Appendix B

Technical Papers

Important Soil Conservation Techniques That Benefit Wildlife

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ABSTRACT

The relationship between increasing row crop production, increasing soil erosion and nonpoint sources of water pollutants, and decreasing farmland wildlife is discussed. These resource concerns are not independent but collectively are symptoms of a degrading resource base. Two principal reasons for the problems are identified: 1) intensive use and management of the land; and 2) extensive cultivation of ever-enlarging fields, which has removed critical plant cover. Application of resource management systems will address the first reason while establishment of permanent vegetation is required for the second. Some important soil conservation practice components of resource management systems and their impact on wildlife habitat quality are discussed. National farm policy should encourage comprehensive ecological assessment in farm planning,

INTRODUCTION

Technological advances have pushed agricultural production to record levels in the United States, yet soil erosion persists as a national menace. Eroded soil is the greatest pollutant (by weight) in the country and is annually one of the most expensive. Technology and external inputs of energy and materials have masked the soil erosion problem to such an extent that it is, as yet, unrecognizable from the production side of the national ledger. Fifty-eight percent of the Nation's non-Federal cropland is in need of soil and water conservation treatment (USDA, 1984). Yet this problem is only symptomatic of a greater problem, the degradation of the total resource base (soil, water, and related plant and animal resources). where a given ecosystem (such as agricultural lands) is managed with single resource objective it has multiresource consequences (Risser, Karr, and Forman, 1984), Policies that allow agricultural production to expand at the expense of resource degradation are ecologically, and therefore economically, untenable in the long run. Wildlife populations in agricultural ecosystems have declined for the same two reasons that soil erosion rates have increased: 1) intensive use and management of the land has reduced habitat quality, and 2) extensive cultivation of ever-enlarging fields has removed critical forms of vegetative cover. Conserving the natural resource base is the first step in managing all renewable resources. This discussion addresses the relationship between soil conservation techniques and farmland wildlife populations.

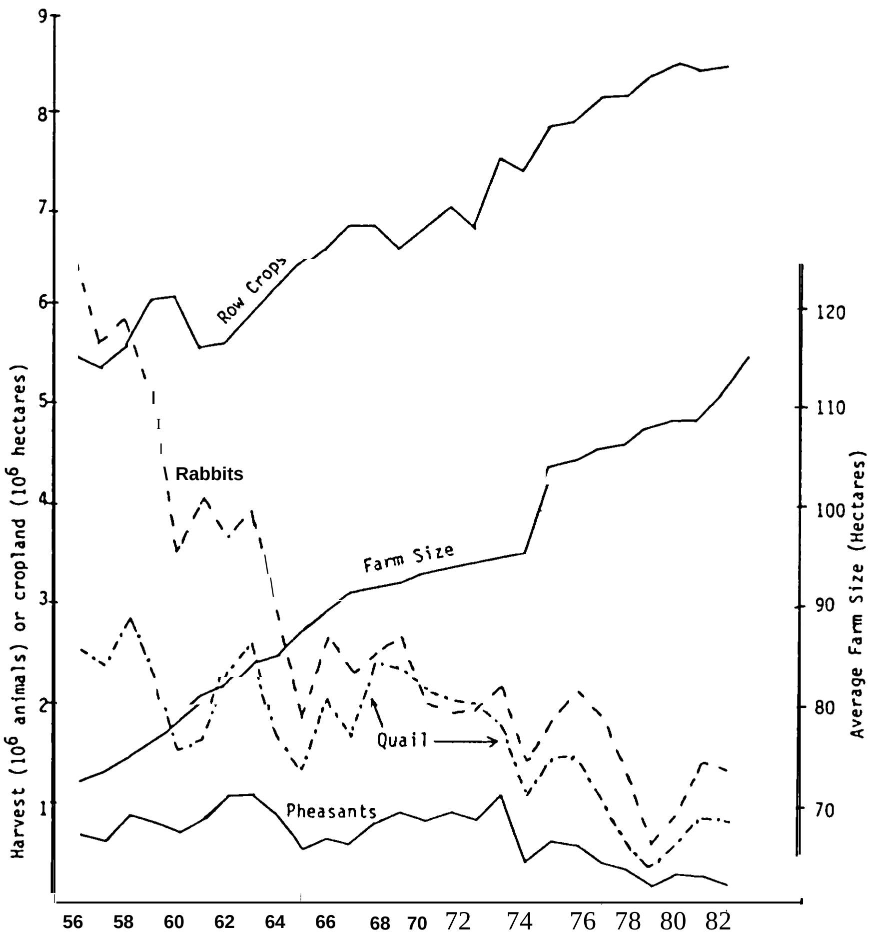
THE PROBLEM

The situation in Illinois is typical of the Midwestern States as well as the intensively farmed regions of the Nation. Declining harvests of rabbits, quail, and pheasants in Illinois during recent decades were each significantly ($P < 0.001$) correlated with increasing hectares of row crops (figure 1). The small game harvest data represent indicator species associated with diverse agricultural practices and farmland habitat. The habitat losses which produced reduced harvests of small game also have resulted in similar drastic declines in nongame wildlife. Table 1 documents the decline of grassland birds in northern and central Illinois during the same period. From 1963 to 1983 pheasant populations also declined approximately 95 percent in this region of Illinois (Warner and Etter, 1984).

Table I.–(Graber and Graber, 1983)

Species	Population loss since 1957—580/.
Savannah sparrow	98
Bobolink	97
Dickcissel	96
Grasshopper Sparrow	98
Henslow's Sparrow	94
Upland Sandpiper	***92***
Meadowlarks (2 species)	84

Figure 1 .—Estimated Harvest of Rabbits, Quail and Pheasants by Resident Illinois Hunters (Ellis, 1983), Average Farm Size and Hectares of Row Crops Harvested (IL Cooperative Crop Reporting Service 1957-83) During the Years 1956-1982



DISCUSSION

The Soil and Water Resources Conservation Act (RCA) of 1977 strongly affects the Nation's resource conservation effort. RCA provides, for the first time, a single statutory base for the comprehensive management of all resources, including wildlife habitat, into one set of programs (Sampson, 1981). Although 74 percent of all 81,008 respondents to an RCA questionnaire agreed or strongly agreed with the need to improve wildlife habitat (USDA, 1980), it did not end up as a national priority, The National Conservation Program (NCP) (USDA, 1982) that evolved from RCA has two national priorities, The first is to reduce excessive soil erosion on agricultural lands. The second is twofold: to conserve water used in agriculture and to reduce flood damage in upstream areas, NCP authorizes priority assistance for improvement of fish and wildlife habitat only in areas specifically designed for such priority by State and local authorities, wildlife and fish are recognized by Soil Conservation Service (SCS) policy as integral components of all primary land and water use systems (SCS, 1983). Safeguarding the habitats of wildlife and fish and preventing or minimizing damage to habitat from changes in land use or from installation of soil and water conservation measures is an objective of SCS's biology policy.

The SCS routinely uses an interdisciplinary approach in helping farmers plan conservation. The objective is to apply a Resource Management System (RMS) to the land. An RMS is a combination of conservation and management practices that is appropriate for the primary use of the land and that will protect the resource base by limiting soil losses to acceptable levels, maintaining acceptable water quality, and maintaining acceptable ecological and management levels for the selected resource use, The most effective conservation treatment of natural resources is achieved by the synergistic relationship of various practices applied to the land. Conservation tillage, for example, may control sheet and rill erosion, but additional practices such as grassed waterways or terraces may be needed to prevent or protect against concentrated flows of water. Additional practices may be needed to filter some pollutants from runoff water, or control soil blowing, or stabilize stream banks, or provide wildlife habitat or address other concerns, The judicious selection of land practice components can provide habitat elements important to many species of wildlife. The use of RMSS is a practical application of the "land ethic" (Leopold, 1966) and the evolving science of landscape ecology (Risser, Karr, and Foreman, 1984). The landowner, however, decides whether or not to apply a complete RMS or just a single component (conservation practice) to his land.

Generally, as soil-conserving measures increase, upland wildlife habitat quality also improves (Lines and Perry, 1978; Miranowski and Bender, 1982). Some soil conservation practices directly benefit habitat quality in that they provide one or more critical habitat elements incidental to their erosion control function. Some of the more important soil conservation practices to wildlife are conservation tillage, grassed terraces, field border strips, and crop rotation,

Conservation Tillage

Agricultural crops and their residues provide a major life requirement to many wildlife species. Conservation tillage generally has a positive impact on wildlife by leaving crop residue on the surface where it may provide cover or food. Conservation tillage[1] refers to seedbed preparation and planting techniques that leave protective amounts of residue mulch (e.g., cornstalks, wheat stubble, etc.) on the soil surface throughout the year. The purpose of the residue mulch is to absorb the impact (kinetic energy) of raindrops or wind before they strike

[1] In this discussion conservation tillage means any of a variety of noninversion types of tillage where a minimum of 32 percent of the soil surface is covered by the previous crop's residue after planting. The mere use of a "conservation tillage implement" (such as a chisel plow or a no-till planter) does not imply that the soil conservation practice has been applied.

the soil surface causing soil particles to wash or blow away. Conventional techniques use a moldboard plow to turn under plant residues and the upper 10 to 20 cm (4 to 8 inches) of the soil to create a "clean" seedbed.

Conservation tillage systems fall into three general categories: no-till, mulch tillage, and ridge-till. Specially designed planters cut through the residue to till a narrow band or slot into which the seed is dropped. In no-till systems there is no secondary tillage at any time. My category of mulch tillage refers to systems that use additional tillage implements such as field cultivators, disks, or chisel plows between harvest and planting times. These two categories use herbicides for weed control and are best suited to soils that are well-drained. On the other hand, ridge-till uses a cultivator for weed control and can be used on poorly drained soils and on well drained soils, but is limited to continuous row crops. The cultivator throws up small ridges (15 to 20 cm or 6 to 8 inches high) along the row. The next year the planter removes the top 2 to 5 cm (1 to 2 inches) of the ridge, throws crop residues between the rows and plants the seeds in a slot on top of the ridge.

In a recent study comparing no-till, ridge-till, and conventional tillage systems on 1,854 plots totaling 9,476 hectares (23,406 acres) in the Lake Erie region, the first year data suggests the following: 1) yields with the conservation tillage systems were competitive with yields produced under conventional tillage systems, 2) costs of production for conservation tillage systems were less than or equal to those of conventional tillage systems, and 3) conservation tillage systems reduced phosphorus loadings from the project area and did not significantly increase herbicide usage (USEPA and NACD, 1984). Incentive payments for using conservation tillage are available through the Agricultural Conservation Program (ACP) administered by the Agricultural Stabilization and Conservation Service (ASCS). In Illinois 13 percent of the row crops grown in 1984 were produced using conservation tillage (Dickerson, 1984).

Conservation tillage benefits wildlife mainly by leaving crop residue on the soil surface during spring and summer which may be used as cover. There was a greater abundance of invertebrates, birds, and mammals in no-till than in conventionally tilled cornfields in southern Illinois (Warburton and Klimstra, 1984). Researchers in Iowa found a substantially greater diversity and density of birds nested in no-till fields than in conventionally tilled fields and nest success was comparable to idle areas, such as fencerows and waterways (Basore, et al., 1983). A companion study found that increased residue cover tended to diversify rather than increase populations of small mammals (Young and Clark, 1983). The low levels of crop damage observed in their study may minimize some previously expressed concerns about rodent damage. If weeds are controlled by herbicides there is minimial physical disturbance to residue-nesting wildlife after planting time, but there is a toxicity risk from certain of the commonly used herbicides (Rodgers and Wooley, 1983). If weeds are controlled by cultivation, as is the case in ridge-till, there is substantial chance of physical disturbance to residue-nesting wildlife.

Although conservation tillage is an important practice for controlling sheet and rill erosion, additional water management practices (e.g., grassed waterways, terraces, etc.) are often needed for safe water disposal. Residue from harvested crops left undisturbed over winter often is identified as a benefit from conservation tillage but may in fact not be related. Such practices as chopping or shredding cornstalks after harvest, though ensuring protection of the soil, significantly reduce the value of the residue to wildlife. It is quite possible to meet the 32 percent cover requirement for soil conservation yet contribute little food to wildlife. Multiple-pass operations commonly used for corn, or single-pass tillage with twisted shank chiseling devices, may be as detrimental to the availability of waste grain as the moldboard plow (Warner, Havera, and David, 1984). Undisturbed harvested crop fields received greater use by wintering wildlife than did fall-tilled crop fields in Indiana (Castrale, 1983).

Grassed Terraces

Terraces are a commonly applied erosion control and water management practice. Terraces are ridges of earth about 60 to 90 cm (2 to 3 feet) high constructed across the slope on a gentle grade (about 0.6 percent) to remove runoff water from the field at a nonerosive velocity (see sketch in Appendix).

Terrace construction costs are variabie depending on soil and site conditions but average costs in Illinois are about $740 to $990 per hectare ($300 to $400 per acre). ACP cost-sharing is available at about the 60 to 75 percent level.

Terraces are best suited to deep soils on long gentle slopes and are poorly suited to soils that are shallow (to bedrock) or that occur on short, choppy slopes where contour farming is difficult. They may be broad-based and farmed or they may be narrow-based with grassed ridges or grassed backslopes. Grassed terraces are less expensive to build than are broad-based terraces, but the grass requires additional maintenance to keep it from being taken over by less desirable vegetation. Broad-based terraces have no direct benefit to wildlife, but the grassed terraces increase the diversity and interspersion of vegetative types in cropland settings. Thirty-five species of vertebrates were found using grassed backslope terraces in Iowa (Beck, 1982). In addition, pheasant nest success was 22.5 percent, or one successful nest per 5 hectares (12.5 acres) of grass. It should be recognized that terrace construction also can result in the loss of habitat if waterways are replaced with underground tile outlets or if new field alignments remove old, grown-up fencerows and odd areas.

Field Border Strips

Field border strips are much underused though they can benefit the resource base significantly. Field border strips consist of permanent vegetation (usually grasses and legumes) in a strip around the perimeter of the field about 5 meters (1 rod) wide. Crop yields are reduced where fields border tall woody cover, or where end rows run up and down steep slopes or are used as machinery lanes. They reduce erosion in end rows, reduce crop planting costs adjacent to woodlands, provide an element of safety for machinery operating next to drainage ditches, and improve water quality. The concern over nonpoint sources of pollutants (Section 208 of Public Law 92-500, Federal Water Pollution Control Act) could be greatly minimized if we would establish field border strips along riparian areas of 6 to 30 meters (20 to 100 feet) in width (Schlosser and Karr, 1980; Karr and Schlosser, 1980). Although riparian green belts do not provide direct economic benefits to the farmer, the benefits to society would be great.

Crop Rotations

Intensive row cropping without small grains or meadow in the rotation increases soil erosion and adversely affects many forms of wildlife. The survival of Illinois pheasant chicks to 5 or 6 weeks of age has declined from 78 to 54 percent during the last 30 years (Warner, 1979). This decline is a result of fewer hectares of forage crops, small grains, and idle areas where broods forage for insects and has resulted in nearly a threefold increase in the size of the area ranged by broods (Warner, 1984; Warner, Etter, Joselyn, and Ellis, 1984). RMSS that include rotations of small grains and meadow and contour strip-cropping would significantly reduce erosion losses and enhance wildlife habitat. Reducing row crop intensity by including small grains or meadow in the rotation may, in some but not all cases, reduce farm income.

The wildlife values of these practices are synergistic. It is the combination of the various conservation practices into resource management systems that will control soil erosion, improve water quality, provide wildlife habitat, and indeed protect the resource base. It is recognized that while many species will prosper from improved management of agricultural lands there are others that will not be so affected. Species requiring the large tracts of habitat with little disturbance will not be benefited

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by mosaics of habitat in agricultural ecosystems (Karr, 1981). The loss of critical vegetative cover because of extensive cultivation of ever-enlarging fields requires additional land management beyond the scope of the preceding discussion. There are additional temporal and spacial aspects of agricultural land use affecting the use by wildlife of otherwise quality habitat (Warner and Etter, 1984) that are often controlled by the agricultural producers. The following example illustrates how one group is trying to address this issue.

Dwindling wildlife habitat is one of the five resource concerns of the Champaign County, Illinois, Soil and Water Conservation District (SWCD). After identifying a township where intensive row cropping dominated agriculture and where landowners had a history of good soil conservation work, in March 1984 the SWCD invited all of the landowners and operators in the township to a meeting about soil conservation and wildlife management opportunities. The idea was that if the farms could each contribute some habitat elements critical to wildlife in the **area,** collectively they maybe able **to** meet all of the life requisites for some wildlife species. A key element in tying these islands of habitat together is the Illinois Department of Conservation's Roadsides for Wildlife Program, which not only seeds roadsides but also grassed terraces, drainage ditch banks, field border strips, and odd areas. It is too early to assess results but clearly the farmers are interested.

The application of the known technology can preserve the long-term productivity of our Nation's soil for agriculture while benefiting farmland wildlife. Bringing soil losses down to tolerable ("T" value) levels will result in fewer hectares of cropland. Fifty-one percent of Illinois' non-Federal cropland is in need of soil and water conservation treatment (USDA, 1984). About 10 percent of Illinois' 10 million hectares of cropland should be cropped less intensively, while 3.8 percent should be converted to permanent vegetation. we cannot afford to sell off the capital wealth of our soil to subsidize short-term agricultural production.

RECOMMENDATION$

I am acquainted with the agricultural recommendations for the 1985 Farm Bill put forth by Berry man (1984), Jahn and Diehl (1984), and Berner (1984) and am in support of those recommendations. The general call is for the four rather basic inclusions: 1) a "sodbuster" provision, 2) a long-term conservation reserve program, 3) a cropland base protection provision, and 4)a cross-compliance provision. Specifically, I recommend that:

1. The heart of our Nation's agricultural policy should be to optimize production within the long-term capacity of the resource base to sustain that production. This requires recognition that excessive soil erosion, nonpoint sources of water pollutants, and dwindling farmland wildlife are not independent problems but collectively are symptoms of a degrading resource base. The solution is an integrated ecological approach **to** "production with protection."
2. Since the relationship between intensive row cropping, increasing soil erosion, nonpoint sources of water pollutants, and declining farmland wildlife is so strong, it is appropriate for the national agricultural policy to recognize and share some of the responsibility.
3. The use of resource management systems is a more effective way to treat our Nation's resource problems than is the use of individual conservation practices.
4. The Universal Soil Loss Equation and SCS's system of Land Capability Classification would be useful in the event that sodbuster-type provisions are enacted.
5. All future cropland retirement programs include:
   a. vegetative protection selected for agronomic and wildlife values;

b. provisions to establish field border strips of 5 percent of the cropland base (equivalent to a 5 meter strip around a 16.2-hectare field or a rod wide strip around a 40-acre field);
c. provision to establish field borders as filter strips along riparian areas; and
d. prohibitions against mowing retired lands before the wildlife nesting season is complete (about August 1).

This paper reflects my observations as a field biologist and may not fully account for various national and economic implications. In closing, therefore, let me stress that agricultural policies and programs must be sensitive to the economic well being of our Nation and the individual farmer as well as wildlife habitat,

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Different Cropping Systems in the United States and Potential Benefits to Wildlife

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CROPPING SYSTEMS AND WILDLIFE

Cropping systems presently in use in the United States have in most instances evolved over the years as a result of a number of factors such as demand for the crop, technological development, crop adaptability, foreign export policies, and national policies controlling the production of major crops. For the most part, gradually over the past four decades or so, there has been a major shift by American farmers to monocultural cropping systems, particularly of cash grains, along with heavy reliance on fossil fuel-based production inputs, especially synthetic pesticides and fertilizers, Much of the driving force behind the trend to these systems has been plentiful supplies of cheap energy,

In the heart of the Nation's croplands, the Cornbelt (sometimes referred to as the breadbasket of the country), there also has been a marked shift to rowcropping, i.e., continuous corn or corn-soybean rotations, away from a more diversified corn-legume-small grain cropping of the pre-world War II era. For example, during the 1960s and 1970s, it was not uncommon for farmers in some areas to plant corn continuously for 8 to 10 years. Moreover, each year of continuous corn cropping the corn stover would be turned under by fall plowing in preparation for the next spring planting, leaving the land bare overwinter. In recent years, there have been a number of production problems encountered with continuous corn, and many farmers have begun rotating corn more frequently with soybeans. Also, there has been increased use of conservation tillage systems, a part of which by some definitions includes leaving the corn stover undisturbed overwinter except possibly for a shredding operation, and followed by a minimum tillage seedbed preparation or no-till planting in the spring. Very recently, there has been increased interest, particularly in the more southern areas, in planting a cover crop in the fall, such as winter vetch, on rowcrop land for erosion control and nitrogen fixation.

In the wheat growing areas of the West, the major cropping system is wheat-fallow in the drier areas and increasing intensity of small grain and/or rowcropping in the higher precipitation areas. The conventional practice with wheat-fallow is to leave the crop stubble following harvest undisturbed overwinter and begin tillage for weed control and seedbed preparation in mid-March to early April of the following spring. The first tillage is usually accomplished with sweep cultivators if the stubble is relatively light (e.g., <3,000 kg/ha] and if wind erosion is a hazard. These undercutting tools preserve maximum amounts of crop residues on the surface and leave some of the stubble in an upright position for added protection of soil against blowing. In areas where the stubble is heavier, the more common implement for initial tillage is a double disk which cuts and buries a relatively high percentage of the stubble.

Following the initial tillage with either the sweep or disking, the fields are rodweeded three to five times during the remainder of the spring and summer for weed control until fall planting in September and October. By this time, much of the crop residues have visibly disappeared by decomposition and mixing with the soil.

With annual cropping, the stubble is often plowed or disked soon after harvest and either planted to a fall crop in September or October or, in the case of a spring crop, left bare overwinter with seedbed preparation and planting carried out the following April.

The main point about these conventional cropping systems pertinent to wildlife is that, with intensive tillage and small diversity in crops grown, there are often relatively long periods when there is little or no vegetative cover on the land. In addition, with rowcropping in particular, field operations of various types (cultivation, spraying, replanting, etc.) may occur frequently and well into the growing season which can be extremely disruptive to wildlife. Even with closegrown small grain cropping there is not a pattern of continuous ground cover provided throughout all seasons.

It is widely accepted that these large-scale, energy-intensive production technologies substantially account for the abundant supplies of food and fiber produced in this Nation. However, some adverse effects of conventional agricultural practices are becoming of increasing concern to American society. Most have to do with increased soil erosion rates and impairment of water quality from pollution by sediments and pesticides that are directly associated with conventional farming practices. There also is concern about biological toxicity of these pesticides to nontarget organisms.

In the United States the loss of potential capacity by soil erosion is regarded as one of the foremost threats to agriculture. Moreover, eroded soil is the major pollutant of stream and waterways in the Nation. As Brady (1984) points out, conventional type agriculture also has adversely impacted wildlife for two reasons: 1) intensive use and management of the land has reduced habitat quality, and 2) extensive cultivation of ever enlarging fields and road-to-road farming has removed critical forms of vegetative cover. He shows from research in Illinois that with increased trends in rowcropping, there is a concomitant decrease in harvest of small game.

CHANGES IN AGRICULTURAL PRODUCTION SYSTEMS

Two major changes are occurring in large-scale agricultural production systems today, both of which can have favorable impacts on wildlife. These are: 1) marked increase in conservation tillage systems including minimum tillage and no-till, and 2) increased intensity in cropping including multicropping practices and reduced summer fallow. These are not independent because, for example, minimum tillage is to a large extent making multicropping and reduced-fallow possible in many areas.

Conservation Tillaga

Conservation tillage usually consists of direct seeding and fertilizing into the previous crop stubble (no-till) or minimum tillage prior to seeding, which results in retention of surface residue-s. Both systems significantly reduce erosion compared with conventional clean tillage and appear to benefit wildlife from the crop residue left on the surface where it may provide both cover and feed.

