interviewees on the original tall and short grass prairies of the USA reported return of native species in their intensively managed grazing cells and reported that their cattle were doing very well on the native forage. Ecologically, this is a very interesting, in that it was agriculture that caused degradation of the American prairies and on these HRM managed lands at least, agriculture is helping to restore the native ecological communities. Our study shows that for most of these ranchers and farmers, their investments of time and money to agrade the land is netting increased profits in higher carrying capacity and lower production costs.

HRM influenced people's time allocation and labor patterns. Many, especially the graziers, reported dramatic decreases of up to 40-60% in labor requirements in their operations, in spite of the extra planning and monitoring required by HRM. " Not only do I have time to go out to eat with my family one night a week now, but I can pick which night", one of the ranchers (7 years HRM) told a group of HRM workshop participants. Another rancher (9 years HRM) reported, "I have time to be a dilettante".

Other interviewees reported that the total time they spend has not changed, but what they do has and is more enjoyable, i.e., their quality of life is better than it was before. "We are no longer doing a lot of things we do not like to do", said one dairyman.

The one exception to observed increases in biodiversity was the organic vegetable grower (case #2, Table 2). He had been an organic producer for twelve years prior to being exposed to HRM, which probably means that his soils were rich in organic matter and soil organisms to begin with. However, he did introduce cover crops into his vegetable operation since beginning HRM, which may have increased the biodiversity of soil microorganisms without him realizing it. Although he was the only member of the group who was not using grazing or animal impact as tools on his income generating land, he is considering incorporating grazing and animal impact on the cover crop part of his rotation in the future and currently is learning the necessary grazing management skills with bartered dairy heifers on a separate 4 ha pasture part of his total land holdings. This brings up a confounding factor that emerged in this study for those interviewees whose entire operation is focused on grazing livestock - it is difficult to separate the effects of Holistic Resource Management, per se, and planned intensive grazing with animal impact as tools on changes in biodiversity. However, a number of the midwestern farmers in the interviews combine field cropping and intensive grazing in their operations (Table 2), and all of them reported increases in biodiversity on their entire operations. For most of these farmers, HRM has influenced decisions to incorporate more extensive rotations of field crops, even agro-forestry in one case (#11, Table 2), and some are experimenting with more diverse spatial cropping patterns, such as narrow strip cropping; all of which create more habitat for soil organisms and wildlife than the conventional corn/soybean monocultures typical for this part of the USA. Of additional interest, is that a few of these farmers are experimenting with grazing and animal impact on stubble in the crop fields after harvest, or even intentionally shattering small grains during harvest for cattle with considerable economic and ecological advantages. For example, interviewee 22 in Table 2 reported increased grazing value of shattered grains, higher yields than indicated by soil tests, 3-4% higher protein in wheat raised in grazed than ungrazed fields, and soil organic matter levels comparable to ungrazed croplands with legumes in the rotation (Kramer et al., 1992). See Kramer et al. (1992), Ahlers (1993) and Goven (1995) for more information on this extremely interesting operation managed by a long term HRM practitioner in North Dakota).

Savory and the Center for Holistic Resource Management stress that HRM is not a grazing system. The observation that the organic vegetable producer saw a significant increase in profits in a short period of time (case #2, Table 2) using HRM goal setting and financial planning makes this point. However HRM and planned grazing do integrate well. In fact, HRM grew out of Savory's ideas on using animals in a planned grazing system to restore biodiversity and vitality of degraded and desertifying land. Because herding animals were important evolutionarily as ecological forces in many grasslands of the world (McNaughton, 1976; 1978; 1979), Savory (1988) argues for the replacement of native herding animals with livestock managed in such a way as to mimic the behavior of the native animals in these areas. However, he learned through experience that this practice alone is not the sole answer to the problem of land degradation (Savory, 1988). Numerous interviewees had similar stories to tell, with many of them discovering HRM soon after they had initiated a conversion to planned grazing and reporting that HRM greatly enhanced the conversion process.

While it is clear that the HRM model is not exclusive of any practice and has applications beyond grazing systems, it is true that keeping permanent sod cover in a healthy state is a very good method to enhance all four of the ecosystem processes Savory stresses as foundation blocks of a healthy landbase capable of sustaining profitable production. The emphasis HRM places on building closed nutrient cycles, which is difficult to do without animals, and as little dependence on non-renewable sources of energy as possible makes HRM unpalatable to many conventional cash-grain farmers and confinement livestock operators. Ranchers and diversified crop and livestock farmers attracted to intensive grazing are inherently predisposed to be receptive to HRM, which is why our group of interviewees was skewed in that direction.