Minimum tillage cropping systems are used for both fall and spring seeded crops. If a spring crop is sown, usually the stubble is chiseled or disked in the fall so that the soil surface is rough and most of the residues remain on the soil surface. For a fall sown crop, such as winter wheat, the soil will be chiseled and then disked once or twice to form a seedbed, then the crop is seeded. With these tillages, most of the residues, while flattened, still remain on or near the soil surface.

The cropping system that now appears to hold greatest promise for the future is no-till cropping. with no-till, the seed and fertilizer are placed into the soil below the crop residues. The only tillage that occurs is from a one-pass operation in placing the seed and fertilizer. Weeds and insect pests are controlled by spraying pesticides. This system offers maximum erosion protection and leaves standing stubble for wildlife cover and snow catchment. Snow catchment is important for uniform snow distribution. No-till seeding causes minimum soil disturbance so that previous crop seeds remain on the soil surface for wildlife feed and offers the potential for increasing soil organic matter near the soil surface.

Most of the concerns about conservation tillage tend to center on increased use of pesticides, mainly herbicides, and possible undesirable ecological effects that may result. With reduction or elimination of tillage, farmers have on the average increased the use of broad spectrum herbicides such as glyphosate and paraquat for preplant application. use of other herbicides has probably changed less because most conventional tillage systems also rely on herbicides to control weeds in the crop. Insecticide use also may increase because certain insect pests can be harbored in the crop residues. with herbicides, wildlife biologists and ecologists are usually more concerned with destruction of the wildlife food base rather than any direct toxic effect on animals. with insecticides, however, mortality can result from direct toxic effects on birds and animals, or after they have ingested poisoned invertebrates. For example, parathion usually sprayed from the air for insect control is lethal in small dosages to virtually all animals and birds.

Another concern is that the chemicals that are applied in conservation tillage systems are more likely to remain at the soil surface rather than being incorporated in the soil, which raises questions about potential runoff loss of chemicals in the environment. However, although arguments are made both ways, the situation is not always clear as to effects of conservation tillage systems and changes in cropping systems on leaching, decomposition, retention, volatilization, and runoff of pesticides and fertilizers.

A strong consensus exists among most agricultural leaders that there is an urgent need to learn more about possible harmful side effects of conservation tillage resulting from more intensive use of pesticides. Researchers appear to be unanimous in their view that few of the ecological effects are well understood and that current research programs are insufficient to provide the needed answers. The increase in the organic matter content of the soil near the surface with no-till cropping systems will greatly change the activity of this zone in regard to pesticides. We think the results will be beneficial, but data are lacking.

Along with minimum tillage and no-till, there also are changes occurring in cropping systems. These changes are being accelerated, not only by the changes in the tillage methods, but also by the economics of crop production. Double-cropping systems such as soybeans following wheat generally have been quite successful in the Southern and Southeast States and are made possible by direct seeding of soybeans into wheat stubble immediately after harvest. In the dryland wheat regions, no-till is reducing or eliminating the need for fallow or making it possible to grow two crops in 3 years in many of the transitional areas situated between true summer fallow and annual crop zones. Aside of the unknowns with pesticides, there changes in cropping systems in combination with reduced tillage should, for the most part, favorably impact wildlife by providing a greater supply, variety, and stability of food base and cover.

Organic Farming and Potontial Benefits for Wildlife

Organic farming **as** an alternative agricultural production system offers a possibility for improving the compatibility between crop and animal production practices and wildlife conservation. This method of farming differs considerably in certain respects from widely practiced conventional agriculture, mainly with respect to tillage and cropping methods, livestock management, and in the way that crop nutrients are supplied and pests are controlled. Organic farmers generally follow a holistic approach to farming which involves a strong interdependency among crops, animals, and management practices that provide for a highly complex production system that is stable, sustainable, resource-efficient, and economically and environmentally sound. Compared with conventional agriculture, organic methods tend to employ less inversion tillage, greater crop diversification, and include livestock production as an integral part of the farm operation. Another major difference between organic farming and conventional agriculture that may be of importance to wildlife is that organic farmers avoid or restrict the use of chemical fertilizers and pesticides in their operations. practices employed by organic farmers can result in conservation benefits to fish and wildlife by reducing soil erosion, which in turn would minimize the movement of sediment, nutrients, and pesticides from cropland into surface waters.

Cropping and tillage practices.—Organic farmers make more extensive use of meadow and small grain crops and, therefore grow less row crops than conventional farmers. On many farms, either a legume or grass, or mixtures thereof, may involve 30 to 50 percent of the rotation. Monoculture cropping, such as continuous corn or long-term rotations of corn and soybeans without intervening sod or close-growing crops, is generally avoided. In addition to less rowcropping, organic farmers generally make greater use of green manure and cover crops during the interim between the major crops than do most conventional farmers. The forage produced on organic farms is usually fed to animals, which encourages a mixed grain crop and meadow (sod crops) in the rotation.

Most organic farmers use tillage implements much like those used in conservation tillage systems to maintain crop residues at or near the soil surface. Because they avoid the use of chemical pesticides and fertilizers, organic farmers are likely to cultivate more frequently for weed control than farmers employing conservation tillage practices.

No-till farming generally is not acceptable to organic farmers because of the heavy dependence of this practice on pesticides to control weeds and insects with present technology. Organic farmers question the sustainability of any agricultural system that depends on pesticides because of perceived harmful effects to soil, water, and biological components of the environment.

Nutrient supply and management.—Organic systems rely heavily on legumes in the rotation to supply nitrogen and, to some extent, on off-farm sources of nitrogen-containing organic wastes such as animal manures and compost. Most farmers strive to recycle nitrogen as efficiently as possible by recycling crop residues and on-farm manures and other wastes or by-products of the farm operation. phosphorus and potassium are supplied either by importation of low water-solubility materials such as rock phosphate or greensand, or through the release of these nutrients from soil. They generally avoid the use of high-analysis inorganic fertilizers such as anhydrous ammonia, urea, and concentrated forms of phosphorus and potassium. A strong consensus is that concentrated fertilizers are generally harmful to the soil biota and can ultimately lead to nutrient imbalances, reduced earthworm activity, impaired soil physical properties, compaction, and pollution of surface and groundwaters.

Pest control.—Organic farmers rely almost entirely on a combination of nonchemical methods for crop protection. Pest control is achieved primarily through crop rotations, with crop sequences within the rotation adjusted so as to maximize effectiveness in disrupting pest cycles. Supplemental weed control is achieved by mechanical cultivation, mowing, adjustments in planting date, and certain biological methods such as crop competition and animal grazing. Organic farmers also place considerable emphasis on preventive methods. For example, weed sanitation techniques are used to prevent the establishment of unwanted vegetation that might harbor weed seeds and insect pests. when absolutely necessary, some organic farmers use registered herbicides selectively and sparingly to support cultural and mechanical practices. They also may use organic insecticides and biological agents for controlling particularly persistent insect pests in the production of fruits and vegetables.

Benefits to wildlife.—The potential benefits of organic farming to wildlife would be associated with the diversity of crops grown and the increased amounts of cover and habitat areas, control of erosion and sedimentation, and minimal use of chemical fertilizers and pesticides (Dahlgren, 1983), Several studies suggest that populations of breeding birds are higher on organic farms as compared with conventional farms as a result of the greater diversity of crops and use of meadow on the organic farms. Ducey, et al. (1980), found that an organic farm in eastern Nebraska had eight times more bird territories than adjacent conventional farms. Similar results were reported by Gremaud and Dahlgren (1982) for breeding bird populations on organic compared with conventional farms in Iowa. Dahlgren (1983) concluded that the amount of crop-litter, seed abundance, and crop cover affected the use of the field by birds, but reported no effects from the use of chemicals.

Decreased soil erosion associated with organic farming practices would reduce the level of water pollution from sediment and chemicals compared with that from many conventional farms. It would appear that the greatest benefit to be derived from erosion control would be the improvement in water quality of fish and wetland habitats.

Most of the insecticides and herbicides in use today are short-lived chemicals that persist in the environment for hours or days. when applied at field application rates most of the herbicides now used would appear to be relatively nontoxic to birds and animals. Nevertheless, currently used chemicals have been implicated as the cause for decline in bird and animal populations; however, there is considerable controversy as to how acute and widespread the effect may be. Again, some adaptation of organic farming methods could restore habitat areas and greatly reduce the likelihood and severity of adverse effects of such chemicals on wildlife in the future.

FUTURE RESEARCH NEEDS

Alternative production technologies are needed to reduce soil erosion and nutrient losses from this Nation's cropland and potential hazards from certain pesticides, which in turn could significantly decrease the pollution of surface waters by sediment and agricultural chemicals, and improve the quality of fish and wildlife habitats.

To achieve this goal, future research should focus on the following areas:

1. Conduct research to improve present methods used by organic farmers, *e.g.*, conservation tillage, biological methods of pest control, crop rotation sequences, and nutrient supply and cycling,
2. Investigate how biological pest control, nutrient cycling, crop rotations, mechanical cultivation, and other cultural methods used in organic farming systems can reduce heavy dependence on chemical pesticides and fertilizers in presently developing minimum tillage and no-till cropping systems,
3. Investigate how organic and conventional farming concepts can be integrated so as to incorporate the best features of each into productive, economically viable, and environmentally sound management systems.
4. Determine factors responsible for low crop yields during the transition from conventional to organic farming or other low-energy intensive methods, and how these relate to changes in soil properties, nutrient availability, and pest and soil microbial

ecology. Also, determine the effect of transition from conventional to organic farming on changes in the numbers and species of wildlife, i.e., birds and animals, and how these relate to changes in the food base, type or cover, and habitat development.

5. Develop improved crop rotation for conservation tillage systems to enhance nitrogen fixation, soil tilth, crop health, and pest control.
6. Develop models to predict and verify responses of wildlife to changes in their food base and habitat as affected by soil and crop management practices, particularly conservation tillage, crop rotation, monoculture systems, and integrated pest management.

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Reducing Wildlife Losses to Tillage in Wheat Production Systems

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ABSTRACT

In wheat producing systems, surface tillage of the stubble that remains after harvest destroys some of the wildlife present and severely diminishes the field's habitat value. This problem is most acute in the wheat-fallow system when surface tillage is used for spring weed control in stubble. Losses include all nests, flightless young birds, and many incubating adults.

This study demonstrated that a substantial portion of the wildlife in wheat stubble can be saved by using undercutter without mulch treaders instead of surface tillage implements fer fallow weed control. Agronomic benefits of undercutting result from excellent surface residue retention and include improved erosion control, lower operating costs, and increased soil moisture and grain yields. weed control with safe chemicals also may reduce wildlife destruction and enhance agronomic benefits.

Opportunities exist to encourage such practices through applied farm policy in standard set-aside and other acreage reduction programs.

INTRODUCTION

Fallowing for wheat is a common cropping practice in the semiarid regions of the United States. The wheat-fallow rotation is used on about 16 million hectares (39 million acres) in 17 States (Greb, 1979). Wheat is planted in alternate years and fields are idled through a complete growing season. The objective of fallowing is to accumulate soil moisture, thereby reducing the danger of crop failure, increasing yields, and improving efficiency (Smika, 1970).

Wheat stubble often is left standing through the winter following harvest. This stubble sharply decreases soil erosion by both wind and water (Homer, 1960; McCalla and Army, 1961). It catches and holds snow on the fields which contributes substantial moisture for wheat production (Smika and whitfield, 1966).

Many wildlife species use wheat stubble, including ring-necked pheasants *(Phasiazzus colchicus),* which are highly dependent on it in portions of the Great Plains. However, stubble can become an "ecological trap" in spring since weed growth must be controlled to conserve soil moisture. Initial control is frequently accomplished with surface tillage implements or by subsurface tillage using an undercutter in conjunction with surface attachments called mulch treaders. The final spring tillage typically occurs after many birds have established nests. Higgins (1975, l977) found sharp-tailed grouse (Pediocetes phasianellus), five species of shorebirds *(Scolopacidae, Charadriidae),* and four species of ducks *(Arias spp.)* nesting in standing stubble in North Dakota. Surface tillage with discs, plows, or treaders destroys these nests and may kill or injure incubating adults. In contrast, the large V-shaped blades (sweeps) of an undercutter pass under the surface to cut and dislodge roots leaving the stubble generally erect.

Objectives of this study were to: 1) determine if tillage with undercutter without mulch treaders would permit successful completion of nests in stubble, and 2) evaluate the effect of undercutting on non-nesting wildlife.

METHODS

The study was conducted on two farms in northwest Kansas. A total of 330 hectares (816 acres) of stubble were undercut during the springs of 1980 and 1981. An ADflex undercutter with five 1.52 m (5 ft) blades was used on 96 percent of this land. The balance was tilled with a Tri-Flex undercutter with three 1.83 m (6 ft) blades. Both were pulled at speeds ranging from 7 to 10 km/h (5 to 7 mph) by tractors equipped with dual rear tires. Blade depth was 12 to 15 cm (5 to 6 in).

Although a few nests were located on foot, most were seen from the tractor by watching for adults flushed during the undercutting operation. This precluded finding unattended nests and many nests of small birds or tight-sitting hens.

Some effort to steer machinery was made to avoid destroying natural nests but all nests were undercut at full speed. Immediately after undercutting, each nest was examined for disruption. A nest was considered intact if no eggs were broken, buried, or separated greater than the estimated reach of the adult from the nest bowl. If nestlings were present, the nest was considered intact if none were injured. Nests were left in the configuration resulting from the tillage.

Intact nests were revisited the day after undercutting and at 3 to 5 day intervals. Nest success was defined as hatching of precocial young or fledging of altricial young. Predation or abandonment was assumed to occur midway between visits.

To provide nest survival estimates where no steering effort was made, 57 artificial nests composed of five to eight bantom hen's eggs were placed randomly in the stubble prior to tillage. Physical disruption of these nests was determined with the same criteria used for natural nests.

The direct effect of undercutting on incubating adults, young flightless birds, and small mammals was observed during tillage.

RESULTS AND DISCUSSION

Artificial Nests

Twenty-two (39 percent) of the 57 artificial nests placed in the stubble fields remained intact after undercutting. This level of nest survival corresponds closely with the proportion of free zone of the ADflex undercutter. The free zone is the soil surface not impacted by tires or blade supports.

The relative percentage of free zone and, therefore, potential nest survival, increases with the size of the undercutter and the width of the blades. Greater nest survival with large undercutter in large fields could compensate partially for wildlife losses due to poor nest interspersion and extensive clearing of habitat associated with large fields.

Natural Nests

Sixty-eight nests of seven species were located of which 36 (53 percent) were intact following undercutting (table 1). The higher survival of natural over artificial nests reflects the potential for steering machinery, when possible, to avoid nest destruction. A northern harrier [*Circus cyaneus)* nest is not included in analysis since nest fate was not determined and a bobwhite (Colinus *virginianus)* nest was destroyed by a predator before it was revisited. Only one of four grasshopper sparrow *(Ammodramus savannarum)* nests and O of 2 horned lark *(Eremophila alpestris)* nests passed through the free zone. If a nest passed through the free zone, eggs were jostled, but rarely damaged. Egg retention in the nest varied from

Table[1].-Fate of Nests After Undercutting Wheat Stubble

			Nests				
Species	Destroyed by tillage n	Left intact n	Attendance resumed n(%)[a]	Successful n(%)[a]	Lost to predators n(%)[a]	Abandoned n(%)[a]
Ring-necked pheasant	2	9	8(89)	8(89)	—	1(11)
Bobwhite[b]	0	1	—	—	1(100)	—
Mourning dove	22	19	18(95)	11(58)	4(21)	4(21)
Grasshopper sparrow	3	1	1(100)	1(100)	—	—
Horned lark	2	0	—	—	—	—
Western meadowlark	2	6	5(83)	3(50)	1(17)	2(33)
All species	31	36	32(89)	23(64)	6(17)	7(19)

[a]Percent of intact nests.
[b]Incubation resumption was undetermined.

excellent in meadowlark (*Sturnella neglecta*) nests to fair for mourning doves (*Zenaida macroura*).

Adults effectively retrieved and rearranged eggs, and attendance was resumed at 32 (89 percent) of the intact nests (table 1). Nests in a wide variety of stages were undercut and nest stage did not appear to affect the resumption of nest attendance.

Twenty-three (64 percent) of the 36 intact nests were successful a mean of 12 (SD = 7.4) days after undercutting. Six (17 percent) nests were lost to predators and 7 (19 percent) abandoned at means of 7 (SD = 5.18) and 5 (SD = 7.31) days following the operation, respectively.

A daily survival rate (Mayfield, 1961) of 0.959 was calculated for 18 attended dove nests, suggesting a success rate of 30.8 percent for dove nests initiated at the time of undercutting. However, three abandonments appeared linked to the abnormal heat after the 1980 undercutting. Exclusion of these three nests produced a calculated nest success of 47.9 percent. Only two losses occurred in the remaining 15 nests where attendance was resumed during 182 post-undercutting exposure days. Cover quantity, not concealment quality, of wheat stubble may explain this high nest survival, since predators may have difficulty searching large uniform areas. Survival could not be calculated for the other species.

Renesting in undercut stubble probably is minimal due to somewhat reduced concealment quality and the availability of new spring growth which becomes more attractive for renesting than residual cover (Dumke and Pils, 1979). Some nests, particularly mourning dove nests may be initiated after undercutting, leaving them vulnerable if subsequent surface tillage is performed.

Other Wildlife Effecfs

Although the coulters could be lethal, no injury of incubating adults was observed. Late flushing adults which survived passage of the undercutter would have been killed during disc tillage. Many, flightless young ring-necked pheasants, meadowlarks, and grasshopper sparrows also passed safely through the undercutter. In contrast, discing destroys broods and, in pheasants, results in total loss of the hen's annual reproductive effort since renesting after brood loss is rare (Dumke and Pils, 1979).

Numerous deer mice *(Peromyscus maniculatus)* and grasshopper mice *(Onychomys leucogaster)* passed unharmed through the undercutter. Other vertebrates observed in wheat stubble during tillage included 13-lined ground squirrels *(Spermoplnlus tridecemlineatus)*, ord kangaroo rats *(Dipidomys ordi)*, horned lizards *(Phrynosozna spp.)*, and unidentified lizards,

Agronomic Aspects

Standing stubble left by undercutting protects the soil from wind erosion better than flattened stubble (Fenster and wicks, 1977) and it effectively controls water erosion (Homer, 1960).

Stubble improves soil moisture storage most during spring and early summer when rains are frequent and high evaporative loss can occur (Greb, et al., 1967). Standing stubble helps moisture intake by reducing runoff (Homer, 1960) and by maintaining soil surface porosity which facilitates percolation (McCalla and Army, 1961; Greb, 1979). The reduced soil disturbance during undercutting improves water conservation since subsequent weed germination is retarded and less subsurface soil is exposed. Shade from stubble also lowers soil temperatures (McCalla and Duley, 1946), further reducing evaporation and weed regrowth.

Grain yields improve a mean of about 10 percent with stubble mulching compared to bare fallow in the semiarid Great Plains (Johnson and Davis, 1972; Smika, 1976) and increase directly with increases in straw mulch. Undercutter retain about 90 percent of the surface residue after one operation compared to only 30 to 70 percent with a one-way disc (McCalla and Army, 1961). Fewer weed control operations are needed with stubble mulching than in conventional bare fallow (Greb, 1979) and power needs are lower with undercutters—compared to discs on a single pass (Smika, 1976). This saves fuel, equipment costs, and time. Loss of soil organic matter and nitrogen is reduced under stubble mulching (Johnson and Davis, 1972; Bauer and Black, 1981).

Undercutting does hold some potential or perceived problems. The warm, sunny days common to semiarid regions should be selected for undercutting since weed kill may not be adequate under cool, wet conditions (McCalla and Army, 1961; Smika, 1976). Although desirable for seedling emergence (McCalla and Army, 1961), surface residue can clog conventional grain drills. Modern high clearance drills with widely spaced, staggered standards effectively seed into mulches and minimize this problem. If desired, surface tillage can be used for winter wheat seedbed preparation in August. Insect and disease problems are no greater with stubble mulching than with conventional fallow (Johnson and Davis, 1972; Greb, 1979).

Related Agronomic Treatments

Though designed for seedbed preparation, some farmers attach mulch treaders to undercutter for weed control tillage. However, negative aspects of this practice outweigh benefits. Aasheim (1949) recommended that treaders not be used because they “pulverize the soil and create conditions which favor soil drifting.” The combination of blade and treaders will bury 50 percent of the residue compared to only 10 percent with an undercutter alone (McCalla and Army, 1961). Treaders also flatten stubble which increases evaporation and erosion. Treader-induced soil disturbance can improve conditions for germination and growth of new weeds. Agronomic and wildlife problems indicate that mulch treaders should not be used for spring weed control in wheat stubble.

Tillage between harvest and spring is of little agronomic value and is often detrimental. The stubble incorporation caused by postharvest discing in wheat-fallow increases erosion, reduces snow catchment, and results in decreased moisture conservation (Black and Power, 1965) and lower grain yields. Postharvest undercutting is of little value in conserving soil moisture for spring wheat (Aasheim, 1949). A single undercutting can conserve moisture through the fall in winter wheat-fallow, but usually has no total fallow advantage since untilled stubble compensates with greater efficiency in retaining snow (Greb, et al., 1967) and in storing rain the next spring (Wiese and Army, 1958). Bond, et al. (1961), recommended delayed subtillage (untilled until spring) since it resulted in no yield loss, reduced loss of organics and nitrogen, superior erosion control, and fuel savings. Undercutting twice after harvest can improve total soil water storage (Smika, 1976), but added expenses make this economically marginal.

Erosion control, yield advantages (Fenster and Peterson, 1979), and improving reliability have increased herbicide use in fallow weed control. Chemical fallow usually involves applying long-lived (10 to 12 months) preemergence herbicides after harvest or short-lived (2 to 3 months) preemergence herbicides the next spring. Contact herbicides also can be used.

Chemical fallowing holds potential for maintaining undisturbed stubble through most of the nesting season and may be superior to undercutting in reducing nest destruction by , tillage. However, chemical fallow may create new problems for wildlife. The commonly used contact herbicide-paraquat-causes mortality and growth impairment of embryos when applied to eggs at typical field application rates (Hoffman and Eastin, 1982). Applying herbicides after harvest also controls weeds which would, otherwise, improve habitat.

OPPORTUNITIES FOR APPLICATION IN FARM POLICY

To qualify for regular deficiency payments, farmers must set-aside a percentage of their wheat base into an Acreage Conservation Reserve (ACR). They are required to control weeds, yet maintain surface residue on the ACR. These goals cannot be jointly accomplished with surface tillage. However, both can be attained by using either an undercutter or chemical weed control while producing added wildlife benefit.

To encourage erosion and wildlife benefits, farmers: 1) should not be permitted to use any form of tillage (including undercutting) on ACR between harvest and spring, and 2) should not be permitted to use any form of surface tillage (including mulch treaders) until August 1. Thereafter, surface tillage could be permitted for winter wheat seedbed preparation. These provisions would allow the use of undercutter without treaders after spring or chemical control at any point. Violation of these provisions on ACR should require forfeiture of at least 10 cents per bushel of the deficiency payment. Better enforcement by the ASCS than has been previously evident would be needed.

Late announcement of auxiliary reduction in acreage programs (RAP) such as occurred with the Payment-In-Kind (PIK) program result in a need for farmers to destroy wheat to qualify for the RAP. Most wheat destruction is accomplished by discing or mowing during spring, both of which result in wholesale destruction of wildlife in these fields. Such situations could be made very positive for wildlife and erosion control if farmers were permitted to allow wheat to mature and stand through August 1. weed control thereafter could be accomplished only by undercutting or with chemicals, thus permitting the ASCS to verify that the crop was not harvested. weed control with surface tillage would make such verification difficult. If wheat destruction in the spring is necessitated by a RAP, wildlife losses can be minimized by requiring that surface tillage or mowing could not be used. This would encourage undercutting or chemical wheat destruction and the residue would provide excellent erosion control, good weed suppression, improved moisture storage, and wildlife habitat. Financial penalties would, again, be of value in encouraging these practices. (See Appendix *1* for additional agriculture policy recommendations.)