Does biodiversity enhance profitability? In the experience of the overwhelming majority of the farmers and ranchers we spoke with in this study, the answer is yes. However, our study cannot answer this question in the typical quantitative manner scientists are accustomed to, we can only report the perceptions of our interviewees. Relevant to this point, Checkland (1981) and Bawden et al. (1984) describe two different approaches to agricultural research. The scientia approach is quantitative, focused, precise, slow, expensive and if done in optimal conditions so controlled as to be disassociated from the complexities of reality. The praxis approach is qualitative, fuzzy, imprecise, relatively inexpensive, quick and highly confounded with complexities of the real world. A more scientia approach to this question, involving long-term quantitative monitoring of ecological and economic parameters on many HRM farms or ranches would be very helpful but, would run into many confounding factors like the grazing issue discussed above. The two farmers from Minnesota (#s 7 and 8, Table 2) that we interviewed are working on such a study involving ecological monitoring study of HRM farms in Minnesota, therefore some scientia based data will be available in a few years. A growing number of agricultural scientists are recognizing the value of different kinds of information, including the kind produced in studies like this one that involves a more praxis approach (Bawden et al., 1984; Standford et al., 1992). An important question for policy makers and societies at large is, what kind of data do we base our policies on? We believe that both scientia and praxis based information are important. It may take science years to "prove" what farmers and ranchers learn quickly from experience, time in which agriculture over much of the globe could change from an horizontally to a vertically integrated system.

Within the praxis approach, this study suggests strongly that for farmers and ranchers who consciously work with biodiversity and ecological processes it is possible to have a win-win-win situation between: 1) profitability, 2) environmental protection and 3) quality of life. However, the implications of this finding must be explored in context of the larger agricultural picture. The Center for Holistic Resource Management has 1900 members in the USA. Although the movement is growing nationally and internationally, this is a very small percentage of the people currently making decisions about how to manage agricultural lands. Furthermore, there is a commitment problem among some people who take HRM workshops, as evidenced in a recent Center for Holistic Resource Management Quarterly devoted to the issue of maintaining commitment (HRM Quarterly, 1995a). It appears that HRM involves more planning and monitoring than many farmers and ranchers are accustomed to or willing to do. The learning is slow at first for most people (an exception to this in our study is the organic vegetable producer who had 12 years of experience managing his land organically before coming to HRM). In our study we found that there can be a considerable time lag before benefits return and managers can report like this one with 10 years of HRM experience, "HRM was mind boggling at first, but so simple now". In our time of expectations of fast technological solutions to specific problems, this approach requires a great deal of patience. Several of our interviewees with 5 years of practice had yet to experience significant economic benefits. Indeed, one response to our question about advice to new HRM practitioners (#13, Table 1) was to persevere, "it will work".

Probably the greatest obstacle to widespread adoption of HRM is the paradigm shift it requires. The paradigm that Holistic Resource Management is based upon, in which humans learn to work consciously with ecological processes to rebuild biodiversity and ecological integrity on their land, is fundamentally and radically different from the paradigm that dominates conventional agriculture, which places relatively little emphasis on ecological processes and biodiversity. Indeed, vertically integrated agriculture results generally in very large scale monocultures of genetically homogenous crops and livestock. However, our study indicates that it is possible to have optimal benefits socially, economically and ecologically with very rich biodiversity on a land scale comparable to vertically integrated operations, in that some of the most dramatic ecological improvements reported in the interviews were on the largest operation out of the group - the Deseret Ranch in Utah at 90,000 ha (# 24, Table 2). See Dagget (1995) for a description of this operation and the ecological changes HRM has brought to it.

Independent farmers and ranchers with more limited resources than vertical integrators are becoming increasingly vulnerable to foreclosure or offers from transnational companies, with little say in how their land is managed and highly dependent on external resources over which they have no control (Hamilton 1994a and 1994b; Hamilton, 1994); the antithesis of what Holistic Resource Management is all about. Educational efforts by the Center for Holistic Resource Management and its registered educators, and numerous federal and private research and education grants involving HRM are extending HRM knowledge and practice among farmers/ranchers, research scientists, extension specialists and other government agency personnel in the US (and other parts of the world). In Ohio, as agricultural scientists doing participatory research with a diversity of farmers, we are using HRM to help farm families who wish to remain independent operators of their own land be economically viable in an environmentally sound way with a good quality of life. As agriculture becomes more and more industrialized and numbers of independent farmers and ranchers decline, opportunities for alternative markets are increasing in many developed countries. This may be the primary hope of survival for small operators, at least as long as fossil fuels are readily available and inexpensive. An approach like HRM can help people build and expand on these opportunities in "niche" marketing (HRM Quarterly, 1995b).

Global agriculture is at a critical cross roads today. The economic pressures as a result of transnational companies to vertically integrate the global agriculture system are very great (Bond, 1995; Hamilton, 1994a and 1994b; Hefferman, 1994; FARE, 1995). If Savory is correct in contributing the failure of past civilizations to loss of biodiversity, ultimately (Savory, 1994), this is an issue of grave importance not only for farmers and ranchers and the rural communities they live in, but all of us. The farmers and ranchers interviewed in this study demonstrate a viable alternative approach to industrialization and its concomitant loss of biodiversity, one in which biodiversity is nurtured as the foundation of sustainable profitability.

For more information on Holistic Resource Management, contact the Center for Holistic Resource Management at 1007 Luna Circle NW, Albuquerque, NM 87102 505/842-5252, FAX: 505/843-7900.

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Economic and Ecological Benefits of Biodiversity on Farms and Ranches in the USA Under Holistic Resource Management

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Abstract

In the USA, farmers often are advised to increase their scale of operation to remain economically viable in the world market. There are many concerns over the social and ecological consequences of this approach, including massive loss of species and genetic biodiversity on large scale industrialized farms. In contrast, a growing alternative approach, Holistic Resource Management (HRM), teaches its students that biodiversity is the foundation of economic wealth. HRM is a process which encourages farmers and ranchers to develop a holistic goal which includes: 1) quality of life values, 2) forms of production to support those values, and 3) resource base and landscape planning, all of which should support fundamental ecosystem processes of succession, energy flow, hydrological and nutrient cycling. For most HRM practitioners this process involves increasing biodiversity on their farms or ranches. In this paper, we present an overview of the HRM model and results of interviews with HRM farmers and ranchers in which relationships between biodiversity and profitability were explored. We found that 95% of the people interviewed reported observing increases in biodiversity (particularly with respect to plants) and 80% reported increase in profits since HRM began influencing their decisions. In addition to increases in biodiversity, the overwhelming majority of the interviewees reported positive changes in ecosystem processes on their farms or ranches. Three of the interviewees who had quantitative data on changes in numbers of plant species and economic indicators are discussed as case studies. We conclude that for farmers and ranchers who consciously work with biodiversity and ecological processes it is possible to have a win-win-win situation between: 1) profitability, 2) environmental protection and 3) quality of life.

Table 1
Interview questions asked of Holistic Resource Management Practitioners.

1. When did HRM start influencing your decisions?
2. What led you to HRM? What attracted you? What allowed you to accept HRM? How did you get started?
3. Before HRM started influencing your decisions, how did you measure success? What economic indicators did you use? (e. g. $/ A?, $ /unit?, cash flow?) What quality of life indicators did you use? (e. g. Time?) What biological, chemical, or ecological indicators did you use? (e. g. soil tests?)
4. Now that you are using HRM, how do you measure success and what quality of life, economic and ecological indicators do you use? How has HRM influenced your use of time?
5. What is your three-part (holistic) goal?
6. What is your definition of biodiversity? How important was biodiversity to you before HRM compared to now?
7. Have you observed or monitored changes in biodiversity on your farm/ranch since you began using HRM? If so what changes have you seen and how have they been monitored?
8. What consequences of changes in biodiversity have you observed on your farm/ranch ecologically and economically?
9. If biodiversity has increased since you began HRM, have you seen increase in profit or overall wealth? How much in percentages?
10. Has thinking and learning about biodiversity through HRM changed your practices as a farmer/rancher? Are your decisions different from before HRM? What are your thoughts for the future with respect to biodiversity?
11. What advice would you give to other farmers just beginning?
12. How have you adapted HRM indicators to your area with respect to the brittleness scale? *(This question is especially for eastern farmers)*
13. How has HRM affected your interactions within your community? Has networking been important to you and if so, in what ways?

Table 2
Summary data from interviews with Holistic Resource Management practitioners. Cases are presented from east to west across the USA. Case numbers are shown on map in Fig. 2.