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APPENDIX 1

Additional **Agriculture Policy** Recommendations

1. Problem.—Knowledge of impacts of new agricultural technologies on wildlife is extremely limited in many areas.

   Solution.—Incorporate wildlife researchers into the agricultural experiment station system. As few as 10 to 20 positions placed at agricultural experiment stations around the country could do tremendous good for as little as $1 million to $2 million annually,

   Benefits. -These individuals would have access to experiment station lands where wildlife testing could be accomplished under relatively controlled conditions. Much current wildlife-agricultural research is being done on private lands where the study may be at the mercy of the producer's whims.

   By having these people inside the system, they will be able to study new agricultural technologies *as they develop,* thus permitting possible modification of the technologies for wildlife benefit *before* the technologies go into general use. Currently, modifications for wildlife are difficult to obtain because new technologies are already entrenched in agricultural practice before their wildlife impacts are known.

2. Problem.—Current set-aside guidelines permit participation in the wheat program without participation in the feed grains program.

This results in farmers reducing their wheat production, but increasing their feed grains production by planting feed grains on the very same ground (ACR) which was to be idled in the wheat program. This is self-defeating since the wheat program essentially contributes to over-production of feed grains, contrary to the purpose of the feed grains program. This is a waste of tax monies and constitutes outright welfare payments to farmers.

Solution.—Farmers need not elect to participate in both programs, however, the Acreage Conservation Reserve (ACR) lands should be idled for one full *calendar year* from the time that the set-aside is announced (not the *crop year).*

Benefits.—Wildlife would benefit from the cover left on the ACR (be it residue, weeds, or other) and erosion control as well as other agronomic benefits would result.

Such a requirement would cost less tax dollars and would result in more effective reduction of feed grain surpluses.

3. Problem.—Conservation agencies currently have little or no input into the application of farm commodity policy at the State level.

   Solution.—State ASC committees should include members from the State's conservation department (fish and wildlife agency) and/or from the SCS.

   Benefits.—The State committee could more effectively develop guidelines which would accomplish the joint goals of cutting production and encouraging conservation. Currently, the application of production cutting programs often contradicts and defeats conservation,

4. Problem.—Even if long-term land retirement programs are adopted and perennial herbaceous vegetation is established on these lands, much of the wildlife benefit will be lost and, indeed, some such areas could become detrimental to wildlife if grazing or, particularly, haying is permitted on a regular basis.

   Solution.—Landowners could maintain the right to graze or hay these lands, but would forfeit 30 to 50 percent of that year's payments on the lands so used. Emergency grazing or haying could be permitted after July 1, assuming *stringent definitions* of "emergency conditions" *are applied.*

   Benefits.—The potential danger of creating "ecological death traps" by attracting nesting birds to cover which is to be mowed would be avoided and great wildlife benefit would be realized from these lands. Emergency conditions, (drought usually) do not typically become apparent until at least July and nesting is primarily, though not totally, complete by that time. Consequently, emergency grazing or haying *after July 1* would assist in reducing the forage shortage while still permitting much wildlife benefit.

5. Problem.—Loose definitions or application of definitions of "emergency" conditions by the ASCS often permit blatant abuse of soil conservation principles on Acreage Conservation Reserve (ACR) lands associated with set-aside programs. For example, certain counties in Kansas have issued essentially "blanket" permits for early plow down on ACR lands. In other words the ASCS in these counties has placed virtually no emphasis on erosion control, but is unreasonably sympathetic to farmer's often unjustified requests to destroy weeds and residue on ACR. This ASCS bias is verified by their comparatively frequent issuance of penalties for weeds on ACR, but extremely rare issuance of erosion penalties.

   Solution.—Tighten definitions and application of "emergency" situations as used by the ASCS so that early plow downs and their resultant residue elimination are permitted only for control of weeds defined as "noxious" by the State. Other weed control means should be used in all other situations.

   Benefits.—Soil conservation would be greatly enhanced and wildlife habitat would be maintained on these ACR lands.

6. Problem.—The Soil Conservation Service often seeds *cool-season* grasses on waterways and terraces. These grasses are subsequently hayed by farmers during the nesting season of many birds. This results in widespread nest destruction and the death or injury of incubating adults.

   Solution.—The use of quality forage producing *warm-season* grasses should be promoted for use on waterways and terraces. Benefits.—Warm-season grasses begin growth later in the spring than do cool-season grasses and maintain growth during the summer when cool-season grasses are semi-dormant. As a result of the growth period of warm-season grasses, the optimal time for haying is about 1 month later than with cool-season grasses. This later haying date would permit much nest completion. Further, the later haying date better fits into farmers schedules, as early-summer is typically less busy than mid or late spring. Forage quality of certain warm-season grasses equals or exceeds that of most cool-season grasses and the improved scheduling of warm-season haying permits cutting at a time when the forage quality is highest. The often-necessary delays in haying cool-season grasses result in over maturity of the forage and, consequently, poor quality. Warm-season grasses also provide structurally superior wildlife habitat.

7 Problem.–If language in the so-called "Sodbuster" legislation denies government subsidies only to the *landowner* who breaks out highly erodible lands, this will do little to minimize sodbusting by speculators who intend to sell the land soon after they have harvested a single crop from the broken out lands.

Solution.—Language in sodbuster legislation should deny government subsidies to the landowner who breaks out the land *and* should deny subsidies on the broken out lands for a minimum of 10 years *even if land ownership is transferred.*

Benefits.—This would minimize benefits which could be gained from sodbusting by speculators. It would also decrease the disparity between rangeland and these "cropland" prices and, consequently, decrease the temptation to break out grasslands by all landowners.

8. Problem.—Urban residents often have little concept of rural needs and vice versa. This has resulted in numerous urban-rural conflicts, particularly at times of high urban demands on private lands such as the opening of certain hunting seasons. The ultimate result has, in some cases, been the destruction of wildlife habitat so it will not attract hunters (especially urban hunters) onto private lands.

Solution.—Funds should be allocated so State extension services could educate both urban and farm groups on the needs of the other. For example, farm tours and seminars which include urban-dwelling hunters could permit an exchange which would educate the urban hunters on the farmers needs for privacy, leaving livestock and unharvested crops undisturbed, etc. Farmers might gain a better understanding of urban needs for contact with nature and the land.

Benefits.—Better urban rural relations and a greater joint commitment to resource conservation.

Wetlands and Agriculture

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ABSTRACT

Evidence is strong that all prairie wetlands provide services to society through runoff and sediment retention, nutrient assimilation, ground water recharge, wildlife production, and recreation opportunities. The state of our knowledge of these services is, however, still in a theoretical stage. Until science can clarify the magnitude of these benefits, economists cannot estimate the value of prairie wetlands. Wetlands also are highly productive systems with regard to natural vegetation and are being used by many farm operators for forage. However, little is known about management practices for wetland forage. The compatibility of wetland forage utilization and wildlife production also is poorly understood. Research is needed to quantify values of wetlands to society and to develop technology that increases their economic value to the landowner without destroying the wetland.

We are studying the use of cattle to graze wetland vegetation to open some of the densely vegetated prairie wetlands. We also are measuring effects of mowing on invertebrate populations and the energy budget of four of the most common shallow marsh plants used for forage in our area, Our aim is to determine the effects of grazing and mowing on prairie wetland vegetation and to measure the value of wetland forage to the farmer. Much more research must be done, but our results may help to form an information base for wetlands in other parts of North America.

Our recommendations are: 1) to authorize a Wetland Research subtitle in Title XIV of the Farm Bill in order to measure values of wetlands to society and to identify wetland management techniques compatible between wildlife management and agricultural practices, 2) to incorporate methods in Title XV that deter wetland drainage, and 3) to increase incentives in Title XV so that economic return to the landowner is comparable between an undrained or restored wetland and a drained one.

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INTRODUCTION

Wetlands are a resource that provide valuable services to society. These services include fish and wildlife production, ground water recharge, pollution abatement, and flood water retention. Larson and Groman (1984) stated that scientific research indicates wetlands can function differently in different regions of the country. Recommendations regarding wetlands by Larson and Groman (1984) included assessing wetland functions on a regional basis and developing wetland protection policies based on those assessments rather than ascribing all wetland functions to every type of wetland. They identified the Prairie Potholes of the North Central Plains of North America as one such region.

Prairie wetlands have been extensively drained since settlement of the Plains. Originally covering 7 million acres of North Dakota and South Dakota, the prairie wetlands that remain today encompass half of the area (Tiner, 1984). Primary reasons for wetland drainage are to increase agricultural production acreage and reduce their nuisance factor to farming operations (Leitch and Danielson, 1979).

Wetlands in the Prairie Pothole Region have long been recognized as important to wildlife. More recently, a number of other functions and values of potholes have been identified (Linder and Hubbard, 1982). However, most of their value is accrued by society instead of by the landowner who controls the drainage.

WETLAND VALUES

During the past few years, we have attempted to measure some of the values of prairie wetlands. We also have initiated studies on management techniques that would help save prairie wetlands from drainage without affecting their values for wildlife.

wildlife

Numerous wildlife species are dependent on wetlands in the Prairie Pothole Region. In North Dakota, on *116* hectares of wetlands, Duebbert (1981) found 35 bird species dependent on wetlands habitat and 35 species nesting in the associated uplands. Brady (1983) found that 38 bird species, other than waterfowl, nested on seven South Dakota public wetlands in 1981 to 1982. Eleven small mammal species were trapped on the same wetlands (Pendleton, 1984). Hubbard (1982) found 12 species of birds nesting on a dry wetland in 1981. Wetlands in South Dakota are extremely important to pheasants (Schitoskey and Linder, 1979) and white-tailed deer (Sparrowe, 1966), especially when the wetlands are frozen or dry. The United States Fish and Wildlife Service classified prairie wetlands as being Number 1 priority for waterfowl in the U.S (Tiner, 1984).

Water Retention

Ludden, et al. (1983), demonstrated that small wetlands in the Devils Lake watershed of North Dakota were capable of retaining 72 percent of the total volume from a 2-year frequency runoff and about 41 percent of the total volume from a 100-year frequency runoff.

In South Dakota, we measured the water volume of 213 small wetlands on 648 hectares (1,600 acres) in Grant and Roberts Counties after spring runoff. Although these wetlands were not filled to capacity at time of measurement, they accounted for 50 percent of the water surface area on the land tract. They averaged 0.27 hectares (0.67 acres) in size and 0.44 meter (1.4 feet) in maximum depth. Seven large wetlands made up the remaining water surface area.

An estimated 19.6 hectare-meter (159 acre-feet) or over 50 million gallons of water were contained within those small ponds. If those wetlands had been artificially drained, that volume of water would have contributed to flooding problems at lower elevations in the watershed. For illustrative purposes, an area 16 x 16 kilometers (10 x 10 miles) under similar conditions would retain 789 hectare-meter (6,400 acre-feet) of water in a proportional number of small wetlands. That is enough water to make a difference in the downstream flow regime.

Ground Water Recharge

In contrast to statements made in other reports that most wetlands do not recharge ground water (Carter, et al., 1978; OTA, 1984) ample evidence exists suggesting that prairie wetlands are important sites for ground water recharge (Hubbard, 1981; Linder and Hubbard, 1982). On our study area in Grant and Roberts Counties, there were 19.6 hectare-meter (159 acre-feet) of water retained in the small depressions. Based on other studies, an estimate of 12 percent water loss from these wetlands to ground water would be conservative (Allred, et al., 1971; Millar, 1971), If only 12 percent of the standing water (2.4 hectare-meter or 19 acre-feet) had entered the saturated zone, this would have supplied an irrigator with a 3.6 centimeter (1.4 inch) application of water to 65 hectares (160 acres) or, at 37.9 liters (10 gallons) of water per day per cow, enough water to supply 1,696 head of cattle for 1 year.

Recreation

Although recreational values of prairie wetlands have not been adequately measured, the total value must be substantial. Results of a survey of six South Dakota wetlands in 1981 to 1982 showed that 10,000 people made 5,000 trips to those wetlands and spent 63,000 hours there for recreational purposes during 1 year (Thompson, 1983). The majority (89 percent) of the visits were for hunting, but 30 other activities, such as photography and bird watching, were enjoyed. We also sent questionnaires to 1 percent of the South Dakota residents who purchased hunting and fishing licenses (Johnson, 1984). An estimated 116,890 hunters (South Dakota population is 700,000) used wetlands at least once in 1982. They averaged 24 days per hunter generating about 2.75 million man-days of wetland-related hunting activity. When consumer surplus for resident hunting value was discounted at 7.875 percent, it yielded a value of $813 per wetland hectare ($325 per acre) as a recreational resource for resident hunters alone.

Water Quality

One problem in the Prairie Pothole Region is the degradation of lakes and streams (Linder and Hubbard, 1982). Nutrients entering the systems may be from agriculture and a number of other sources, Tabatchnik (1980) stated that wetlands function as “pollution treatment plants” at no cost to man and that plants may decrease concentrations of both manmade and natural pollutants. Davis, et al. (1981), have concluded that prairie marshes may be most effective at removing inorganic nitrogen, particularly nitrate, from runoff waters. Considerably more research is needed concerning the role of wetlands in maintaining water quality in the prairie.

Forage

Forage on prairie wetlands is a valuable resource to the landowner, An average of 50 percent or more of all wetlands can be hayed after August 15 in North Dakota (Higgins, et al., 1984). Land-use data collected in the spring of 1983 (reflecting 1982 conditions) (Wittmier, 1984) on three watersheds comprising about one-third of the east half of South Dakota, revealed that about 22 percent of the natural temporary, seasonal, and semipermanent wetland area was used for forage (either grazed or hayed). Estimates of above ground standing crops in prairie wetlands show that these systems are capable of high yields of dry matter (see review by Linder and Hubbard, 1982), but adequate data on the nutritional composition and the response of marsh vegetation to mowing or grazing has not been measured for most marsh plant species. Impacts of grazing and mowing on wildlife associated with a wetland also have not been measured.

$ummary of Values

Linder and Hubbard (1982) stated that “a great diversity of kinds of basins is highly desirable and the number existing is needed to maintain wildlife associated with them. ” They felt that there are monetary values for landowners such as trapping, hunting, and forage production, but that techniques should be developed for managing wetlands so that the dollar return to the landowner can be increased. However, the true value of prairie wetlands to society must be determined and programs developed to compensate landowners according to those values. Consicierable effort will need to be exerted to measure economic wetland values. The aesthetic value of wetlands for the general public cannot be measured (Reimold and Hardisky, 1979) nor can their value to the scientific and academic communities. Wetlands serve as classrooms for school children of all ages and offer natural laboratories for us to study the functions of an ecosystem.

CURRENT RESEARCH EFFORT

Although forage in prairie wetlands is used, little information is available on proper management schemes for wetland forage production. Of the several hundred plant species that occur in prairie wetlands, only whitetop (Scolochloa festucacea) (Smith, 1973a and b), slough sedge (Carex atherodes) (Corns, 1974; Hawley, et al., 1981), and hybrid cattail *(Typha "glauca")* (Linde, et al., 1976; Hubbard, et al., in prep.) have been investigated to an extent where some management recommendations for forage use can be made. We are currently investigating the seasonal nutritional composition and energy status (total nonstructural carbohydrates) of whitetop, slough sedge, smartweed (Polygonum coccinemn), and giant burreed *(Sparganimn eurycarpum),* but many other species need to be studied.

At present, wetland forage is being used without adequate knowledge of the impacts on wildlife resources. Some wetlands mowed late in the season lose their value as winter cover. Mowing also may decrease the invertebrate food base for waterfowl because of decreased litter accumulation. Our current studies include measuring the effects of mowing on invertebrate populations.

Grazing of uplands and its effect on wildlife species has been the subject of numerous investigations (Kirsch, et al., 1978); however, the grazing of wetlands and the subsequent effect on wildlife has received very little attention. It would seem that use of wetlands for grazing may be more compatible with wildlife values than mowing, especially with regard to resident wildlife species. Except under overgrazed conditions, some vegetation is usually left standing after grazing. If enough vegetation remains, then the wetland may still afford winter cover. It would seem that moderate grazing of wetland vegetation would be compatible with waterfowl resources, but studies have not been conducted to assess this compatibility.

We are investigating the use of grazing as a prescribed management tool for those wetlands that, while still containing water, are too choked with dense cattail to be used by waterfowl. Cattail, especially the hybrid variety, is an aggressive plant and given ideal conditions will take over a marsh and eliminate all openings. The low point in the energy reserves of cattail occurs about mid-June in South Dakota. Grazing during that time should lead to a reduction in stand vigor and perhaps result in opening the stand. Hubbard, et al. (in preparation), have found that prior to the energy reserve low point in cattail, the plants nutritive value to cattle is adequate. We have experimentally grazed two cattail stands in June of 1984, and are monitoring the plant and animal response to the grazing treatments, However, the project will not be completed for another 2 years.

RECOMMENDATIONS

Wetlands provide a large range of values to society. With some exceptions, individual landowners have not been adequately compensated for preserving or restoring their wetland acreages. The following recommendations are to aid in the preservation of wetlands:

1. Authorize a Wetland Research subtitle in Title XIV of the Farm Bill. Studies should be made to determine the role of wetlands in the hydrology and ecology of an area. In the Prairie Pothole Region, economic wetland values for society should be quantified and management techniques for the landowner developed. Techniques that are compatible with wildlife should be developed to use forage production from prairie wetlands.
2. A multi-year set-aside program (minimum 3 to 5 years) can benefit wetlands, wildlife, and agriculture. Upland set-aside acres adjacent to or surrounding existing

or restored wetlands can increase wildlife production, reduce erosion, and protect water quality.

3. A study is recommended to determine effects of existing Federal programs on wetlands. All USDA agencies should have annual reporting requirements on any projects relating to wetlands. Measures should be taken to eliminate any negative impacts on wetlands.
4. The Water Bank Program should be continued with an increase in funding. The Program should be strengthened by including technical assistance for wildlife management on Water Bank lands with additional compensation to the landowner for incorporating wildlife techniques.
5. A "freeze" should be placed on the breaking of any new lands. This should include the draining or filling of any wetlands. Any wetlands that are drained for agricultural production after the initiation of this Program should not be included in base acreages.
6. Existing or restored wetland acreages should be allowed to be designated as set-aside acreage in any Conservation Reserve that is included in the 1985 Farm Bill.
7. Since wetlands have a tremendous value to society, monetary incentives should be developed to reimburse landowners for protecting and restoring wetlands. These incentives may be in the form of a Federal income tax credit or direct cash payment.

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Rangelands, Wildlife Technology, and Human Desires

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ABSTRACT

Although we probably will never have enough knowledge to make a perfect analysis of the impacts of rangeland management action on wildlife habitat, more information is available than is used. To be useful, however, it must be organized to make sense biologically and in terms of livestock management. While additional research is needed, a lack of technical knowledge is not the real problem we face in resolving conflicts between various land uses. What then remains? Why are we not doing a better job of resolving conflicts? In my view, the real problem is insensitivity to the crucial importance of the human dimension. Thus I believe that the most effective tool for achieving land management goals is sensitive leadership that recognizes and builds on human desires.

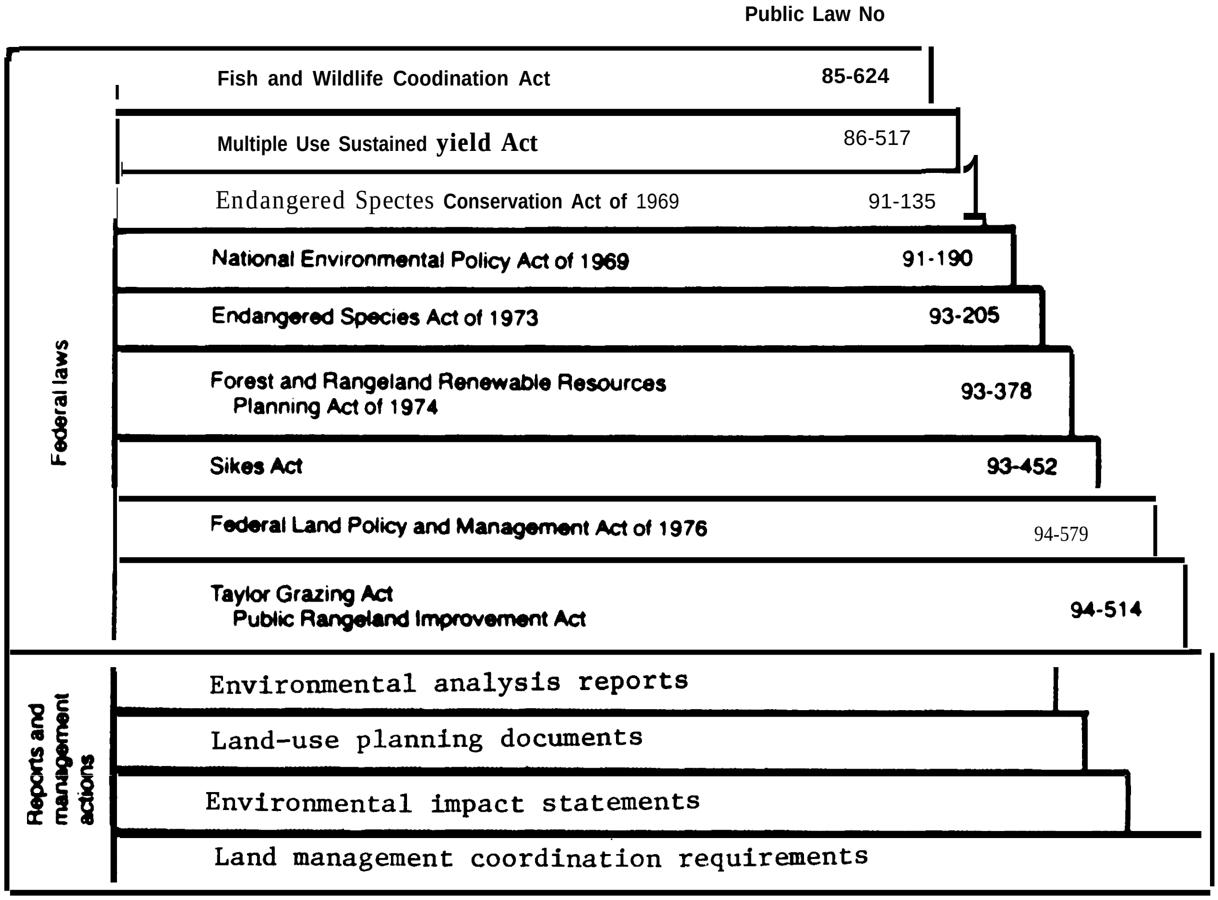
INTRODUCTION

Much of the Nation's vast rangelands have changed dramatically in the last 200 years. They can no longer be considered wild because they are now managed to produce multiple benefits, dominated by livestock production but including wildlife. Until a few years ago, a rangeland manager's only concern with wildlife was with "predators" and "big game." The law neither recognized nor required an accountability for wildlife. Now rangeland managers are under increasing pressure to account for wildlife in management activities, particularly land-use planning, And wildlife means all species—not just species that are hunted, or are esthetically pleasing, or are classified as threatened or endangered. See figure 1 for list of laws that specify or intimate that wildlife shall be a product of Federal lands and that wildlife shall be considered in every management decision.