Case[1]	Location	Enterprises[2]	Scale (Ha)	Yrs. HRM	Changes in Biodiversity[3]	Profit[4]	Community Dynamics	Mineral Cycle	Water Cycle	Energy Flow
1	VT	S. Dairy Sheep/Horses (G)	80	1.5	+	+	+	+	+	+
2	VT	Organic vegetables	7.3	1.5	0	+100-200%	0	+	0	+
3	WV	Sheep/Beef (G)	82	2	+	+	+	+	+	+
4*	WV	Sheep/Goats Beef/Poultry Dairy heifers (G)	32	5	+	+500%	+	+	+	+
5	OH	Sheep/Beef (G)	56	2	+	+250-300%	+	+	+	+
6	OH	Dairy (G)	120	2	+	0*	+	+	0	+
7	MN	S. Dairy (G)	140	5	+	+*	+	+	+	+
8	MN	Dairy (G)/Maize Soybean/Hay	120	5	+	+	+	+	+	+
9	IA	Beef/Chickens Sheep (TG)/Maize Soybean	144	2	+	+	+	+	+	+
10	IA	Beef/Hogs Sheep/Chickens Dairy heifers (G) Maize/soybean)		4	+	+	+	+	+	+
11	IA	Hogs/Beef (G) Agroforestry Maize/soybean		3	+	0*	+	+	+	+
12	MO	Beef (G)	360	7	+	+	+	+	+	+
13	MO	Beef (G)	116	2	+	+	+	+	+	+
14	MO	Beef (G)		3	+	+	+	+	+	+
15	MO	Beef (G)	116	3	+	+	+	+	+	+
16	TX	Beef (G)	8800	9	+	+60%	+	+	+	+
17	OK	Beef/ (G)	1200	9	+	+	+	+	+	+
18	OK	Beef (G)	5600	7.5	+	+200%	+	+	+	+
19*	OK	Beef (G)	1040	8	+	+200%	+	+	+	+
20	OK	Beef/Chickens Goats (G)	400	5	+	0*	+	+	+	+
21	KS	S. Dairy Beef (G)	120	5	+	0	+	+	+	+
22	ND	Beef(G)/Oats Wheat/Millet Lentils/Flax	100	10	+	+	+	+	+	+
23*	NM	Beef (G)	4800	9	+	+300%	+	+	+	+
24	UT	Beef (G)	90,000	17	+	+1400%	+	+	+	+
25	WA	Beef (G)	+1520	10	+	+	+	+	+	+

[1] * indicates farms or ranches from which quantitative data was provided and is presented in Tables 3 - 5.

[2] S=Seasonal; G=Planned intensive grazing; TG=Transitionl planned intensive grazing from cropping.

[3] + indicates that the interviewee observed increases in biodiversity of plant species and sometimes in birds and wildlife. See text for further explanation.

[4] + indicates that profits increased since beginning HRM. +* indicates that the farm/ranch was operating at a loss before HRM was implemented and is now breaking even. 0* indicates that increased profits have not been observed yet, but that the interviewee was confident that profits will increase. 0 indicates no change in profits. Percentage increases are shown where the interviewee provided that information.

Table 3
Plant biodiversity, stocking rate and net profit data from the 32 Ha Windy Slope Farm in West Virginia .

	# of Plant Species	Stocking Rate/Yr.*	Net Profit/Ha
1990	8	1:2	<$40
1995	32	1:0.4	$200

* One animal unit : # of hectares required to carry that animal.

Table 4
Goal statement for the Coffey Ranch, Marietta, Oklahoma (Altom, 1992).

I. Quality of life
  A. To carry out the mandate of the Coffey will
  B. To develop a good community / neighbor relationship
  C. Develop a positive impact among neighbors, community, and other agricultural agencies by sharing information in field days, tours and publications.
  D. Develop economical, physical, mental and spiritual well-being of all persons involved by using a team approach and being collaborative in establishing ranch policies and research and demonstration needs.
  E. Find a high degree of satisfaction and pride in work for staff and families and perform at a high level of productivity.
  F. Improve the ecosystem of the ranch (soils, grass-forbs, wildlife, etc.).

II. Production and education
  A. Develop desired landscape using management systems that require limited expenditures for inputs.
  B. Demonstrate the use of a cow herd for producing income and changing the landscape.
  C. Demonstrate wildlife and fisheries management and recreational leasing on a cattle ranch.
  D. Demonstrate value of corps, timber, minerals, and aesthetics on a ranch.
  E. Monitor and access
    1. People
    2. Finances
    3. Land
    4. Plants and animals
  F. Identify and initiate needed research.

III. Landscape - The major goal is to develop and / or maintain a wide diversity of plants to support livestock and wildlife, reduce erosion, and create a positive water cycle. The ranch has been divided into plant communities and soil areas for description and monitoring.
  A. Woody plant communities
    1. Bottomland
      a. Loamy bottomland goal description: Grasses 15-50% frequency, grasslikes 0-10% frequency, forbs 10-25% frequency, and woody plants 85% canopy cover. (A specific list of desired plants has been written, but is not listed here).
      b. Blackclay prairie
      c. Sandy
    2. Upland
      a. Blackclay prairie
      b. Loamy prairie
      c. Sandy savanna
      d. Very shallow
  B. Herbaceous plant communities
    1. Bottomland native
      a. Loamy
      b. Sandy
    2. Upland native
      a. Blackclay prairie goal description: Grasses 80-90% frequency, grasslikes 0-5% frequency, forbs 10-25% frequency, woody plants 0-5% canopy cover. (A specific list of desired plants has been developed, but is not listed here).
      b. Loamy prairie
      c. Sandy savanna
      d. Very shallow
    3. Planted
      a. Bermudagrass
      b. Mixed grass
  C. Wetland - Ponds, streams, and marshes.

Table 5
Changes in biodiversity and profit indicators on the Coffey Ranch, Marietta , Oklahoma from 1987 to 1994.*

	1987	1991	1994
Changes in Forage Type (% Frequency)			
Low-seral**	60	32	25
Mid-seral	25	27	27
High-seral	5	5	25
Stocking Rate/Yr.	110	140	200

*Sources of data Griffith and Stevens (1992) and Newport (1995).
**Seral stages refer to early, mid and late successional species of grasses and forbs.

Table 6
Changes in biodiversity and profitability indicators on the Rafter F Ranch in northeastern New Mexico[1].

	1984[2]	1991[2]	1994
# Perennial grass species	6	18	
% Bare soil	46	30	
Distance between plants (cm)	3.25	1.75	

	1983	1991	1994
Stocking rate	1:17	1:6.7	
Kg. of beef produced/Ha	66	171	
Cost/Kg of beef	$1.36	$0.66	

[1] Data from Butterfield (1992).
[2] Data from the two oldest transects.

Figure 1. Holistic Resource Management Model.

HOLISTIC RESOURCE MANAGEMENT MODEL

"WHOLE" UNDER MANAGEMENT

PEOPLE — RESOURCE BASE — MONEY

GOAL

QUALITY OF LIFE (VALUES)
FORMS OF PRODUCTION & FUTURE RESOURCE BASE

ECOSYSTEM FOUNDATION BLOCKS

Community Dynamics — Water Cycle — Mineral Cycle — Energy Flow

TOOLS

Human Creativity (Rest | Fire | Grazing | Animal Impact | Living Organisms | Technology) **Money & Labor**

GUIDELINES

TESTING

- Whole Eco-System
- Weak Link 1 2 3
- Cause & Effect
- Marginal Reaction
- Energy/ Wealth Source & Use
- Gross Margin Analysis
- Society & Culture

MANAGEMENT

- Time -Personal -Crops -Livestock -Wildlife
- Stock Density / Herd Effect
- Crop-lands
- Population Management
- Burning
- Flexibility -Strategic -Tactical -Operational
- Biological Plan -Livestock -Crops -Wildlife
- Organization/ Personal Growth / Education Training
- Financial Planning & Wealth Generation

Figure 2. Map showing locations of interviewees.