Livestock management and wildlife habitat management are compatible on public rangelands, but only if the needs of wildlife are recognized and accounted for along with the needs of livestock. A series of 15 publications exist which provide information on ways managed rangelands and wildlife interrelate. This series of publications has three purposes: 1) to develop a common understanding of wildlife habitats on managed rangelands, 2) to provide a system for predicting the impacts of range management practices on wildlife, and 3) to show how the system can be applied to a specific area—in this case, the Great Basin in southeastern Oregon. With the information provided, resource specialists can work together to assure the continued existence of most, if not all, wildlife habitats in managed rangelands. The following discussion of range-wildlife management system is taken from the "Introduction" section of the series of publications which deal with *Wildlife Habitats in Managed Rangelands—The Great Basin of Southeastern Oregon (1983).1*

[1]C. Maser and J. W. Thomas, *Wildlife Habitats in Managed Rangelands—the Great Basin of Southeastern Oregon.* USDA Forest Service General Technical Rep. PNW-160, Pacific Northwest Forest and Range Experiment Station, Portland, OR, 1983.

Figure I.—Some Major Federal Laws and Pianning Requirements That influence Wildlife Habitat Management on Public Lands (adapted from Thomas, 1979)



RANGE-WILDLIFE TECHNOLOGY

A Basic Assumption

A basic assumption about wildlife habitat in rangelands managed for multiple use is that wildlife and livestock management must be coordinated. On public rangelands in the Great Basin of southeastern Oregon, as in many other parts of North America, livestock production is the dominant land use. Large-scale alterations of wildlife habitat usually result from the manipulation of vegetation primarily to enhance livestock production. Management for livestock production, therefore, is de facto wildlife management. The degree to which it is good wildlife management depends on how well habitat is manipulated to achieve wildlife goals. Interrelationships are shown in figure 2.

The Need

How is a public rangeland manager to balance demands for rangelands, including wildlife, and still maintain a sustained yield of livestock forage? How can managers account for the needs of all wildlife? In seeking answers to these questions, the wisdom of two of Commoner's (1971) "laws" of ecology becomes apparent—" everything is connected to everything else, " and "there is no such thing as a free lunch. " Any action that alters vegetation has an influence on wildlife habitat and, in turn, on wildlife. If wildlife is of concern, goals for wildlife must be established and all management actions must be judged against those goals. Rangeland managers must take a more holistic view.

The Federal Land Policy and Management Act of 1976 (Public Law 94-579) requires that detailed and holistic plans be prepared for the management of public rangelands. Further, the National Environmental Policy Act of 1969 (Public Law 91-190) requires the environmental impacts and consequences of planned actions involving Federal funds be examined and revealed. One of the weakest aspects of such planning has been the inability of managers to predict the effects of management alternatives on wildlife populations. Frequently, this has resulted in criticism of land-use plans and environmental impact statements by the public, other agencies, and the courts.

Better techniques to predict the consequences of management on wildlife, whether good or bad, are needed: Managers need a conceptual framework that will enable them to: 1) account for habitat needs of all vertebrate wildlife, 2) emphasize management of particular wildlife species, and 3) identify habitats that require special attention. The greatest challenge is to integrate existing information so it can be readily used in resource planning.

Development of a process to consider the impacts of management on wildlife is needed. Land-use planning continues at full speed; large-scale conversions of sagebrush-dominated rangelands to crested wheatgrass and other species are being contemplated and implemented; and the demand for increased forage production from public lands is incessant. Some say it is too soon to undertake such a task, that there is too little "hard" data. But there are really only two choices—too soon or too late. The first is preferable. With intensified management of rangelands, impacts on wildlife are magnified. We need to get on with the job.

Managers need more flexibility in applying technical information to local situations. The information should be presented as a system to predict the consequences of management alternatives on wildlife, rather than as specific guidelines. A manager then has the ability to respond to particular situations while being fully accountable for the impacts of such decisions on wildlife habitat. Managers can survey alternatives, make trade-offs, and account for those decisions.

Rangeland Wildlife Management Systems

Wildlife management is the scientifically based art of skillfully controlling habitat *to* enhance conditions for a selected species or

Figure 2.—Large-Scale Management of Wildlife Habitat Must Be Mainly Accomplished Through Rangeland Management (adapted from Thomas, 1979)

Large-scale wildlife goals must be accomplished through rangeland management

because

management for enhanced livestock production

- affects many acres
- is -relatively well financed
- dramatically affects wildlife habitat
- has great impact on wildlife

whereas

management for wildlife habitat

- affects relatively few acres (however, the acres affected are generally in "key areas)
- has relatively little financing
- has relatively small influence on wildlife habitat (but does influence key habitat components in localized areas)
- has relatively small impact on wildlife (but could do much more with better financing)

of manipulating animal populations to achieve other desired ends (figure 3). The term "wildlife management" implies the ability and managerial flexibility to control habitat factors, or animal populations, or both (Giles, 1971; Leopold, 1933; Trippensee, 1948).

There are two general production goals in wildlife management—management for species richness (Evans, 1974; Siderits, 1975; USDA Forest Service, 1973 and 1975) and management for featured species (Holbrook, 1974; USDA Forest Service, 1971; Zeedyk and Hazel, 1974) (figure 4).

The goal of management for species richness is to ensure that most resident wildlife species are maintained in viable numbers in the managed area (King, 1966). Hence, all species are important. Management for species richness can be achieved by providing a broad spectrum of habitat conditions. It is necessary, therefore, to have information on the habitat needs of each species, This must be incorporated into guides to protect the integrity, stability, and diversity of the rangeland ecosystem. The result should be a relatively stable and varied wildlife population.

For featured species, the goal is to produce selected species in desired numbers in specific locations. This can be achieved by manipulating vegetation so the limiting factors for food, cover, and water are made less limiting for the desired species, These may be game species, threatened or endangered species, or species that have particular esthetic value.

Management for featured species has also been called "key-species management" or

Figure 3.—The Art and Goals of Wildlife Management on Public Rangelands (adapted from Thomas, 1979)

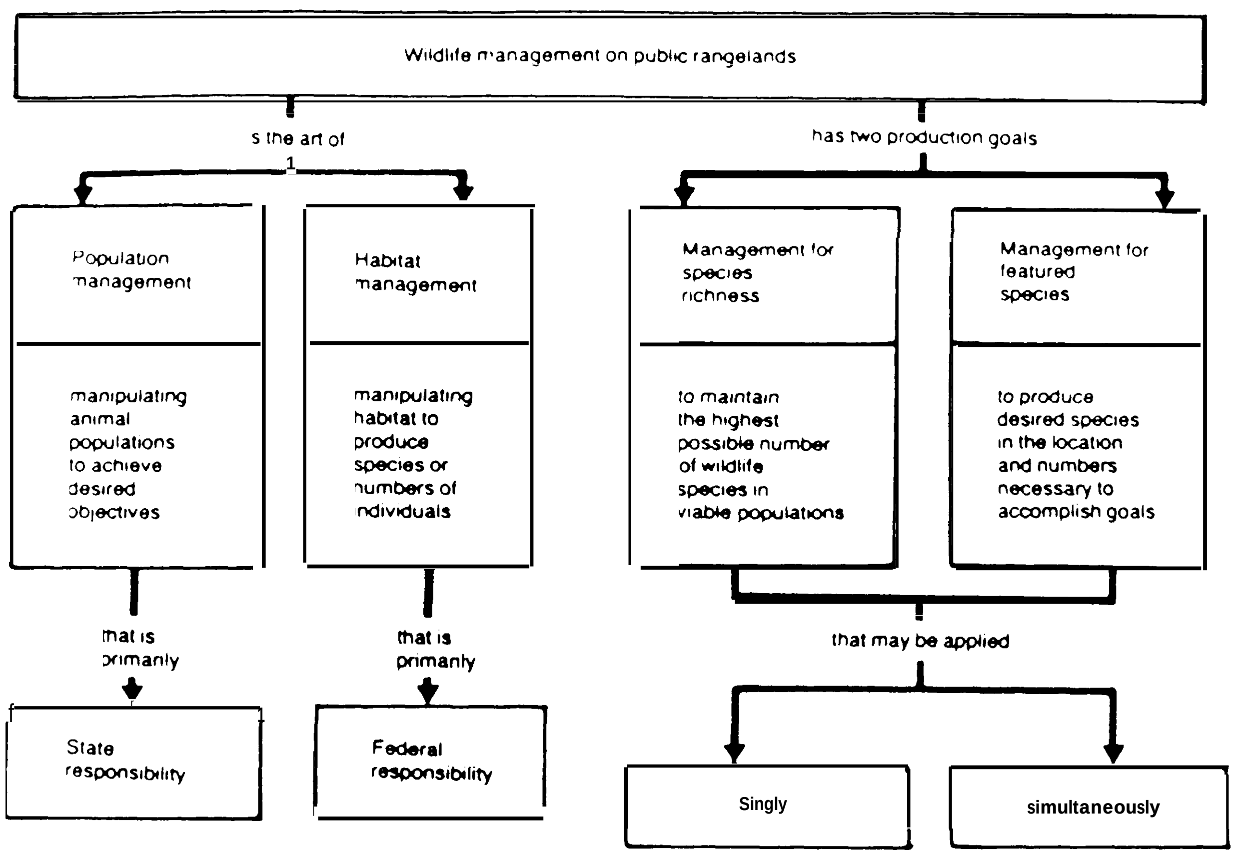


Figure 4.–Production Goals in Wiidlife Management (adapted from Thomas, 1979) ‘

Production goal	Management for species richness	Management for featured species
Objective	Insure that all resident species exist in viable numbers. All species are important.	Produce selected species in desired numbers in designated locations. Production of selected species is of prime importance.
Process	Manipulate vegetation so that characteristic stages of each plant community are represented in the vegetative mosaic.	Manipulate habitat factors so that limiting factors are made less limiting.

“indicator-species management” if the species selected represents the habitat needs of several species. If the species to be featured are carefully selected and their habitat needs vary widely, then management for featured species also will ensure habitat diversity. The result can be similar to management for species richness.

Rangelands are managed—that is, the vegetational composition and structure are controlled—through one or a combination of the following: 1) shrubs are controlled by mechanical means, herbicides, or fire; 2) controlled areas are frequently seeded with grasses, forbs, and shrubs palatable and nutritious for livestock; and 3) grazing management, defined as “. . . manipulation of livestock grazing to accomplish a desired result” (Kothmann, 1974, p. 36). Grazing management may include deferred grazing or use of a grazing system that is defined as “a specialization of grazing management which defines a systematically recurring period of grazing and deferment for two or more pastures or management units” (Kothmann, 1974, p. 36). Kothmann (1974) said there are many possible combinations of the four primary factors involved in any grazing system (number of pastures, number of herds, length of grazing periods, length of rest periods); but other factors, such as season of use, species of livestock, and class of livestock, also must be taken into account. In addition, such management involves livestock density and distribution of grazing within pastures or management units, which can be influenced by fencing, location of drinking water, or herding.

There are many options available to achieve the desired compositional and structural state of vegetation under the constraints of what the site can support, the availability of resources, and limitations of law, regulation, or custom. That the goals and objectives be clearly set and the progress toward those goals be periodically evaluated is of overriding importance. The goals and objectives must encompass both livestock production and wildlife habitat. It is essential that these goals and objectives be developed in conjunction with and cooperation between user groups and resource specialists and be stated in terms of vegetative condition first and numbers of outputs, such as animal unit months (AUM) of grazing or animal units (AU), second.

The Setting

The Great Basin of southeastern Oregon includes portions of Malheur and Harney Counties. The landscape is mostly rolling plateau at 1,066 meters (3,500 feet) in elevation, but there are mountains, cliffs, and canyons. Annual precipitation ranges from 18 to 30 centimeters (7 to 12 inches) (Heady and Bartolome, 1977).

The Great Basin rangelands in southeastern Oregon support 28 plant communities dominated by grasses, shrubs, or trees. Trees vary from conifers to deciduous and evergreen hardwoods. Big sagebrush communities predominate, whereas tree-dominated and true grassland communities constitute the least common types. True grasslands occur as relict meadows, relict stands of valley-bottom bunchgrass, and relict subalpine bunchgrass types (Dealy, et al., 1981; Maser and Strickler, 1978). The diversity of topography and plant communities made the Great Basin of southeastern Oregon an ideal place to develop and test the range-wildlife management system.

The land ownership in the Great Basin of southeastern Oregon is shown in table 1. The Bureau of Land Management (BLM) controls the majority of the land (66 percent); 29 percent is in private ownership. Agriculture and grazing of domestic livestock are the activities that dominate management of private land. Grazing of domestic livestock is the dominant use of BLM-administered lands. In 1980, 373 permitters ran 116,806 head of cattle and horses and 5,945 sheep composing of 618,608 AUM on BLM lands (U.S. Department of the Interior, Bureau of Land Management, 1981).

Table 1.—Land Ownership in the Great Basin of Southeastern Oregon[a]

Ownership	Hectares	Acres	Percent
Bureau of Land Management	3,025,792	7,476,881	66
Other Federal	62,506	154,456	1
State ...	174,944	432,296	4
Private	1,302,875	3,219,467	29
Total	4,566,117	11,283,100	100

[a]From USDI. Bureau of Land Management, 1981

Livestock management was facilitated on BLM lands in the Vale and Burns Districts from 1934 through 1981 by the following actions: vegetation was manipulated on 140,770 hectares (347,702 acres); crested wheatgrass was seeded on 211,682 hectares (522,856 acres); 7,192 kilometers (4,469 miles) of fence was constructed; 477 cattle guards were installed; 1,611 kilometers (1,000 miles) of road were constructed to move livestock; 1,286 kilometers (799 miles) of water pipe was laid; 927 water storage tanks were built; 2,119 reservoirs were constructed; 749 springs were developed; and 121 wells were drilled (U.S. Department of the Interior–Bureau of Land Management, 1981).

Livestock grazing has been relatively constant since the 1870s (Maser and Strickler, 1978). The livestock industry of the area is strongly dependent on public rangelands, and it seems likely that there will be increasing pressure on the public rangelands of southeastern Oregon to provide red meat to sustain the local economy.

At the same time, these rangelands are being used increasingly for recreation. The number of people hunting and fishing has continued to grow. This results in more pressure to produce and sustain large numbers of game animals. The number of “rock hounds” also has increased. Such special use allocation will heighten pressure from industry and the public on managers of public rangelands to produce more red meat on fewer hectares (acres) at less cost to the livestock industry.

Extensive public ownership increases pressure from local governments for more intensive livestock management that, in turn, increases employment. Increasing demands for more red meat, wildlife, fish, recreation, wilderness, and water from a finite land area inevitably lead to conflicts. Careful, farsighted management is necessary to obtain the desired wildlife and wildlife-related recreational experiences from such heavily managed rangelands.

HUMAN DESIRES

The assignment given to me was to discuss techniques for assuring successful co-existence of livestock and wildlife on rangelands. As is shown in the foregoing section, the basic technology exists. Thus, while additional research is needed, a lack of technical knowledge is not the real problem we face in resolving conflicts.

What then remains? Why are we not doing a better job resolving conflicts? In my view, the real problem is insensitivity to the crucial importance of the human dimension. Why and how technology is applied in land management is a function of human desire, which may be expressed as laws, policies, and regulations. So, "How can human desires be fostered to get the best possible land management?"

One example of the problem. might be as follows. A solution to recovery of a severely grazed riparian zone is to remove livestock from the area for 5 years. The biological need for this action may be evident, but if no one really cares whether the area recovers there can be no desire to take action. Thus, nothing is done because the biological need has not become a personal desire. The task, therefore, is to raise the value of a perceived need sufficiently that a land owner can see the need as a desirable goal.

A good example of a solution to the problem, raising the perceived need to the level of desire, is the idea of "fee-hunting" proposed by Thomas (1984). He saw fee-hunting as a means of raising the tangible value of certain species of wildlife sufficiently that they can compete economically with cash crops. If game animals, fur bearers, or other species of wildlife were to become a substantial cash crop for a rancher, then habitat manipulation and/or protection for that species would become desirable. At that point, technical information would be applied: 1) to meet a desired goal, 2) to achieve the goal within a specified time, and 3) to reach the goal as economically as possible. In this case, the why, when, and how of technology applied to land management have been determined by a rancher's desire to achieve a particular goal. When this happens, livestock and wildlife can co-exist with some degree of equality on rangelands.

An understanding of desire as a motivating force may help explain how and why goals are set or not set, achieved or not achieved. Commitment to a goal is determined by the emotional strength of desire. To set a firm goal is to clearly define something to be achieved that, in turn, determines a course of action to be taken. The goal mtist remain firm, but the course of action may change if the one originally selected does not work. A common human tendency, however, is to change the goal—devalue it—if the goal cannot be reached in the chosen way. It is much easier, for example, to devalue a goal than it is to change a whole 5-year plan that would not achieve the goal as originally perceived.

If the desire is not sufficiently strong, then somewhere along the way we may decide the price is too high and our desire is really only a wish. Commitment wanes, then disappears. Every action has one or more trade-offs. How we—as individuals—view and analyze the cost of achieving a desired end depends very much on how strong our desire is. If a desire is strong enough, we simply determine to pay the price.

To minimize trade-offs, we develop technology and techniques to accomplish an end. But just knowing how to do something and possessing the necessary technology means nothing until we also desire to apply what we know. The most tedious part of ranching, for example, is applying what we know about short-term, intermediate, and long-term planning to achieve particular goals. Those who discipline themselves to plan know where they are going and have an array of options available to reach their goals. They can respond positively to upcoming situations, rather than simply react to them.

In an age of rapidly increasing technology, the land manager too often relies on the promise of new techniques to solve problems. The trap, again, is that without need being raised to strong desire, technology is not likely to be applied. Desire cannot be legislated—it is the product of sensitive leadership.

Leadership deals intimately with human values because one must lead by example. A leader must have a moral conviction, usually expressed as justified enthusiasm, that causes people to want to follow in action. Essentially, a leader can so motivate people by sensitive negotiation that perceived need is raised to strong desire.

Negotiation is a cooperative process (Nierenberg, 1981). In a successful negotiation everyone wins something, so negotiation can be thought of as one means of defining the strength of human desires. Since human desires direct the course of land use, we need to learn and practice the art of negotiation. There are as many points of view as there are people, and everyone, from his or her own point of view, is right. There can be no solution to problems when each person is committed to defending a narrow interest, Sensitive leadership is therefore critical in any negotiation.

We like to think we manage vegetation, animals, land, water, etc., but we really only manipulate these components of the ecosystem. What we manage is people's attitudes and desires. This leads me to believe that the most effective tool for achieving land management goals is sensitive leadership that recognizes and builds on human desire.

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Agricultural Practices and Aquatic Resources

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ABSTRACT

Streams, lakes, and marine estauries are extensions of the terrestrial watersheds that surround them. The quality of these aquatic resources are determined by the nutrient inputs, the ambient temperatures, the riparian vegetation, and the sediment loadings. Agricultural practices have a dominant influence on these critical constraints, Standards for organic and inorganic compounds transported by sediments should be adopted. Riparian vegetation strips should be maintained and encouraged by agricultural policy and practices. Stream channelization should be required to augment aquatic resources as well as provide necessary discharge capacity. Land Grant Universities should be directed to facilitate demonstration projects and technology transfer that encourage integrated ecological and agricultural conservation practices.

INTRODUCTION

In preparation for this workshop, I read a number of policy papers previously developed by Federal and State agencies, environmental organizations, and sportsmen groups. From these varied documents, a pattern rapidly became evident. A majority of the policy recommendations were restatements of the traditional soil and water conservation practices employed by our grandparents prior to the 1940s. Some new concerns arose associated with synthetic organic chemicals, acidification of watersheds and more intensified uses of irrigation water; but the majority of concerns were restatements of old problems.

To merely reiterate these issues is necessary but not a sufficient exercise for this workshop. It is essential that we also address explicitly the economic, technological, and political factors that forced us to abandon environmentally sound conservation activities.

These changes usually were not motivated by a desire to reduce stocks of aquatic organisms or to destroy critical aquatic habitats, Rather, they resulted from the common practice of our economic and planning institutions to focus on short time horizons and small spatial dimensions. The 1978 International Joint Commission Agreement between Canada and the United States mandates an “ecosystem management” perspective for the Great Lakes, A similar orientation should be mandated for our agricultural ecosystems.

Unfortunately, this is easier said than done. While most people would agree in concept with ecosystem management, most people and the majority of institutions at all levels have no idea how to implement this holistic view. Submissions of broader concerns to temporal and spatial externalities is the rule, not the exception.

AQUATIC RESOURCE CONSTRAINTS

There are many environmental and ecological factors that interact to produce a given quantity and quality of aquatic resource (Reid, 1961). Different aquatic systems are constrained by differing dominant factors. Lakes and ponds are usually phosphorus limited. Marine estuaries are more often nitrogen limited, and high order streams are substrate limited. In general, the social utility and biological stability of aquatic systems are determined by water quality, water quantity, habitat diversity, and type of biological community.

These characteristics are directly affected by the dynamics of the adjacent terrestrial communities. Management of aquatic resources is absolutely dependent on the management of the associated watershed. Leaf inputs from trees constitute the primary energy flows for woodland streams. Riparian vegetation provides shades which is critical for temperature control and constitutes a buffer system that modulates sediment and nutrient inputs. The list of ecosystem interactions is very long and biogeochemically very diverse illustrating the absolute necessity of integrating agricultural and ecological management.

NONPOINT SOURCE POLLUTANTS

Pisano (1976) estimates that total amount of nonpoint source pollution at least equals, if not exceeds, the total pollutant loadings contributed by all point sources. Agriculture and silviculture occupy 64 percent of the total land area in the United States, 55 percent in Canada, and 73 percent in Mexico. The magnitude of nonpoint source inputs will be roughly proportional to the total area involved in these production processes (McElroy, 1975; Canada Yearbook, 1975; wilkie, 1976). The U.S. Commission on Water Quality estimated future stream loading as follows:

> Of the total point and nonpoint source loadings of 150 million pounds per day of suspended solids, nonpoint source loads will account for 145 million pounds or 92 percent.
>
> Of the total daily nitrogen loading of 35.7 million pounds nonpoint sources will contribute 28.3 million pounds, or 79 percent.
>
> Of the 3.63 million pounds per day of phosphorus, nonpoint sources will provide 1.93 million pounds, or 53 percent.
>
> For both fecal and total coliform counts, nonpoint sources will account for over 98 percent of the remaining national loading.
>
> Of the 119,000 pounds per day of zinc, 51,000 pounds or 43 percent will derive from nonpoint sources. (AFS Policy Statements, 1983),

Many forms of nitrogenous and phosphoric compounds are bound up in particulate material. The major nonpoint transport mechanism for these materials from the terrestrial to the aquatic systems is by sediment transport.

In addition to the pollutants it holds, sedimentation is a major cause of aquatic habitat destruction. This is particularly true for rocky substrates that represent niches for aquatic insects and spawning areas for fish,

The water quality standards designed to fulfill the commitment of the 1977 U.S. Clean Water Act to protect aquatic resources do not address the problem of sediment transported toxicants and nutrients, Nor do criteria for sediment loading reflect potential impacts on aquatic habitats. Regulation of the transport process would affect a whole suite of water quality issues simultaneously,

Recommendation.—The U.S. Department of Agriculture should develop and implement nonpoint source discharge standards for organic and inorganic compounds transported by sediments in their pollution control programs.

MANAGEMENT OF RIPARIAN VEGETATION

Many scientific studies exist that demonstrate the importance of riparian vegetation as a buffer zone between terrestrial and aquatic systems (Cummins, 1979). These buffers include streamside and lakeside terrestrial plant communities as well as wetland habitats such as Spartina salt marshes, mangrove communities, floodplains, and cattail marshes (Merritt and Lawson, 1978; ValieLa, et al., 1978). Water quality parameters are modulated by nutrient uptake, denitrification, and chemical partitioning to the soil or sediment components, Many experiments and operating treatment facilities have applied secondary treated effluent to estuaries, wetlands, and marshes to take advantage of these biological processes (Sloey, et al., 1978).

Riparian vegetation also contributes a significant proportion of the energy budget through organic material inputs for many types of aquatic systems. This is of particular importance in low order streams (Cummins, 1974), marine estuaries, and vernal ponds (Teal, 1962), These inputs have a direct effect on the secondary productivity of aquatic populations of fish, shellfish, crabs, and insects.

Riparian vegetation also is essential to maintain low-temperature regimes and acceptable habitats for many desirable stream fishes. This is particularly true for cold-water species which desire summer temperatures between 500 and 700°F, For small streams, low shrubs and grasses can provide a protective overstory from predation. For streams over 30 feet wide, trees for about 40 percent of the stream length on both sides should be present (Soil Conservation Service, 1971),

There is no generic policy nor systematic process of implementation in current agricultural regulations to develop and protect riparian vegetation buffers. Attempts have been made, however, to protect buffer strips along waterways from sources of destruction of riparian vegetation such as animal grazing and crop production. The largest to date is the new Chesapeake Bay Program costing some $48 million and involving two proposed projects. One is to implement phosphorus removal from secondary municipal treatment facilities, and the other is to obtain a vegetation buffer strip all around the Bay.

One current approach which appears feasible is to use the USDA's set-aside program to develop buffer strips but two modifications to the existing program will be necessary. One requires the maintenance of the same acreage for a long period of time free from grazing and plowing. The other is an incentive system that provides rewards for selecting riparian acreages for the set-aside. This could be achieved by using an increasing scale for riparian acres when calculating credits for the set-aside.

Recommendation.—The USDA should modify the set-aside program to encourage the development and protection of riparian vegetation buffer strips.

STREAM CHANNELIZATION

Watershed management is a complex process involving many trade-offs between economic, social, and environmental issues. The management of water through impoundments, channelization, and nonstructural storage constitutes an important component of the management plan.

This is also an area where there have been historical controversies between agricultural and environmental interest groups. Farmers need to till and drain low areas so that soils can be worked as early in the spring as possible. Natural streams often do not have sufficient discharge capacity to handle the excess runoff in a timely fashion. Streams are, therefore, declared agricultural drains and engineered to increase capacity. Often this increases flooding and sedimentation problems downstream where many of our urban centers are located on floodplains.

Until recently, the evaluation of alternative designs and mitigation programs through the environmental impact statement process has focused only on the portion of the watershed that was to be altered. This was justified by the fact that the costs of the studies was borne by only those riparian owners that benefited from the stream improvements; but this practice has been successfully challenged in many States. Environmental Impact Statements (EIS) are increasingly taking a watershed perspective. Water quality, sedimentation rates, diversity of fish habitats and esthetic aspects of "stream improvements" are being compared to the benefits of rapid discharge (wildlife Society, American Fisheries Society, 1983; Soil Conservation Service, 1971). The new Palmiter method in particular emphasizes subsurface structures that allow both diverse aquatic habitats and increased surface flows.

The other main issue here involves structural versus nonstructural impoundments for the storage of water to prevent downstream flooding. Wetlands and vernal ponds represent a distributive storage component scattered throughout the watershed. If these are drained for agricultural purposes, society must then invest large amounts of money for downstream structural impoundments. These structures also impound sediments, increase water temperatures, impede fish migrations, and affect downstream water quality. Since the destruction of the natural storage capacity is scattered in space and distributed over time and since the riparian-owner populations are distinctly different groups, a systems analysis of cost and benefits of the alternatives for the total watershed is hardly ever available for decision makers.

Recommendation.—The USDA should implement a generic EIS that evaluates the total costs, benefits, and risks of nonstructural controls for water management in agricultural watersheds.

EDUCATION AND DEMONSTRATION PROGRAMS

Many of the management practices that are being considered for the enhancement of aquatic resources are well-known soil conservation practices from the early 1900s. The environmental constraints have not changed in the last 50 years, but the social and economic conditions are considerably different. There is a real need to implement a network of education and demonstration programs that build credibility for the fact that good environmental management also is good economic planning. The general perception that agricultural production processes are inescapably in conflict with good ecology is incorrect and counterproductive.

watershed demonstration projects accompanied by material mass balances and complete economic cost/benefit analysis are the best way to establish credibility with the farm community, This is similar to programs recommended in the 1981 Agriculture and Food Act, Title XV: Resource Conservation (Johnson, et al., 1982).

The Land Grant Universities of this country are institutions whose original charters mandate education and demonstration programs to facilitate technology transfer to the agricultural community. Land Grant Universities have become infatuated with intensive, big-scale agricultural production technologies in the last 40 years. These same institutions have the relevant array of academic disciplines (economics, soil science, fish and wildlife programs) to initiate and document these demonstration projects. The Land Grant Universities have the mandate and the resources to transfer to agro-ecosystem management. All they need is the will,

Recommendation.–The 1985 Farm Bill should include under Title IX a directive to the Land Grant Universities to develop watershed management demonstration projects which integrate ecological and agricultural conservation practices.

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Agricultural Activities and Marine Fisheries

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INTRODUCTION

Approximately 7.7 billion pounds of fish and shellfish were landed commercially by U.S. fishermen in territorial waters or the Fishery Conservation Zone in 1983 with a value of more than $2.7 billion (National Marine Fisheries Service, 1983). when ancillary industries, such as processing, distribution, and marketing, are considered, the value is significantly higher. To illustrate the importance of the value of ancillary industries to fisheries economics, a variety of multipliers have been developed to determine this additional value. Using a multiplier of 7.4, developed by NMFS economists (National Marine Fisheries Service, 1975), would increase the total value of the 1983 commercial fisheries to $19.7 billion. Additionally, although the marine recreational harvest has not been estimated since 1980, it was then determined to be approximately 700 million pounds with a total economic impact valued at $7.5 billion (National Marine Fisheries Service, 1983). The total economic impact of recreational fisheries includes associated expenditures such as tackle, boat purchases or rentals, transportation, and lodging, and restaurant accommodations associated with fishing trips.

The continued economic viability of the American fishing industry is dependent on maintaining biologically productive stocks, which, in turn, is dependent on competent management and ensuring that adequate habitat is available for reproduction and development. Significant numbers of species, even those caught in the ocean, depend on the estuaries for the survival of one or more stages in their life cycles. Between 11 and 98 percent by weight of the U.S. commercial harvest is considered estuarine-dependent; approximately 97 percent of the Chesapeake Bay harvest is estuarine-dependent (McHugh, 1976). However, many estuaries including Chesapeake Bay are environmentally stressed and degraded as a result of a myriad of human activities.

ENVIRONMENTAL IMPACTS ASSOCIATED WITH AGRICULTURAL PRACTICES

Many agricultural practices can contribute significantly to habitat degradation in some areas. The withdrawal, impoundment, and/or diversion of freshwater from streams and rivers can change the salinity gradient downstream and result in displacement of spawning and nursery grounds. Patterns of estuarine circulation necessary for larval and plankton transport could be modified. Such changes can expand the range of estuarine diseases and predators associated with higher salinities that affect commercial shellfish,

Channelization results in increased sediment loading, both during and following construction. Stream banks denuded of vegetation and destabilized during construction are readily eroded; increased stream velocities resulting from channelization also accelerate erosion. Eroded sediments laden with nutrients and other contaminants are transported downstream where they can degrade water quality, foul fish spawning habitat, and smother shellfish beds,

Additionally, channelization often results in the destruction of substantial acreage of wetlands that serve as natural buffers and filters by slowing the velocity of upland runoff, trapping sediments, and assimilating nutrients.

Farming in river basin drainage areas can produce changes in water chemistry adjacent to and downstream from agricultural areas, Biostimulants, such as fertilizers and animal wastes, entering streams as nonpoint source pollutants may promote the overproduction of algal species, which results in high biological oxidation demand and an increased abundance of undesirable species, Animal wastes also degrade water quality and pose a potential health hazard that can result in closure of shellfish beds to harvest. Biocides used for weed control may inhibit the growth of important submerged aquatic vegetation.

Runoff from farm fields into adjacent streams and major tributaries transports sediments into anadromous fish streams, where spawning areas are affected. Sediments transported to estuaries decrease the transparency and increase the turbidity of the water, thereby limiting the penetration of light and decreasing photosynthesis. Heavy metals and other compounds from terrigenous sources are adsorbed to these sediment particles and become distributed throughout the water column and in bottom sediments, Eroded sediments can blanket the bottom and destroy oyster bar communities and other epifaunal populations. As little as 1 to 2 millimeters of silt on oyster cultch can render this substrate unsuitable for the attachment of spat (Galtsoff, 1964).

TECHNOLOGIES THAT WILL BENEFIT BOTH FISH AND AGRICULTURE

The washing of soils, together with the pesticides and fertilizers applied to them, represent an economic loss to farmers as well as a degrading influence on aquatic ecosystems. It is to the best interest of all concerned—farmers, fishermen, and the public—to keep sediments and chemicals out of our Nation’s waterways, The benefits and costs to estuarine fisheries resulting from the alteration of agricultural practices have not been fully assessed in previous farm policies. An opportunity to improve this situation now exists as the USDA and others take a serious look at conservation measures appropriate to the impending 1985 Farm Bill. The reauthorization of the Farm Bill could provide incentives to encourage use of Best Management Practices (BMPs) such as fencing off rivers and streams to livestock and establishing vegetated buffer strips along waterways that would provide riparian habitat and reduce erosion; all to the mutual benefit of landowners and fish and wildlife resources.

Cooperative activities between agencies also could jointly aid farmers and fish and wildlife habitat. The National Marine Fisheries Service (NMFS) of the National Oceanographic and Atmospheric Administration (NOAA) is providing the Economic Research Service of USDA with information on the impacts of agricultural practices on estuarine fisheries. The National Ocean Service of NOAA has developed a county/commodity data base for the East and Gulf Coasts that can estimate agricultural pollutant loadings under different scenarios of cultivation. NMFS is beginning a research program to quantify the value of estuarine habitat for fisheries production. NMFS also has responded to the Agricultural Stabilization and Conservation Service’s request for information on the environmental impacts of production adjustment programs. NMFS intends to combine our efforts of quantifying pollutant loading by hydrological basin and assessing the effects of such loading on fish resources. The program should assist USDA to develop policies that will reduce adverse effects on living aquatic resources.

There are areas of cooperation where future progress can be made. For example, it maybe worthwhile to explore how NOAA's Sea Grant and USDA's Extension programs can cooperate in implementing joint research projects or monitoring programs and in getting the resultant information to the farmer. NOAA also would appreciate the opportunity to pursue with USDA and other agencies, as appropriate, potential mechanisms to reduce off-farm impact on fish and wildlife by ensuring that BMPs are considered in Coastal Zone Management, Section 404 of the Clean Water Act (including exemptions, nationwide and individual permits), and other pertinent Federal programs.

Additionally, educational programs and demonstration projects that encourage conservation of land and aquatic resources should be promoted. Previous projects and programs clearly illustrate the mutual benefits to agricultural and fish and wildlife interests.

Interagency Domonstration Projects

Shoreline Stabilizatiom With Wetland Vogetation

Erosion of varying degrees of severity exists along many shorelines throughout Talbot County, Maryland, resulting in the loss of valuable properties, estimated to exceed over 30 acres per year. Much of the land bordering Talbot County waters is agricultural. Traditionally, erosion abatement has been accomplished by structural means (i.e., stone revetments, bulkheads, etc.). These physical structures are expensive, and they often require the destruction of intertidal or shallow water areas that provide nursery and feeding habitat for many valuable species of marine life. Such structures may be the only solution along exposed (high energy) shorelines; however, for many rivers and protected coves, alternative nonstructural techniques to control erosion are available.

A proven method of nonstructural shoreline stabilization is by planting marsh plants. Along the mesohaline shores of Chesapeake Bay, smooth cord grass *(Spartina alterniflora)* is typically planted in areas regularly flooded by tides, and saltmeadow cord grass (S. *patens)* is commonly used in areas subject to intermittent tidal flooding. Both species are often used in conjunction to simulate natural marsh zonation and to afford greater protection.

Establishment of fringe marshes along these shorelines can abate erosion at a cost of 10 to 50 percent of that for conventional physical structures. Such savings are significant, particularly on large agricultural tracts where the expense of conventional methods may be cost-prohibitive. Although occasional maintenance may be required, and annual fertilization of the marsh grasses is recommended, the costs are inconsequential when compared with the repair or replacement of traditional structures, such as bulkheading. At the same time, fringe marshes enhance the ecological values of treated areas by providing spawning, nursery, and feeding habitat for an abundance and variety of lower trophic organisms that serve as forage for commercially and recreationally important species of fin- and shellfish. Additionally, fringe marshes act as buffer strips that filter pollutants from upland runoff entering aquatic ecosystems.

In consideration of these potential benefits, NMFS in cooperation with the Talbot County Soil Conservation District, the Soil Conservation Service (SCS), and the Talbot County Planning Department worked cooperatively to identify reaches of County shoreline where landscaping alternatives could abate erosion.

Under contract to NMFS, an expert in the field of vegetative stabilization developed a series of maps to identify shore reaches where landscaping stabilization methods were feasible. These maps were coded to indicate the estimated cost for the landscaping treatment.

Approximately 296 miles of the 490 miles of assessed shoreline in Talbot County were found suitable for stabilization with wetland vegetation. The remaining shoreline (194 miles) was either stable because of extensive natural marsh systems (152 miles) or unsuitable for vegetative stabilization because of severe energy regimes (42 miles).

Property owners identified in the study were sent letters by the Talbot County Council inviting them to a workshop held in April 1983 by the project cooperators. The advantages of vegetative stabilization, both ecological and economic, were explained to the workshop attendants, Additionally, the Corps of Engineers and the Maryland Water Resources Administration agreed to develop administrative procedures to expedite the processing of permits for these projects as further incentive. Following the workshop, local interest appeared relatively strong. Between the spring of 1983 and fall of 1984 (approximately 18 months), the Talbot County SCS office received more than 50 inquiries about the technique from property owners who attended the presentation. The contractor who performed the shoreline survey has completed approximately 50 projects involving shoreline stabilization with marsh vegetation throughout the county,

Demonstration Farm (Best Management Practices)

A demonstration farm proposal is currently being planned as a cooperative effort between the University of Maryland, Maryland Department of Natural Resources, SCS, and NMFS. The purpose of the project is to identify, implement, and evaluate the BMPs on a site-specific basis. The BMPs, although not thoroughly detailed at present, will include such methodologies as vegetated buffer strips, sediment ponds, reverse drainage grading, directional furrowing, water control structures, and other techniques designed to retard flows and reduce velocities to minimize nonpoint source discharges to natural waterways. Although the project is site-specific, rather than generic, successful technologies could be applied to other sites with similar conditions. Additionally, the methodologies developed to assess the effectiveness of various experimental techniques could have broad application.

Pest Control (Open Marsh Water Management*)

In Maryland, the State Department of Agriculture (DOA) is responsible for mosquito control as well as the management of other pest organisms. Much of this work is conducted in tidal wetlands. Because of the potential adverse impacts of mosquito control work in sensitive tidal habitats, cooperative efforts between the DOA and the State and Federal regulatory and resource agencies began as early as 1975. Working with a concept formulated in New Jersey, Open Marsh Water Management, techniques were developed that controlled mosquitoes biologically, rather than chemically, resulting in minimal physical impacts to the treated marshes, and enhancing other elements of the estuarine food web. Although this program may be the most specialized of those described, it does contain elements that may be applicable to agricultural 1ands, For example, silled ditches used to minimize lateral drainage in mosquito-controlled marshes, may be used in channelization projects. Such ditches allow the removal of surface waters without desiccating wetlands. Also ponds with radial ditches and no outlets could be used to direct surface flows into sediment basins, thereby preventing contaminants from running off into natural waterways.

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Designing Landscape Mosaics for Integrated Agricultural and Conservation Planning in the Southeastern United States

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ABSTRACT

To allow sustained growth and ensure resource availability Sunbelt States must integrate conservation planning with development planning, A generalized model that relates wildlife type and abundance to land capability and land use intensity is presented. High density, tolerant, opportunistic species are seen to occupy areas of high intensity land use. Medium densities of tolerant but larger and wider ranging species occupy areas of lower land use intensity. Very low densities of large, wide-ranging wilderness species demand wide expanses of low intensity land use or else an integrated system of conservation areas such as refuges and national forests. Economic incentives can be sufficient to ensure wildlife conservation on large private or industrial ownerships. A Wildlife Habitat Incentives Program (WHIP) administered through USDA/ASCS is suggested to motivate wildlife conservation on small nonindustrial private land, A Federal interagency coordinating council is suggested as a means to guide development of regional systems of national forests, parks, refuges, etc., as an alternative to land use restrictions on agricultural lands.

A GENERALIZED MODEL OF LAND USE/WILDLIFE RELATIONS

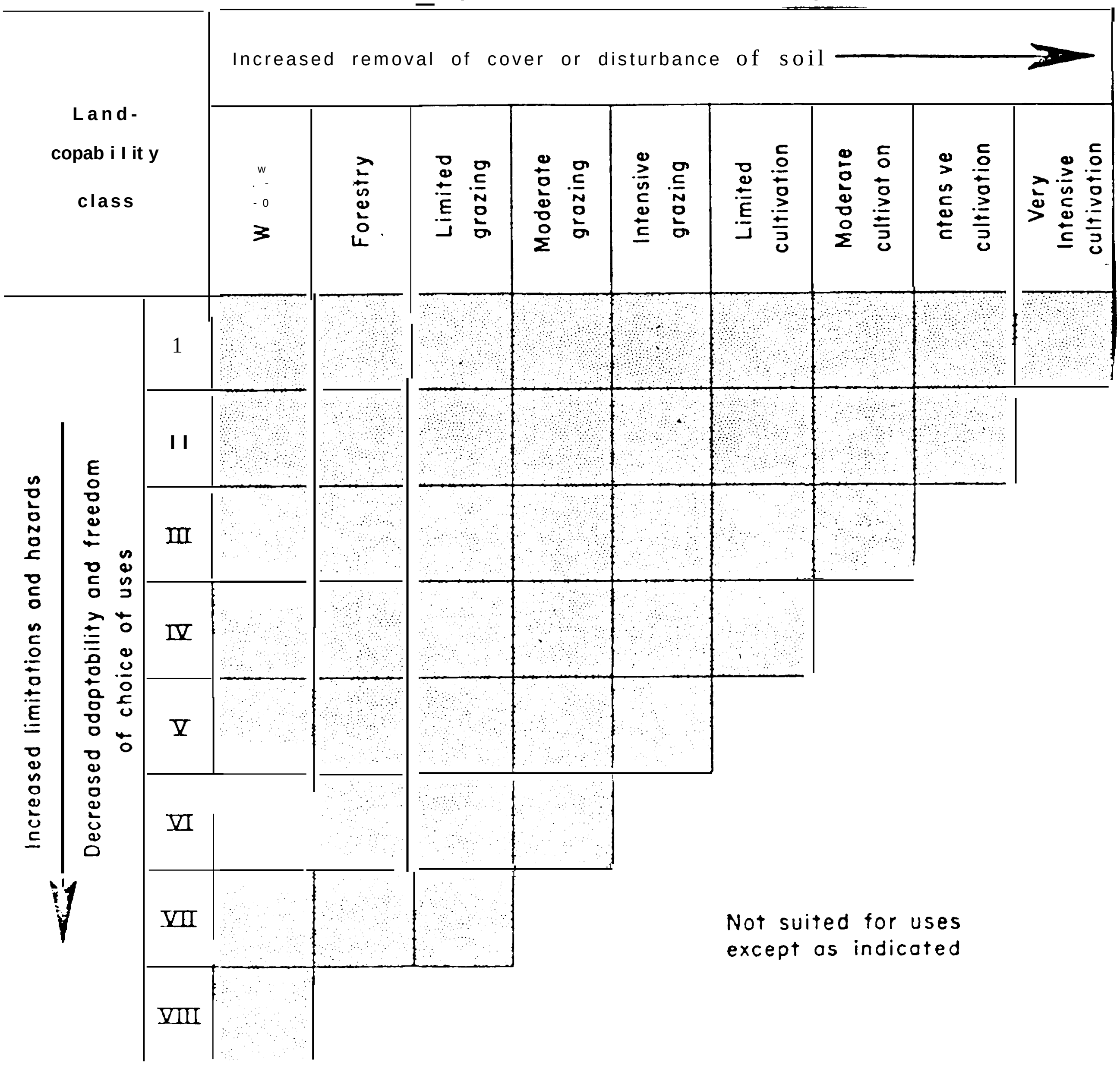
Nearly 50 years ago the Soil Conservation Service developed a simple classification scheme to aid interpretation and proper use of soil and land types (Hockensmith and Steele, 1949). The system consists of classes ranging from I to VIII with the best soils that have greatest capability being assigned to class I and the worst soils with great limitation being assigned to class VIII. The classes are described as follows:

I. Few limitations. Wide latitude for each use. Very good land from every standpoint.
II. Moderate limitations or risks of damage. Good land from all around standpoint.
III. Severe limitations or risks of damage. Regular cultivation possible if limitations are observed.
IV. Very severe limitations. Suited for occasional cultivation or for some kind of limited cultivation.
V. Not suited for cultivation because of wetness, stones, overflows, etc. Few limitations for grazing or forestry use.
VI. Too steep, stony, arid, wet, etc., for cultivation. Moderate limitations for grazing or forestry.
VII. Very steep, rough, arid, wet, etc. Severe limitations for grazing or forestry.
VIII. Extremely rough, arid, swampy, etc. Not suited for cultivation, grazing, or forestry. Suited for wildlife, watersheds, or recreation.

Lands of high capability are expensive and require intensive use to offset the high capital investment, Lands of lower capability that require less capital investment maybe used less intensively and generate smaller returns. It follows almost directly that land use intensity will be proportional to capability and thus inverse to numerical rank (figure 1).