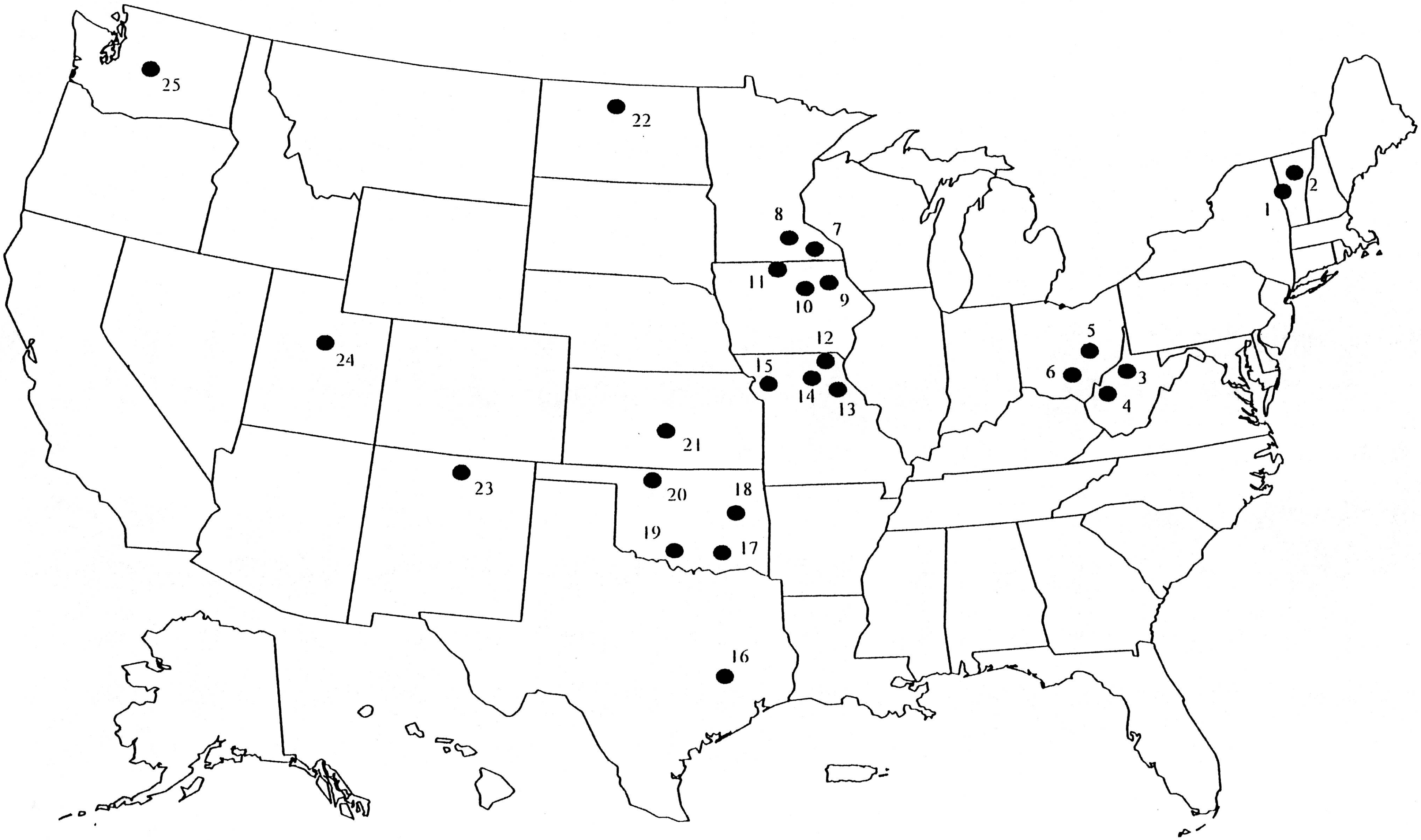
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Figure 3. Center for Holistic Resource Management biological monitoring data form page 1.

Center for Holistic Resource Management

MONITORING DATA FORM

Ranch: Cell: Xsect. nos. Photo nos. Examiner: Date: Date HRM

Hist. Plant & Point Hits		Dot Tally	Total		Dist.	C/W	Age	Form	Specie	Dist.	C/W	Age	Form	Specie	Dist.	C/W	Age	Form	Specie	Notes
Cover	bare			1																
	litter 1			2																
	litter 2			3																
	rock			4																
	basal			5																
Canopy	grass			6																
	forb			7																
	brush			8																
	tree			9																
Capping	mature			10																
	immature			11																
	recent			12																
	broken			13																
	"covered"			14																
Living Organisms	insect			15																
	bird			16																
	small animal			17																
	large animal			18																
Plant Type	grass			19																
	forb			20																
	brush			21																
	tree			22																
Habitat	dry			23																
	middle			24																
	wet			25																
Erosion	soil			26																
	litter			27																
	pedestal			28																
	flow			29																
	rill			30																
	gully			31																
	Total			32																
	Distance	C/W / Age / Form		33																
				100																
			GRAND TOTAL	SUB TOTAL																

Figure 3, cont. Center for Holistic Resource Management biological monitoring data form, page 2.

Center for Holistic Resource Management

MONITORING DATA FORM - 2

Species

	Name	#,%	Notes
Grasses			
Forbs			
Brush			
Tree			