Wildlife populations are as responsive to soil richness and capability as are agricultural or silvicultural crops, Numerous studies report a positive relationship between wildlife growth and abundance and soil richness. But wildlife is also very responsive to land use and thus it is the combination of land capability and land use which dictates the composition, disposi-

Fiaure 1.—A Soil Conservation Service Land Capability Classification Portraying the Land Use Intensity Appropriate to Each Class (from Hockensmith and Steele 1949)

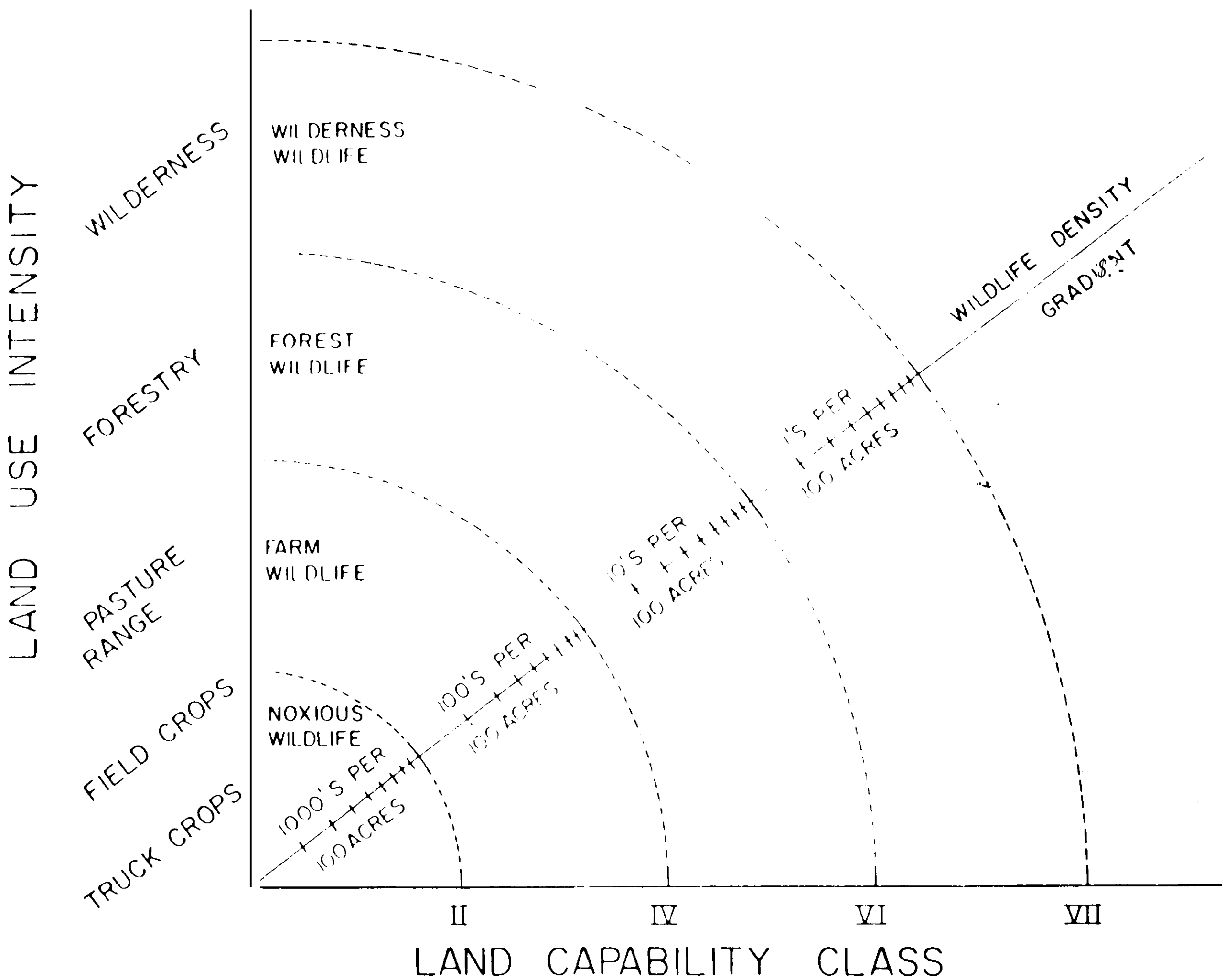


tion, and abundance of the wildlife community.[1]

A slight modification and rearrangement of the capability class and land use chart given in figure 1 allows the addition of these four general classes of wildlife (figure 2). It seems reasonable that wilderness species are not only defined by, but largely restricted to the low intensity land use areas which tend to be of low capability class. It goes without saying that forest and range wildlife largely corresponds to forest and range lands of classes V through VIII, but the intensive mechanized forestry practices in the Southeast is more restricted to classes IV through VII. Farm wildlife (e.g., quail, rabbits, doves, and squirrels) do well under low intensity agricultural conditions generally associated with small farmsteads and both this land use and these species will occur on the higher capability class lands. Finally, class I lands, those which are very expensive

[1]The American Game Policy (Leopold, et al., 1930), developed in 1930 identified four classes of "game" consisting of farm game, forest and range game, wilderness game, and migratory game. For the purposes of this paper, migratory game will be excluded and a new category called pest wildlife is added because of increasing levels of wildlife depredation on agricultural crops.

Figure 2.—Generalized Model Illustrating the Relation Between Land Capability Class, Appropriate Land Use Intensity and the Expected Type and Relative Abundance of Wildlife Occurring on the Land



and which must be used very intensively in order to justify the capital expense, can only be used for urban, residential, or intensive agricultural development. Under these circumstances, almost any wildlife species may be deemed a pest (figure 2). In summary, we now have a scheme that not only relates land use intensity to land capability class, it predicts the general type of wildlife that is likely to occur in various land use types. Florida panthers, large alligators, or bears will not be tolerated in urban, suburban, industrial, or intensively used agricultural areas. These species and their future will depend on conservation and management either in a wilderness context or in an integrated system of preserves. Turkeys, ruffed grouse, and feral hogs will generally find acceptable habitat in and simultaneously be limited to forest and range conditions. Species such as white-tailed deer that aggressively invade farmland situations frequently will not be compatible with crop production systems and thus they too may be restricted to forest and range circumstances. Quail, doves, squirrels, rabbits, and "small game" in general will not only profit from, but also will be tolerated amongst agricultural fields and farmlots.

A second, somewhat surprising, pattern that emerges from this scheme portrays the expected density of wildlife under various land use conditions. By nature, wilderness wildlife tends to be rare and densities of 1 per 1,000 acres are reasonable for this type of species. Other wilderness species may be as dense as 1 per 100 acres or more, but higher densities should generally not be expected. The density of forest and range wildlife tends to be higher than that of wilderness species and densities of 10 per 100 acres or 1 per 10 acres is a reasonable expectation for most species of this class. Farm game species generally occur at yet higher densities and 1 per acre or 100 per 100 acres is a reasonable expectation. A little known fact, however, is that urban wildlife, especially birds, tend to be the most abundant of all. For example, Emlen (1974) found a 26-fold increase in bird numbers along a gradient from the desert to the urban environment of Tucson, Arizona. The bird density of Tucson was reported at 600 pairs per 100 acres.

In total, I believe this scheme fairly represents the probable correspondence between land capability and its use intensity while identifying both the general type and relative abundance of wildlife that can be expected under various circumstances. It does not assert that farm, forest, or even wilderness wildlife cannot or does not occur under very intensive land use conditions, but if it does occur there it will almost certainly be considered a pest. It does not assert that some species such as white-tailed deer can not occur in all of the categories, but that if they do, then the management objectives and approaches probably will be quite different.

MODEL IMPLICATIONS FOR MANAGEMENT

In previous decades a predominantly species-by-species and situation-by-situation approach has characterized wildlife management in the United States. More recently, comprehensive planning has emerged as the predominant theme in both Federal and State legislation, Thus the Resources Planning Act, the National Forest Management Act, and the Federal Land Policy and Management Act all rely on an integrated, multiple use planning approach. The majority of States have now implemented non-Qame programs in an attempt to focus attention on the large array of species that are neither game species nor rare and endangered species. Florida, for example, considers that some 1,200 vertebrate species residing in the State require "an integrated approach to the management and conservation of all native fish, wildlife, and plants" (Fla. Statutes 372.992). This can only be achieved if the plan is acceptable to: 1) those who approve it, 2) those who pay for it, and 3) the landowners where it is carried out (McConnell, 1981). The plan certainly must encompass the greatly different types of wildlife and land use and consequent management opportunities that exist. The model presented above attempts to do just that. The additional premise incorporated here relies on a multi-faceted approach based on: 1) development of economic incentive when possible, 2) provision of free technical assistance and habitat plantings to encourage voluntary participation, 3) feasibility of land purchase and reservation, and 4) regulation of species and land use when necessary (McConnell, 1981).

Land and soil types generally follow a recurrent pattern of distribution with predictable sequences and location. Plants are usually adapted to specific site conditions as are certain vertebrate species. As a general principle, resident animal species with very local movement patterns are closely tied to specific site conditions while resident species that range widely show less linkage to specific sites. This means that the concept of habitat management is very well developed and useful for most species of farm and woodlot wildlife, but the concept becomes less useful as we progress toward the wilderness species. Large carnivores and species such as bears range over many soil, vegetation, and land use types daily and the concept of habitat management becomes virtually useless, It follows from this that a localized habitat management approach can be very successful for small game species such as quail, rabbit, and squirrel on farms of only a few hundred acres, Several hundred if not thousands of acres are necessary to successfully manage for forest and range species such as deer, feral hogs, and turkey. Landscapes of tens and thousands of acres are necessary for the successful management of bears and bobcats.

Although this material is not new, it should serve to emphasize that opportunities for economic incentive and self-initiative are not tied to either small or large landholders. Small landholders are most limited in the species they can manage for, but landscapes consisting of numerous small landholdings can provide excellent habitat for resident species. This is especially true if natural habitat features such as outcrops, drains, and odd areas are maintained as other features such as fencerows, windbreaks, shelterbelts, and buffer strips are created. It is the landscape mosaic and the heterogeneity existing between and among fields that creates this habitat value. County, State, and Federal agencies, planning councils, and the public must provide the mix of incentives, rewards, and regulations to achieve these smaller scale habitat qualities.

The trend toward larger farm size and industrial ownership is not in and of itself bad for wildlife. In fact, it greatly increases the opportunity for economic development of the wildlife resource because a greater number of species can be managed for. Far and away the greatest economic returns from wildlife in the Southeast derive from large private and industrial ownerships. Certain corporations derive more than $1/acre/yr from hunting leases on million-acre ownerships while other private owners derive over $3/acre/yr from hunting leases on l00,000-acre ownerships. Prime wildlife habitat such as bottomland hardwoods may lease for $10/acre/yr.

Although there is no obvious economic incentive for managing private lands for nongame species, most owners would happily do so on a voluntary basis if habitat improvements such as food and cover plantings and nest boxes were free and if technical assistance were readily available (McConnell, 1981), Social reinforcement such as good citizen awards, direct compensation for conservation planning, and tax credits for approved management plans are incentive mechanisms that will complement and enhance game lease receipts,

Having briefly considered farm and forest wildlife, I now turn to the many species that either have such specific habitat requirements or which range over such vast areas that the private sector cannot be expected to manage them. It is these species that require integrated State and Federal regulations and/or land reservation.

Strategic purchase and placement of State and National Parks and Preserves, State and

National Forests, and National Wildlife Refuges is critical to the regional conservation of these species, Habitat specialists that occur only locally (e.g., red-cockaded woodpecker) are vulnerable to the effects of inbreeding and genetic drift unless genetic interchange between the subpopulations is ensured, Conversely, the very rare, but wide-ranging species usually cannot be "contained" within any single park or refuge and therefore require some sort of travel corridor system that attempts to link one habitat island with another (Harris, 1984a). Although the prospect of providing continuous physical connections between the habitat islands may initially seem remote, the range of opportunities is great. Both natural and anthropogenic connectors can be drawn upon. Conservation easements may serve as well as actual ownership. Candidate corridors will include streams and streamside buffer strips, rivers and riparian strips, State and national recreations trials, scenic roadsides, high voltage power lines, drainage canals, windbreaks, shelterbelts, greenbelts, and dispersal corridor designation (Forman, 1983; Harris, 1984a),

The important point to all of this is that economic incentives and the free enterprise system can be made to work toward wildlife conservation on large private and corporate ownerships, but that it falls short on both ends of the scale. Farms and landholdings too small to support hunting leases will provide habitat for resident species with small ranges, but this is only if a heterogeneous mosaic derives between and among field arrangements. Similarly, wide-ranging species that require entire landscapes will depend on the strategic layout of sanctuaries or habitat islands interconnected as much as possible by dispersal corridors.

Tax incentives, planning guidelines, the provision of technical assistance, and perhaps even regulation will be required at the small scale while multiagency coordination guidelines from the level of the U.S. Congress will be required to ensure integration and cooperation at the regional level.

APPLICATIONS IN THE SOUTHEASTERN UNITED STATES

The Southeastern Coastal Plain is characterized by low topographic relief, numerous alluvial bottomlands generally flooded during late winter, and expansive flatwoods where the water table is generally near the surface. Because of the low latitude, winter daylength is about *30* percent greater than that of 50 N latitude. Hurricanes and tropical depressions frequently cause summer flooding throughout the lowlands. Hardwood tree species diversity is high. Whereas a single species of oak occurs in the forests of Maine, *25* species and *4* recognized subspecies occur in Florida. Broadleaved evergreen trees, bushes, and shrubs dominate the bottomland forests and many species such as the hollies (Ilex spp.) either bear their fruit during or hold it through the winter. This combination of abundant acorns, winter fruits, evergreen foliage, warm temperatures, and long day lengths make the bottomland hardwoods ideal winter habitat (Harris, 1984b).

Open pinelands characterize flatwoods and most upland sites. Frequent lightning strikes and subsequent fire suppressed and/or eliminated the woody, fruit-bearing midstory and understory and created expansive, open foraging areas interspersed with hardwood and cypress bottomlands that were generally too wet to burn.

Wild turkey and black bear are two examples of species that depend on the heterogeneous mosaic of bottomlands and uplands. Wild turkey's require open areas where the broods of young poults can easily forage for a diet that is almost **100** percent arthropods. Adults and large chicks require the fruits, seeds, and nuts from flowering plants during winter and have a strong preference for roosting in trees over water during all seasons. Black bears range widely and tend to acquire their omnivorous diet from upland habitats during summer and fall but from bottomland hardwoods during

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winter and spring. They frequently rely on shallow water areas to extinguish their scent trail as they flee from pursuit of hunters using tracking dogs.

The Southeastern United States supports fewer species of birds and mammals but very many species of reptiles and amphibians (figure 3). For example, the greatest concentration of salamander species anywhere in the world occurs in the Southeast and the 25 species of turtles in Florida are five times as great as what occurs in all of Europe (Gibbons, 1983). The interspersion of flooded bottomlands with dry land areas is critical for these 175 species of lower vertebrates, especially the very large carnivorous forms such as alligator and alligator snapping turtle. While the number of breeding bird species is quite low, the overwintering population of birds in the bottomlands is very high (figure 3). It is estimated that 90 percent of all of eastern North America's bird species use the Southeastern bottomlands as habitat during the 5 to 7 winter months or as stopover feeding areas during their spring and fall migrations. Taken in total, these characteristics emerge:

- Overwintering populations of North American birds exceed breeding season populations.
- Reptile and amphibian species and abundance exceed breeding bird and mammal species and abundance.
- Nongame species and populations exceed game species and populations nearly 10 to 1.
- The number of rare and endangered species is greater than elsewhere in North America.
- The importance of bottomlands, marshes, and estuaries is exceedingly great to the abundant semi-aquatic species of forbearers, wading birds, reptiles, and amphibians.

Until now land use intensity and development has been sufficiently low to preserve most of the natural landscape diversity and intersection of bottomlands. Drainage and conversion to agriculture has been particularly severe in the lower Mississippi Valley, however, and during the last 40 years bottomland hardwood forest acreage decreased by 6.6 million acres in this valley while agricultural lands increased by 5 million acres (MacDonald, et al., 1979). Conservative Southern farmers are generally not gamblers or risk takers and would not invest in bottomland conversion unless there were only a small likelihood of loss. Numerous Federal Government programs have been aimed directly at reducing the risk associated with farming in the bottomlands (Shabman, 1980:

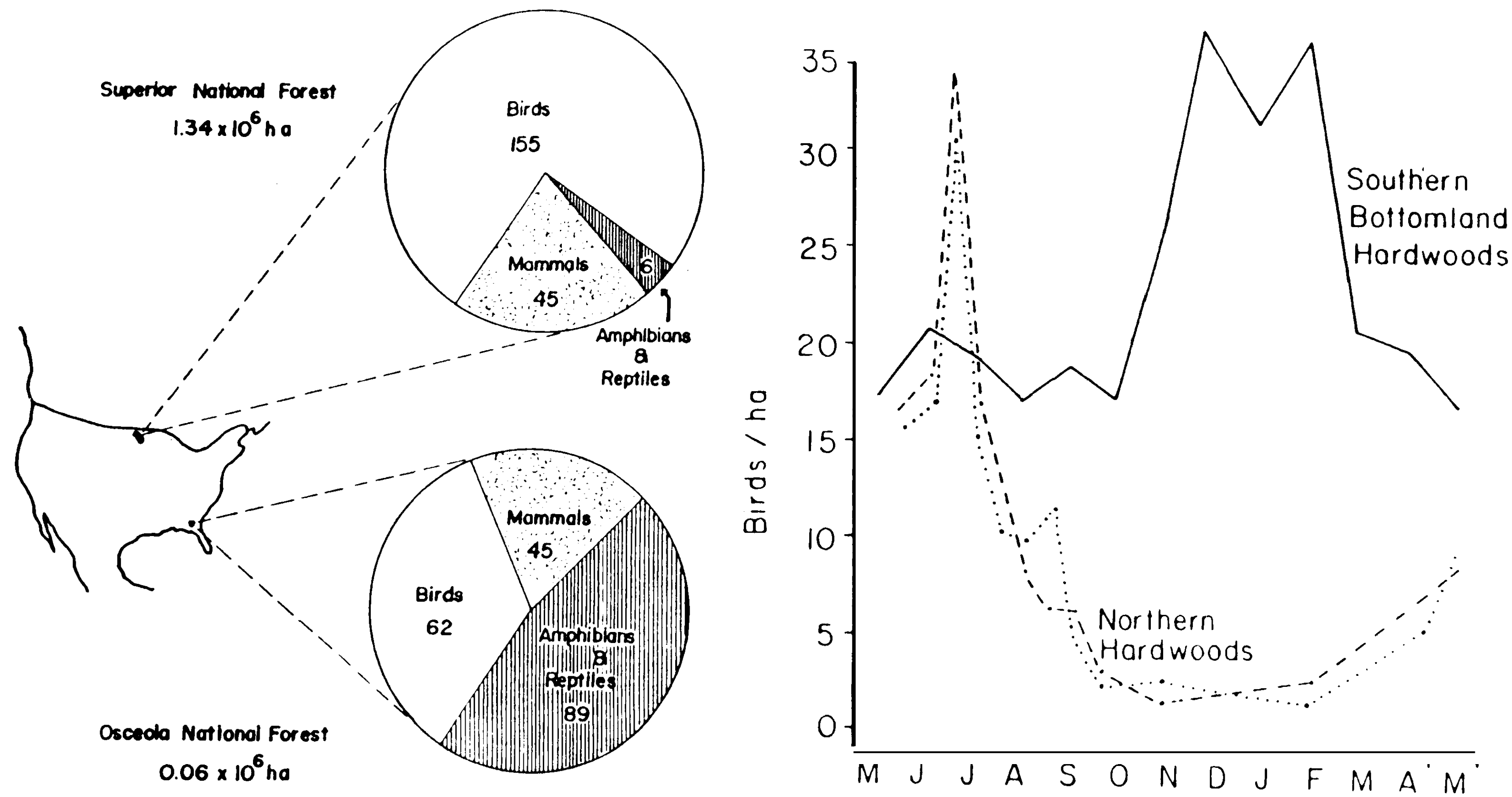
1. Public works projects of the Soil Conservation Service and the Corps of Engineers are aimed at reducing and/or preventing risk from flooding.
2. Several aspects of income tax law provide for shifting a farmer's investment in drainage and land conversion over to the general public.
3. "Deficiency" payments supported by the Commodity Credit Corporation virtually eliminate risk due to market fluctuations.
4. Farmers Home Administration and the Agricultural Conservation Program of the Agricultural Stabilization and Conservation Service make direct payments to farmers who convert bottomland hardwoods.
5. Disaster assistance compensation for losses due to natural flooding patterns further reduces or eliminates risk of monetary loss.

River diversion, land drainage, and hardwood conversion have the immediate effect of changing former class VIII lands to class I lands. Planting soybeans immediately transforms a low intensity land use into a very high intensity land use. These two changes immediately eliminate native species such as ivory-billed woodpeckers, Carolina parakeets, red wolves, Bachman's warbler, and others while forcing other species such as white-tailed deer and bear into hostage or fugitive situations. They become pest species.

Rocommendations

In addition to the fish and wildlife habitat that would be conserved if its destruction were

Figure 3.—Breeding Species of Vertebrates



not subsidized, new programs aimed at re-creating and conserving the natural vegetation mosaic and riparian forests are needed.

Massive acreages were abandoned after the reconstruction era and logged over forestlands were never replanted. The outlawing of native burning early in this century and the general public's negative sentiment about prescribed burning to this day has dramatically changed the upland forest environment. In many cases it has led to a hodgepodge of lands that are poorly stocked with low-quality invader species that represent neither good forestry nor good wildlife habitat. *A Wildlife Habitat incentives Program (WHIP) similar to the Forestry Incentives Program is called for.* Congress should authorize a cost-sharing program that encourages: 1) forest nurseries to propagate, stock, and distribute native tree and bush species of known wildlife value; 2) at a cost comparable to that of current plantation species (e.g., $50 / 1,000); and 3) encourages the development of agency approved habitat reclamation plans on private lands. This should be aimed especially at the small, private, nonindustrial landowner. Like the Forestry Incentives Program, this could be administered through the ASCS but the plans should be approved by certified wildlife biologists in wildlife extension or in a relevant State agency. The plans should be aimed at creating meaningful landscape mosaics consisting of habitat islands and abundant travel and dispersal corridors as mentioned early in this paper.

A Federal Interagency coordinating council empowered to guide regional land acquisition, disposition, and management is necessary to have life saving impact on dozens of endangered species. The purpose and role of the council would be to look at "the big picture" and work toward establishment of functional regional systems of preserves, parks, forests, refuges, wild and scenic rivers, recreational trails, and related interconnecting corridors. An example of a situation analysis from the Southeastern Coastal Plain involves the presently uncoordinated and sometimes competitive efforts of numerous State and Federal agencies. The 400,000-acre" Okefenokee Swamp in Georgia formerly extended south into what is now the 150,000-acre Osceola National Forest of Florida. The Okefenokee National Wildlife Refuge (NWR) managed by USDI / Fish and Wildlife Service does not, however, abut with the Osceola National Forest managed by the USDA / Forest Service. Linkage seems not only logical but may ultimately be essential in order to maintain a viable population of black bears. It is also the most likely release site for Florida panther should the south Florida population be recovered to a level that will support transfer or should captive-reared individuals become available. The Suwannee River is the major outflow from the Okefenokee that drains to the Gulf Coast. It was seriously considered as a Wild and Scenic River, but it now seems unlikely to gain this status. Nonetheless, interagency endorsement and coordination could virtually ensure its purchase as a Florida Area of Critical State Concern. If and when designated, it can connect the northern two areas (Okefenokee NWR and Osceola NF) with the new 57,000-acre Lower Suwannee River NWR. This refuge, in turn connects with the 5,000-acre Cedar Keys Scrub State Preserve which connects with the small Cedar Keys NWR in the Gulf of Mexico. Coordinated planning and effort can link these to the 31,000-acre Waccasassa Bay State Preserve, Lake Rousseau State Recreation Area (3,600 acres), Crystal River NWR, St. Martins Marsh Aquatic Preserve (20,000 acres), Chassahowitzka NWR (30,000 acres), and perhaps even Withlacoochie State Forest (113,000 acres).

The purpose here is not to suggest a shopping list for State and Federal acquisition but only to suggest that a complex system of parks, preserves, and refuges already exists and many uncoordinated and probably inefficient efforts are already underway. Many lands zoned as "agricultural" are affected and the southern rural character of tens of thousands more would be maintained if such conservation planning were coordinated. Streamside buffers, riparian forests, and swamps are the single best way to mitigate nonpoint source pollution from agricultural lands. Moreover, in the face of unrivaled human population growth, sunbelt agriculturalists are facing unprecedented competition for their land. Conservation easements should not be considered as competition when in fact they frequently represent safeguards against the competitive force. Integrating intensive agriculture into a large-scale mosaic of conservation preserves is the only alternative to low intensity land use if the wide-ranging wilderness species are to survive in the American Southeast.

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Dodge County Interagency Project to Enhance Wildlife Habitat on Farmlands

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ABSTRACT

The Dodge County Interagency Project was designed to improve wildlife habitat while reducing soil erosion and runoff into water bodies by motivating farmers to apply practicable wildlife habitat management and soil conservation measures on privately owned farmlands in western Dodge County, Wisconsin. The emphasis of the project is on reducing agricultural crop production costs and using cost-sharing and incentive payments to achieve multiple natural resource conservation objectives. This area traditionally had some of Wisconsin's best pheasant populations and prairie waterfowl production. Increases in critical habitat types for pheasants and prairie waterfowl production will be accomplished by modifying crop production practices, by diverting somewhat poorly drained or erosible croplands from crop production to wildlife habitat (wetland or grassland), and by protecting and improving the quality of existing noncropland habitat types. There is no technology in this project where short-term increases in crop yields are anticipated.

* * * *

In response to a steep downward trend in pheasant populations and prairie waterfowl production in Wisconsin, the Federal, State, and county level agricultural and natural resource agencies[1] established an interagency project to motivate farmers to apply practicable wildlife habitat management and soil conservation measures on privately owned farmlands in selected areas of Dodge County, Wisconsin. The primary goals of the Dodge County Project are to fulfill the habitat requirements of pheasants and prairie waterfowl and to protect long-term soil productivity (by reducing soil erosion) while maintaining reasonable farm profits or income for individual producers. The focus is on reducing production costs and using cost-sharing or incentive payments to achieve natural resource conservation objectives.

The Dodge County Project began in 1984 and will end in 1990. Field application of habitat development and soil conservation measures will be emphasized from 1985 through 1987. Wildlife habitat enhancement is directed primarily at pheasant populations and prairie waterfowl production with anticipated indirect benefits to other species such as cottontail rabbits and grassland nesting birds such as upland plovers, dickcissels, and bobolinks. The Dodge County Project will assess changes in the pheasant population and in waterfowl production that are attributable to the net gain in critical habitat types on treatment areas versus controls, It also will document gains in soil conservation, accumulate data on costs incurred by all agencies for benefiticost analysis, and assess any changes in landowner attitudes toward government agencies, the acceptance of conservation practices, and toward wildlife.

Previous research conducted by Gates (1970) in Wisconsin indicated that pheasants typically nest within 2 miles of traditional wintering sites. Therefore, minimal population management units can be circular units with a 2-mile radius centered on critical winter habitat types currently used by pheasants. Additional guide-

[1] Wisconsin Department of Natural Resources, USDA Soil Conservation Service, USDA Agricultural Stabilization and Conservation Service, University of Wisconsin Extension, USDI Fish and Wildlife Service, Wisconsin Department of Agriculture, Trade and Consumer Protection.

lines developed by Gates (1970) indicate that at least 5 percent of the land in each population management unit should be in high-quality nest cover that is not disturbed during the peak nesting period. Less than 1 percent of the management unit needs to have adequate winter food and cover for pheasants (usually shrub and tall emergent wetland vegetation in Wisconsin). For prairie waterfowl a guideline adopted from the Water Bank Program in Wisconsin provides about 4 hectares (10 acres) of high-quality upland nest cover for each hectare (2.5 acres) of permanent or semipermanent wetland capable of rearing broods. Limited information on differences in nest densities and success rates for specific cover types is currently available for Wisconsin.

Critical habitat (food or cover) types to be established or enhanced for pheasants include grassy-herbaceous nest cover secure from mechanical disturbance during the nesting peak (April thru July), winter cover to aid in the escape from predators and to minimize the effects of severe weather, and high energy grains available above the snow adjacent to the winter cover. The undisturbed grassy-herbaceous cover also is the preferred habitat type for nesting prairie waterfowl from April to July and thus can be used by ducks as well as pheasants.

Seeding of no-till winter wheat in small grain stubble is being empirically tested in cooperation with landowners. This method is new and relatively untested in Wisconsin in terms of effects on crop yields and nesting pheasants or waterfowl. No-till or reduced tillage for row crops will be encouraged as a soil conservation measure but, due to persistent snow cover on the ground, it cannot be relied on (in Wisconsin) to provide winter food for pheasants. Food patches or strips of corn will be left unharvested to provide winter food. Short duration grazing systems and converting parts of cool-season grass pastures to warm-season grasses for grazing in July and August will be attempted. These practices are also untested in Wisconsin, although Missouri and Iowa have been cost-sharing warm-season grass pasture establishment since about 1980. Incentive payments for no-till wheat, warm-season pastures, and unharvested corn strips will be offered.

Establishment of grassed waterways for soil erosion control combined with incentive payments to delay or otherwise modify mowing practices on these waterways will be attempted. Agreements will be sought to harvest selected hayfields in late June. Certain hayfields, due to their location and plant composition, are likely to have a disproportionate number of nesting pheasants and waterfowl. Landowners will be encouraged to divert established, eligible hayfields for soil erosion control and wildlife nesting under the 1985 USDA Acreage Reduction Program (ARP). Some also will be encouraged to plant winter food patches for pheasants on diverted ARP croplands.

Some wetland restoration on poorly drained croplands or impounding of surface water runoff in upland basins is being proposed. Conversion of some erodible upland row crop fields to perennial grassy-herbaceous vegetation (either with no harvest or with mowing and grazing limitations) also is being proposed. Whenever cropland is converted to a noncrop habitat type, annual compensation will be provided through 1990 by agreement with the Department of Natural Resources. Cost-sharing for conservation practice installation may be supplied by the Water Bank Program, by the Agricultural Conservation Program (ACP) or by agreement with the Department of Natural Resources.

Finally, an attempt will be made to enhance critical habitat types on selected noncropland sites. This will include altering emergent vegetation patterns in semipermanent wetlands, changing traditional roadside mowing practices to improve residual nesting cover, changing destructive grazing or burning of wetlands, and selectively removing trees to minimize raptor predation at wintering sites. The Department of Natural Resources will offer all landowners an optional lease for public hunting by permission for a payment expected to average about $1.00 per acre annually for the entire farm.

Cropland modification practices may result in slightly lower yields or quality of forage. Sometimes lower crop production costs offset yield reductions but, if not, incentive payments are designed to compensate the landower for the reductions. Agency cost-sharing will be used to reduce landowner costs for the application of conservation practices not related to crop production. Cropland enrolled in the Water Bank Program or converted to a noncrop habitat type will not be used to produce agricultural crops; its role is to provide critical noncrop habitat for wildlife.

The Dodge County Project planning efforts to date indicate that there is some potential benefit to wildlife in modifying the physiognomy of crops, the degree of tillage, and the timing or method of harvest. Project planning does not project short-term increases in crop yields from these practices compared to other agronomic alternatives available to the producer. The habitat benefits *per hectare* from crop modification also appear to be less than noncrop cover devoted to wildlife habitat as a primary objective.

While it maybe possible and certainly desirable to improve technologies to modify crop physiognomy or the timing of tillage or harvesting to meet the critical habitat needs of target wildlife species in the future, current wisdom indicates that not all cropland now in production is needed to meet the domestic and export food and fiber needs of the Nation.

The greatest wildlife habitat benefits at the least cost are still likely to be obtained by enhancing habitat quality on existing noncropland sites. In many locations, however, the habitat type (terrestrial or aquatic plant community) cannot be easily or inexpensively altered to meet critical habitat needs of important species in short or declining supply. Cropland diversion under an expanded Water Bank Program or multi-year cropland diversion under ARP (with undisturbed grassy-herbaceous cover required) would appear to meet the critical habitat needs of farmland wildlife better than currently available technology to modify crop production.

Agricultural producers appear to be most strongly motivated by economic self-interest. Considerably more Federal tax dollars are spent on price support loans and deficiency payments than on conservation programs (ACP). Most agricultural producers do not benefit financially from wildlife or wildlife habitat and they sometimes suffer crop depredations or increased costs for animal damage control or abatement. Thus, wildlife does not compete economically with the alternative of growing agricultural crops, especially on the better soils. Wildlife has been and continues to be primarily a byproduct of farmland use. To increase or restore wildlife abundance habitat management technologies must either produce very great increases in survival or recruitment on relatively small areas, + * 4,000 hectares (10,000 acres), or they must produce smaller percentage increases over a very large area (thousands of square kilometers).

The Dodge County Project seeks big increases in survival or recruitment of pheasants and ducks over small areas through relatively intensive management, affecting a variety of habitat types and their juxtaposition. The Water Bank is a program administered by USDA that could be broadened and expanded to apply Dodge County technologies directly. The Water Bank Program is relatively expensive but intensive wildlife habitat management affecting very small units of range also has many other indirect public benefits attributable to wetlands (Linder, et al., 1984).

Applying Dodge County Project technologies to very large areas of range would result in greater dispersion of critical habitat types (less intensive management) and, therefore, would produce smaller increases in wildlife population survival and recruitment per unit of area. However, USDA multi-year cropland diversion programs have the potential for increasing farm wildlife populations substantially over very large areas, including those where erosion rates generally are less than twice the soil rebuilding value (T).

One basic goal of the 1985 Farm Bill should be to achieve long-term soil conservation benefits and reduce crop surpluses with wildlife habitat enhancement included as a primary or secondary objective. Multi-year diversion of croplands seeded to perennial grasses and legumes that are not harvested or grazed would be fundamental. Provisions to allow wildlife food patches on diverted croplands where soil erosion risks are low also should be provided. Ideally for wildlife, grass-legume fields would not be disturbed for 3- to 5-year periods.

Assuming that the United States can afford to set aside 13.8 million hectares (34 million acres) annually, which it has done for the past 25 years (Berner, 1984), at least some percentage of that should be diverted annually (for 3 to 5 years on a given acreage) until feed grain and wheat production when added to reasonable reserves reaches the desired level. Farmers would benefit because it would tend to stabilize prices and enable longer range planning. Taxpayers would benefit if only because soil conservation and wildlife benefits would be markedly greater than those realized under annual programs that ranged from nothing in set-aside to 32.6 million hectares (80.6 million acres) under the 1983 PIK program. Farmland wildlife does not require that the same fields be kept undisturbed more than 3 to 5 years as long as replacement fields come on line with residual nest cover before the original diverted fields are brought back into crop production. In fact nesting cover quality and production by ground-nesting game birds may benefit from shifting dedicated nesting cover sites at least every 5 years (Frank, 1984). Agribusiness also may prefer to have 5 percent of cropland set aside annually until it reaches 15 to 20 percent of all cropland over a 3- to 4-year period so they can adjust gradually to a reduction in sales of seeds, fertilizer, and pesticides.

Broadening the Water Bank Program concept to keep critical noncropland habitat types from being converted to cropland and diverting larger acreages of adjacent cropland to provide other critical habitat types could maximize wildlife benefits while accomplishing acreage reduction as a fringe benefit. It would also be possible to target cropland diversion to the fields with the greatest soil erosion potential on each farm and to select perennial plant materials that provide habitat types in short supply for important species of wildlife present in the vicinity.

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An Educational Approach to Increase the Production

The greatest opportunities to improve forest management on private nonindustrial woodlands are through programs which address the goals and objectives of those who own the land, not through policy mandates to increase timber production. Many recent studies have shown that people own woodlands for a number of different reasons, most of which are not oriented toward the production of timber (Weiseman, 1983; Kingsley, 1977). Tree farmers, owners of large wooded tracts, and others who harvest timber periodically, almost always have ulterior motives which compel them to manage their lands. In Vermont, woodland owners who have been asked to evaluate our Extension forestry programs say that, even though enhancing timber values is an important objective, wildlife habitat values rank high as well.

FOREST MANAGEMENT: WHAT DOES IT MEAN?

Many woodland owners have been led to believe that forest management means, exclusively, timber management. Indeed, our public agencies, with a mandate to provide forest management services and information to woodland owners, must use tangible production units—thousands of board feet, cords, and tons—as a measure of program accomplishment. Yet if one asks woodland owners why they own land, a probable response is distinctly different from what one might expect. They own land as an investment, or for recreational purpose, or simply because it is part of their residence; some reason which is completely other than that for which we offer publicly supported assistance programs—to increase timber production.

The number of private nonindustrial woodland owners and the share of land in America which they control is staggering. Fifty-eight percent of the Nation's 487 million acres of productive forestlands (as defined by capability to grow wood products) is owned by nearly 7.8 million landowners. Together, nonindustrial private owners account for 47 percent of the timber harvested in the country. This timber helps support an industry that employs 1.8 million workers who collect an annual payroll of $22.9 billion. Total value added by U.S. forest products industries is estimated to be $52.5 billion (Extension Council on Policy, 1984; office of Technology Assessment, 1983).

Yet, according to the same sources, wood production from private nonindustrial woodlands is less than half of the potential. Possibly this is a result of a misconception on the part of millions of private owners, that harvesting timber for the sake of wood production is not compatible with their interest in other forest values, such as wildlife habitat, personal recreation, and esthetics. This, coupled with the fact that most woodland owners do not depenal on their forests as a principal source of income, underscores the need for a more holistic, objective-oriented approach to forest management. Foresters, both public and private, have oversold the need for timber production and as a result may be missing opportunities to manage forestland.

Virtually all management objectives except to hold land undisturbed—as a natural area—will result in the production of timber. Whether or not timber production is a primary use of forestland is unimportant; and objective-oriented approach to forest mangement, coupled with the economic realities of forest ownership (carrying charges for the land–primarily taxes) will result in the production of timber.

There is good evidence, however, for a shift away from timber production as a high-priority benefit from private woodlands. Although wildlife populations have been increasing in recent years, there are indications they have not been rising as rapidly as demand (USDA Forest Service, 1984a). The number of small game animals and upland game birds bagged per hunter has been declining throughout the country. Furthermore, recent data have shown existing supplies of timber to be more plentiful than was predicted to be the case (Crowell, 1984). Secretary Crowell states further that " . . . people have come to realize that if there is a timber supply problem it is partly one of oversupply. " In spite of this, Federal forecasters still predict a shortfall of timber supply within the next 50 years (USDA Forest Service, 1984 b). A near deemphasis of timber for the sake of other forest values, particularly wildlife habitat, may improve the posture of private woodlands to produce timber in the future.

Despite adequate timber supplies in most regions of the country, and oversupply in some areas, foresters still have a compulsion to convince woodland owners of the importance of one objective over another—usually income production from immediate timber sales. Should we impose our view of what forest management is on woodland owners? A major premise of this paper is that we should not. Forest management is something more than timber management; what it is, or should be is something defined by the owner. Education of private nonindustrial woodland owners, as to the range of potential forest management opportunities, and the consequences, may be the most cost-effective catalyst to increase forest productivity—for timber, wildlife, and other important natural resources. Furthermore, an educational process which recognizes the value of peer groups for diffusion of innovations may be the most socially viable (Rodgers, 1983).

COVERTS PROJECT: AN EDUCATIONAL APPROACH TO FOREST MANAGEMENT

The Extension Services at the University of Vermont and University of Connecticut are involved in a special 3-year educational effort, which is supported through a grant from the Ruffed Grouse Society, called the Coverts Project. The main purpose of the project is to encourage woodland owners to manage their forests. Philosophically, the project is founded on the premise that forest management decisions should be based on two things: first, the owner's goals and objectives for the land; and second, the ability of the land to provide a mix of benefits which are in proportion to the owner's objectives. Since wildlife interests are high in New England, we are focusing on multiple-purpose management that includes wildlife; particularly grouse, woodcock, turkey, and deer, as well as other game and nongame species.

The principal objectives of the project are to establish four demonstration sites in each State which can be used to show good forest management practices for wildlife, timber, and other resources; and secondly, to provide intensive training to a corps of woodland owners who will, in turn, become sources of information in their communities.

In the Coverts Project, demonstration sites will be the fabric of our approach to teach woodland management practices. It is significant to note, however, that the sites will demonstrate a manifestation of the cooperators' objectives, rather than a range of different kinds of practices that may be applicable to a situation. We do not intend to argue the virtues of one practice over another; each will be prescribed in accordance with the owner's objectives and the capability of the land to meet those objectives. Unfortunately, our level of funding and time commitment to the project is such that we will not be able to measure and document site response. We are hoping that the millions of dollars and thousands of scientist-years, devoted to testing the merits of one practice over another have given us a reliable enough base from which to make prescriptions. The innovation of the Coverts Project is its approach to education, not research of forest management practices.

Some of the practices that we will emphasize on the demonstration sites include: strip clearcutting to regenerate spruce and fir in deer yards, small patch cutting to regenerate decadent aspen clones in mature northern hardwood stands, clearcutting to create structural diversity to aspen stands, timber stand improvement for high-value timber production, single-tree and group selection for timber and mast, shelterwood regeneration of oak-hickory and northern hardwoods, day-lighting of forest access roads, open field maintenance and forest edge softening, and other practices. The most important aspect of these practices is that we anticipate only a minimal timber production trade-off in stands for which the primary objective is wildlife.

The key issue, though, is that the overall gain in timber productivity for a tract of land will probably far exceed the trade-offs for wildlife. A case in point would be the owner who avoided management altogether because he or she believed that the only forest management opportunity was for timber. By advocating forest management for values other than timber, we can anticipate long-term gains in forest productivity (capability of the land to supply multiple benefits—not just wood products), especially since the tangible values of management—prices paid for standing timber—are expected to increase as well (USDA Forest Service, 1984b). Although I want to avoid the cliche that nearly every forester leaves college with, that "good forestry is good wildlife managemerit, " if we want to increase timber production we should promote the inverse of it—"good wildlife management is good forestry. " It is equally arguable and indefensible, but most Americans would agree. Public opinion polls commissioned in recent years by the American Forest Institute consistently showed that Americans rank wildlife as one of the most important users of our forests (Yankelovich, Skelly, & White Inc., 1982).

The technique of training Extension clients who, in turn, provide information to others is not new (Fletcher, et al., 1984). This approach is the main theme of the Coverts Project. Although we do not expect to make experts of our students in 3 days, we do hope that they will be able to respond to requests for information more than half of the time. Furthermore, through careful selection of our students, we hope to identify individuals who are opinion leaders among their peers; people other woodland owners can look to for advice and assistance. We believe that a local source of information from a peer group member is more likely to be acted upon by the client. our quasi-Extension agents presumably will not have professional or agency instilled biases that most natural resource managers either overtly or subliminally communicate to their clients.

We are now in the process of developing the selection criteria for our students. A graduate student in the Natural Resource Planning Program at the University of Vermont (UVM) is exploring methods to choose opinion leaders. He is reviewing literature on psychology and sociology in an attempt to define the characteristics of the kind of opinion leader we're looking for. Interestingly, well-defined peer groups, like doctors and farmers, act more readily on information from their peers than from expert sources. Possibly, woodland owners are more likely to try practices that their neighbors advocate, practices which they can see on their neighbor's land as opposed to those which a specialist might propose.

What kinds of people are we looking for? They must have an interest in forest management and be willing to implement habitat and timber management practices on their lands. They also must have the time to share information with others in their community. Above all, they must be good, effective communicators—people who can inspire and encourage others to manage their land. We're asking these people to actively share their experiences with others, to demonstrate that forest management is a means of achieving their ownership objectives.

Will it work? The success of our project hinges mostly on our ability to accurately evaluate candidates. We are looking for people who are or have the potential to be opinion leaders. They must be committed to helping others manage their woodlands. we don't expect them to go home and wait for the phone to ring, nor do we expect them to start a crusade. We do, however, intend to let people know they exist and will encourage woodland owners to contact them. We also are hoping that our leaders will become familiar with the local media and be inspired to write an occasional article. Ultimately, we're hoping that our quasi-Extension agents will become a unique part of the web of public and private human resources available to woodland owners.

A second graduate student at UVM will study the relationships that develop between our leaders and others in the community. We're most interested in discovering the ways in which our leaders provide information, whether or not people act on the information, and how they are perceived by others, particularly natural resource managers and users (loggers). Furthermore, we want to evaluate our ability to select opinion leaders. This will allow us to refine the process in the future, and may tell us a great deal about how to target Extension programs and improve our efficiency.

RECOMMENDATIONS

Although education is considered to be a cost-effective means of providing public assistance to private nonindustrial woodland owners, we do not fully understand the impacts of education and the extent to which woodland owners use new information for management decisions. It will be increasingly difficult to justify a program because we know it is good, when we cannot say why; public education programs, like Extension, need to critically evaluate their effectiveness. An analysis of education versus other approaches to public assistance for woodland owners, such as cost-sharing and technical assistance, is in order.

The efficiency and effectiveness of education programs may be substantially increased through the training and use of private woodland owners who serve as local sources of information for other members of their peer group. Many private woodland owners are at or near retirement age. Serving as an advocate of forest management in their communities is likely to appeal to many of them. At a time when public program cost efficiencies are carefully scrutinized, a public-private partnership approach to forest management educational assistance may be more politically viable.

Woodland owners, who have not previously managed their lands, may be avoiding management because of a misconception—which resource managers may be responsible for fostering—that forest management means timber management. Furthermore, they may incorrectly view management alternatives, such as for wildlife or recreation, as inherently incompatible with timber. Public assistance programs should use an objective-oriented approach to management which considers an informed landowner's goals as the first and foremost determinant of how his or her forests will be managed.

Public agencies that provide forest management assistance to woodland owners need to develop meaningful accomplishment criteria to recognize efforts that create nontangible benefits from private forest lands.

Finally, the Renewable Resources Extension Act (RREA) (Public Law 95-306), a 10-year authorization allowing Congress to allocate up to $15 million annually for expanded Extension natural resources programs, has been funded only three times at a level of $2 million since 1979 (fiscal years 1982, 1983, and 1984—the fiscal year 1985 request is for $2.5 million). The Act encompasses an objective-oriented educational approach to multiple-use management on private nonindustrial forests and rangelands. The 1985 Farm Bill should extend the sunset clause of the Act. It should also reauthorize funding to the original $15 million level or more. Full funding of the program can be reached in annual increments of $2.5million—e.g., $5.0 million in fiscal year 1986, $7.5 mil1ion in fiscal year 1987, $10.0 million in fiscal year 1988, $12.5 million in fiscal year 1989, and full funding in fiscal year 1990, maintaining at least this level thereafter.

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Economics of Joint Production of Agricultural Commodities and Wildlife

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ABSTRACT

Allocation of a fixed resource (land) between competing uses is discussed from a production economics perspective. Competitive, complementary, supplementary, and joint production possibilities functions are developed relative to amenity and agricultural outputs. An empirical example of conservation tillage in North Dakota shows that certain soil conservation practices also can increase farm revenues. Policies for affecting changes in agricultural production practices to accommodate amenity resources include market processes, regulation, social pressure, and government provision. Implementation of appropriate technologies and policies (institutional change) can promote production of amenity resources on private lands.

INTRODUCTION

Few agricultural management schemes are designed with any intention to maintain a habitat for wildlife. In most cases the components of a wildlife habitat occur by accident in areas that are difficult to till, that are too wet, or whose inclusion in fields devoted to row crops could not be achieved efficiently (National Research Council, 1982].

A "more is better" philosophy predominates the production of agricultural commodities and natural amenities, yet the resources to produce these goods are limited. Exacerbating the problem is the competition between agricultural and amenity goods for the same primary resource, land The purpose of this paper is to briefly discuss the fixed resource allocation problem, review policy instruments to ameliorate resource allocation controversies, and present an empirical example of a complementary relationship among soil conservation and agricultural production.[1]

[1]Alt, et al. (1981), provide an excellent discussion of the effect of potential conservation measures of the 1981 Farm Bill on agricultural production.

CONSERVATION AND PRODUCTION AGRICULTURE

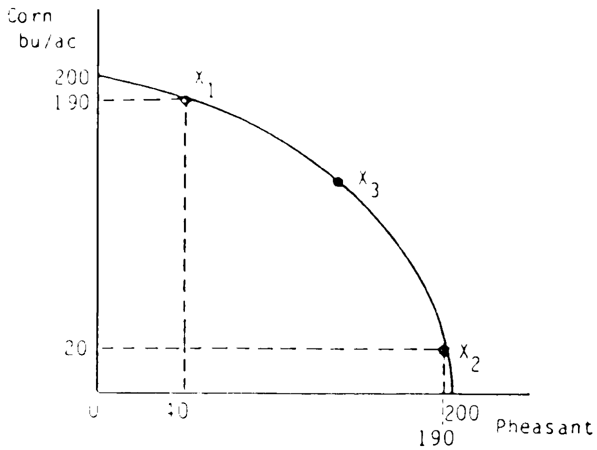
A free market economy oriented toward conversion of resources into commodities provides little incentive to the landowner to produce or protect wildlife and amenity resources. Private returns to agricultural production accrue to landowners, while most benefits of soil conservation, wildlife habitat maintenance, and wetland preservation accrue to society. Only the most altruistic landowner will produce public benefits at the expense of personal gain. "Farmers tend to hold very positive attitudes toward profitmaking, a strong motivating factor for them to employ agricultural practices that erode land resources" (Cotner and Halcrow, 1982). Even though social values of soil conservation, wildlife habitat maintenance, and wetland preservation are well-documented (OTA, 1984), there is only so much an individual is willing to sacrifice for society. ". . . Men will not cooperate indefinitely (provide public goods) when the incentives are limited to social rewards. . . . Human beings do not feel willing to provide for those who do not do their share in production unless they receive material rewards rather than moral ones" (Dailey, 1984).

Several questions need to be answered to successfully integrate amenity and agricultural commodity production on private lands. What is the technical relationship between production of agricultural commodities and amenity resources? What technical and economic trade-offs are involved? Do appropriate technologies exist? How could institutions better accommodate implementation? The contemporary constraint is as much institutional as technological (Ciriacy-Wantrup, 1971). Some technologies exist to integrate agricultural and wildlife production (e.g., Nason, 1982; Bryant, 1982; Hanway, 1982; Stormer and Guthery, 1982). A production economics paradigm illustrates the issues and helps to suggest answers to these questions.

Theoretical principles of the optimum combination of two (or more) competitive uses of a fixed resource (e.g., land) are well developed. The case of recreation and agriculture has been discussed by Pearse (1969). A generalized production possibilities curve depicts usage of a fixed input among two outputs (figure 1). Starting with 200 bushels of corn and zero pheasants, 40 units of pheasant production can be accommodated with little reduction, 10 bushels, in corn production, point X_1. However, at the other extreme (point X_2) a larger amount of corn production (20 bushels) is given up for only a small gain in pheasant production (10 units). In the central area, X_3, there is approximately a l-to-l trade-off.

At least four different production possibilities scenarios can be developed relative to production of agricultural and amenity resources: l)competitive, 2) complementary, 3) supple-

Figure l.—The Production Possibilities of Two Products Using One Acre of Land

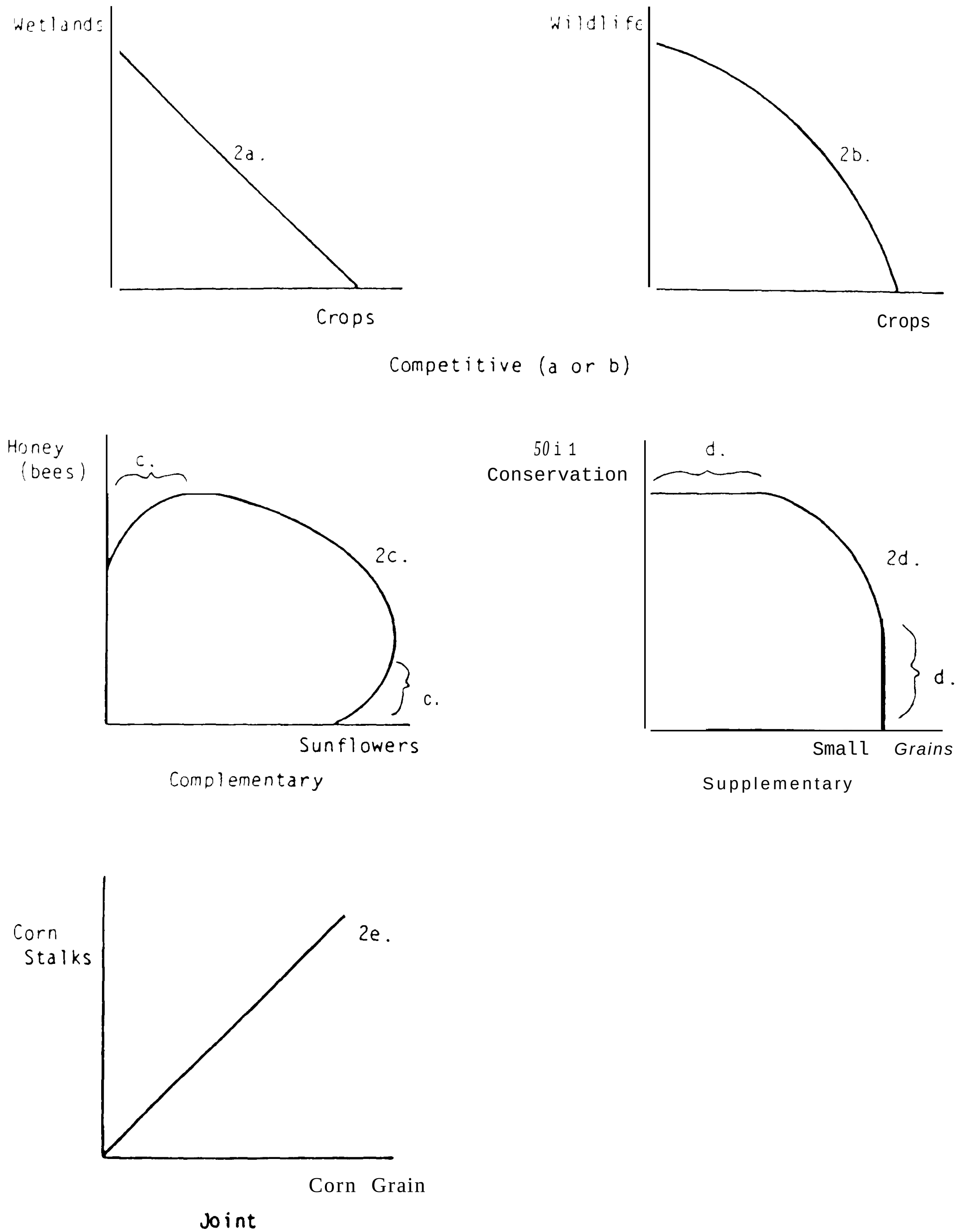


mentary and 4) joint products. A competitive scenario is typified by wetland preservation and row-crop production. A l-hectare increase in land used to produce row crops results in a l-hectare decrease in wetlands and vice versa, represented by a linear production possibilities function (figure 2a). This relationship may not be a precise l-to-l trade-off, since one hectare of wetland may reduce crop production by more than 1 hectare due to equipment logistics or perimeter salinity.

A subtle difference may occur in the trade-off between wildlife and row-crop production from the previous example (figure 2b). While competitive, a l-hectare increase in crop production may not reduce wildlife production by one full increment because crop production will provide some food for wildlife to partially offset the reduction in habitat.

A complementary relationship is illustrated in figure 2c. In this example, the two segments of the curve labeled "c" represent the situation where both products can be increased simultaneously. An example of this relationship is honey (bees) and sunflower, where sunflower will increase honey production and bees will increase sunflower production. Another example is deer and timber. The new growth after logging can increase deer carrying capacities per acre with little effect on forest regrowth.

Figure 2.— Production Possibilities Functions for Selected Joint Products



An example of a supplementary relationship is soil conservation and crop production (figure 2d). If one starts at the lower, right-hand segment "d," soil conservation (reduced soil loss) can be increased through improved production systems without reducing agricultural production or profit (figure 2d). Empirical evidence of this will be presented later.

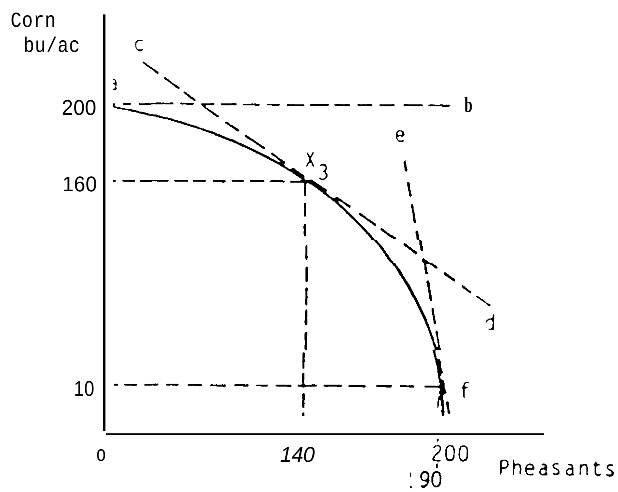
The final set of relationships between two products can be illustrated by corn production, where grain and corn stalks are produced as a set. Products are produced jointly (figure 2e); however, only one may have value to society or to the individual property owner.

Each of these production situations calls for different policy solutions to achieve production of amenity goods. Competitive production is the strongest argument for public transfer payments to private landowners since a socially optimal number of wetlands, for example, will be greater than that determined by market forces (Krutilla and Fisher, 1975). Complementary production requires economic incentive only after the complementary effects are exhausted. Joint products require only education, since uses do not compete for resources. Supplementary products require education to achieve low levels of amenity resource, technology for higher levels, and financial incentives for even higher levels. Soil conservation, for example, has been demonstrated to add only marginally to net private income, yet substantially to net social income (Swanson, 1978).

TRADE-OFFS

Incentives—monetary, moral, or legal—to increase amenity output on private lands would change the relative quantity of amenity and agricultural production (figures 1 and 2). When there are no private returns to production of amenity resources, such as pheasants, on land capable of producing crops, the private owner would produce at the point of maximum crop output. with a low monetary return to production of amenity resources (pheasants), say a fifty-cent per hectare property tax credit, the trade-off shifts slightly toward pheasants (point X_1 figure 1). However, if a return to amenity production approximating the return to crop production were present, the optimum combination would be at point X_3. These value combinations can be thought of as trade-off lines which identify the optimal mix of outputs that maximize return to the landowner. Line ab (figure 3) shows a positive corn price and a zero amenity price and that the owner would maximize his private return if all of the input (land) is used to produce corn. Line cd (figure 3) shows a balance in value of corn and amenities and that 160 bushels of corn production and 140 pheasants would maximize private return to the land resource. Line ef indicates that producing 10 bushels of corn and 190 pheasants would maximize private return. The trade-off lines reflect the economic returns and personal satisfaction to the landowner under different assumptions regarding his alternatives.

Figure 3.— Economic Trade-Offs and Production Possibilities



The significance of the situations presented in figures 1, 2, and 3 is that technology determines the shape and location of the production possibilities frontier, while institutions determine prices and therefore the slope of the trade-off line. Both technology and institutions are thus significant in influencing optimal uses of land from a private landowner's perspective.

SOIL CONSERVATION: AN EMPIRICAL SEST

Traditional farming in western North Dakota is a fallow-durum rotation with conventional cultivation tillage to maintain a barren surface during nearly 20 months between durum crops. This system is based on cultivation as a means of weed control and fallow to gain additional soil moisture to stabilize durum yields. Twenty-one of twenty-two farmers in a 20,000-acre watershed used this farming system (Nelson, et al., 1984),

A computer simulation model, based on a 1-hectare (2.5-acre) cell and using the Universal Soil Loss Equation (USLE), was used to estimate the impact of alternative farm production systems on soil erosion and farm income. The conventional fallow-durum rotation yielded annual revenue above cash costs of $67.93 per hectare ($27.49 per acre) and an average soil loss of 24.21 metric tons per hectare (10.8 tons per acre) (table 1). The threshold level above which long-term productivity effects are negative is 11.21 metric tons per hectare (5 tons per acre).

Several alternative systems resulted in higher profit levels and lower levels of soil erosion than the traditional system. The long-term impact would be even more beneficial from environmental and economic viewpoints. This is similar to the complementary relationship between two products illustrated in figure 2c. Both products, revenue, and soil conservation, are increased simultaneously.

There was a more dramatic impact on Class VI (highly erosive) land. The traditional system annually yielded 71.73 metric tons (32 tons) of soil loss and a net revenue of – $0.52 per hectare (-$0.21 per acre). Transfer of this land to pasture increased expected net revenue to $15.69 per hectare ($6.35 per acre) and reduced soil loss to 5.94 metric tons per hectare (2.65 tons per acre). A comparison of this value $15.69 ($6.35) to the negative revenues of cropping Class VI land identifies a potential solution: converting all Class VI land back to rangeland. However, conversion to rangeland is often not feasible because much of the Class VI land is in small areas, intermingled with other cropland. These areas have no water supply and would involve a high cost per hectare to construct fences. It would appear feasible to convert cropland to pasture only in those areas where it adjoins existing rangeland or when there is a sufficiently large area of Class VI land to justify the cost.

An alternative for small, isolated areas of Class VI land is conversion to wildlife habitat.

Table 1.—Annual Soil Erosion and Net Revenue on Cropland for Alternatives Crop and Soil Management Systems in the Market Lake Watershed, Mountrail County, North Dakota

Crop and soil management system[s]	Weight average for all soils: Soil loss metric tons/hectare	(tons/acre)	Profit[b] $/hectare	($/acre)
No conservation:				
F-D	24.26	(10.82)	67.93	(27.49)
F-D-WW	18.23	(8.14)	67.01	(27.12)
F-D-WW-SFL	22.02	(8.93)	83.00	(33.59)
D-WW-SFL	12.16	(5.43)	79.07	(32.00)
Conservation—no till:				
F-D-SFL (Z)	21.68	(9.68)	90.36	(36.57)
D(Z)-WW(Z)-SFL(Z)	7.73	(3.45)	82.70	(33.47)
Conservation—no-till contour strip:				
F-D-WW(Z)	8.36	(3.73)	63.70	(25.78)
F-D-SFL(Z)	10.44	(4.66)	85.77	(34.71)
F-D-WW(Z)-SFL(Z)	8.51	(3.80)	81.47	(32.97)
D(Z)-WW(Z)-SFL(Z)	3.76	(1.68)	78.11	(31.61)

[a]F = fallow, D = durum, WW = winter wheat, SFL = sunflower, and Z = no-till.
[b]Return to land, overhead, risk, and management.

The North Dakota Game and Fish Department has an upland game habitat program to lease small areas for nesting cover and winter protection for wildlife. The upland game habitat program is limited to 8.1 hectares (20 acres) per section and requires cropland to be seeded to an alfalfa-grass mixture and not to be used for livestock grazing or hay. The contract is for 6 years with annual payments varying from $52 per hectare ($21 per acre) for Class II and III land to $17 per hectare ($7 per acre) for Class V, VI, and VII land. Also, it must be open to the public for hunting. Cost-sharing through the ASCS and the North Dakota Game and Fish Department has generally been available to reduce farmer costs of conversion to grassland. This use of Class VI land could be an effective way to reduce soil loss while maintaining a profitable use of the land.

Technology is providing a solution to the soil loss-revenue trade-offs for average land in the watershed. New crops and tillage equipment have shifted and changed the shape of the production possibilities curve. The public sector needs to be involved in continued research and in education to promote adoption. For highly erodible land, Class VI, technology needs an assist from the public sector to change the trade-off line between soil conservation and revenue. A transfer payment is needed to stimulate change,

POLICY INSTRUMENTS

Several policy measures have been suggested that would achieve higher levels of amenity resources concomitant with agricultural production. There are four general types of public policy instruments: 1) market processes, 2) regulation, 3) social pressure, and 4) government provision (table 2) (Baumol and Oates, 1979),

"Environmental policy is long on good intentions, and short on consistent, workable, reasonable regulations" (Libby, 1979). Implementation and subsequent success of public policies hinge on a number of related factors.

Table 2.—Policy Instruments

Type	Examples
Market processes , ...	Payments to producers
	Taxes on nonproducers
	Tax structure accommodation
Regulation	Prohibition
	Control by permit
Social pressure	Public information campaigns
	Understanding attitudes
Government provision. .	Research and technology change

Market incentives or subsidies work when funds are available to provide incentives (e.g., Duck Stamp Program, Water Bank) and when property rights (to the inputs required for amenity production) are held privately. Sidle (1983) has shown support and enforcement are sometimes needed to ensure compliance after payment of incentives. Taxes and charges work when enforcement and measurement are feasible. Miranowski (1978) found a soil loss tax to be the least costly method for achieving soil loss reductions. Stromstad (1983) argues property tax exemptions and credits could be successfully used to maintain prairie wetlands. Income tax provisions can work well when land management changes are significant and when landowners have other than minimal tax obligations. Government regulation works when property rights are held de facto by society and enforcement is feasible, Social pressure (moral suasion) works in time of crisis (e. g., brown outs, water shortages) or where the issue is merely one of information shortages or technology adoption that can be ameliorated by education.

PAST PR0GRAMS

Public programs to preserve, conserve, or enhance production of amenity resources on private lands historically run the gamut from strict prohibition to monetary payments. Federal programs to conserve soil, preserve wetlands, maintain wildlife habitat, and preserve endangered species' habitats have relied on economic incentives, regulations, and social pressure. The history of wetlands preservation typified the changing public role in regulating amenity resources. Several excellent policy and program references are available (Kusler, 1983; OTA, 1984).

CURRENT EMPHASIS

Sodbuster-type legislation that forces consistency with public conservation goals is currently receiving considerable attention. Much concern has been expressed about the role of governmental agricultural commodity programs in contributing to soil erosion (USDA, forthcoming), Recent studies have questioned cross-compliance for soil erosion control on both equity and efficiency grounds (Ervin, et al., 1984; USDA, forthcoming).

IMPLICATIONS FOR POLICYMAKERS

Since the problem of integrating amenity resources and agriculture is both institutional and technological, policy makers should concern themselves with institutional constraints and technological change which can significantly affect choices available to the private decisionmaker, Each policy measure can potentially work for specific resource issues; none works for all. The most serious policy constraint will be tying the appropriate policy instruments to specific resource management objectives. Technological change can be brought about through both public and private research and development programs. But, since the results are typically public goods (knowledge) with implementation leading to increased production of amenity resources, little can be expected from private sector innovations in this area. The major responsibility for research leading to technological change favorable to amenity resources will continue to be the Federal Government.

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The Impact of USDA Programs on Fisheries and Wildlife[1]

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ABSTRACT

This paper is a brief analysis of major USDA programs that impact fish and wildlife habitat. If fish and wildlife are to benefit from "Farm Programs" and USDA policy, commodity and conservation programs need to be more closely and effectively linked. Traditional conservation programs of research, extension, financing, and technical assistance have not been able to offset the continued decline of fish and wildlife habitat on the farms, ranches, and forests of the Nation. The 1985 Farm Bill offers a timely opportunity to improve conservation and fish and wildlife objectives.

[1]This paper relies heavily on the most available data and studies done related to agriculture and wildlife concerns: 1980 *Appraisal Part I and II—Soil, Water, and Related Resources in the United States: Analysis of Resources Trends* and *Impacts of Emerging Agricultural Trends on Fish and Wildlife Habitat.*

WILDLIFE HABITAT AND AGRICULTURE POLICY

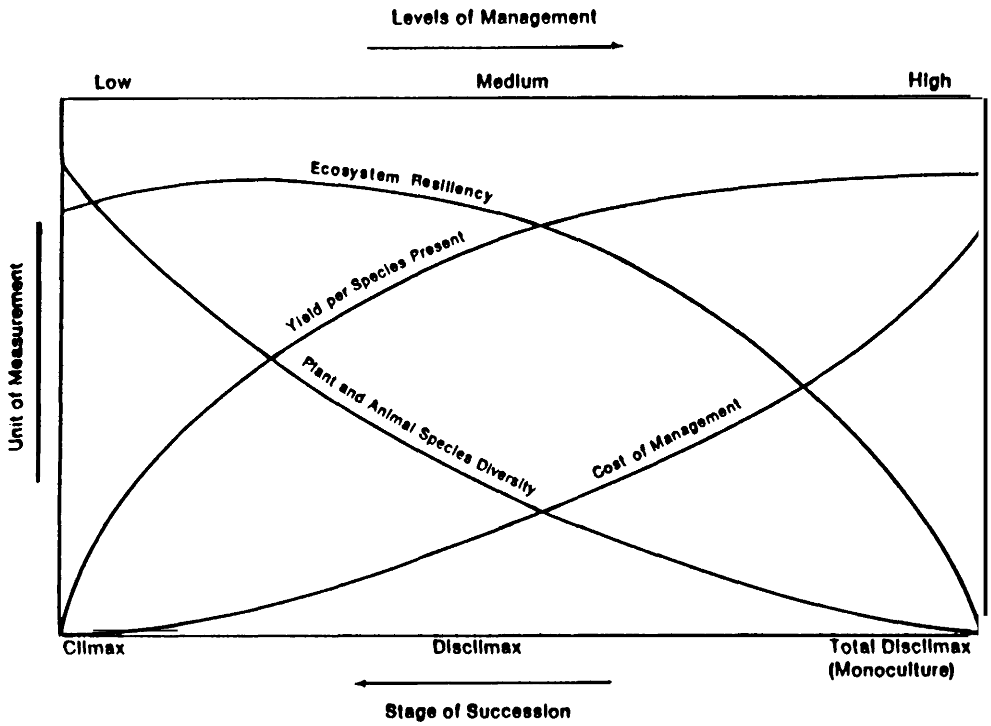
Fish and wildlife are very important economic, esthetic, ecological, recreational, and scientific resources. Unusual changes in the numbers of fish and wildlife are often indicators of the general health of the environment and the quality of life for people. The Nation's 520 + million hectares (1.3 billion acres) of non-Federal cropland, rangeland, and forested land provide needed habitat for about 3,000 species of birds, fishes, reptiles, and amphibians.

All land has the capability or potential to produce and sustain wildlife, subject to a variety of factors both natural and manmade. These factors include climate, soil characteristics, and the use of the land itself, which in turn affect other factors such as plant communities, their stage of succession, and the proximity of one plant community to another. This is depicted in figure 1—the effects of different management levels on the successional stages of an ecosystem. Climate and soil characteristics are natural limiting factors that cannot be altered greatly, but can be affected to a degree by the actions of people, For example, construction of dams and reservoirs can provide water where none existed before and thus can benefit fish and wildlife. Also, irrigation can cause substantial changes in the habitat. However, these manmade changes require maintenance to prevent reversion to the former conditions.

Some land uses, such as urban development, are mostly incompatible with wildlife habitat, whereas others including agriculture can be complementary. Although wildlife may benefit from land used for agriculture, the primary land use (agriculture) will determine the lands effectiveness for the secondary use (wildlife habitat).

Historically, U.S. agricultural policy has been both beneficial and destructive to the fish and wildlife resource. In the conservation-minded 1930s and 1940s, incentives for establishing shelterbelts, windbreaks, and contoured strips enlarged wildlife habitat. In the 1950s, USDA's Soil Bank Program established excellent cover for "wild living resources" on about 8 million hectares (20 million acres) of the cultivated cropland not needed for wheat and corn at that time. However, in the 1970s the Federal Governments' push for farm production led to "fencerow to fencerow" cropping that elimi-

Figure 1 .—The Effects of Different Management Levels on the Successional Stages of an Ecosystem



nated much of the good habitat that was created through conservation, land set-asides, and reserve commodity programs. Too often in recent years farm policy for commodities and for conservation have run on separate tracks and at times have even run in opposite directions. Fish and wildlife habitat has not been a high priority in the formulation of farm policy.

The 1982 National Academy of Sciences report found that agricultural practices have large impacts on habitat. The report concluded that fish and wildlife values must be considered along with the value of productive agriculture. It recommended that these values can be brought into better balance through improved planning, consistent policy, and appropriate incentives to landowners. Now that we know what problems have impacted fish and wildlife, their impact also should be analyzed as to the effect on habitat.

SOIL AND WATER CONSERVATION PROGRAMS

Table 1 shows the USDA Soil and Water Conservation Programs and their authorizing legislation. Under the Soil Conservation and Domestic Allotment Act (Public Law 74-46), the Soil Conservation Service (SCS] was established to provide national leadership for soil and water programs. The broad purpose is to:

- improve and conserve soil and water resource quantity and quality,
- improve agriculture, and
- reduce damage caused by floods and sedimentation.

SCS provides technology transfer through local entities to landowners, communities, watershed groups, Federal and State agencies, and other cooperators. SCS activities that can impact fish and wildlife include:

Table 1.—USDA Soil and Water Conservation Programs and Their Authorizing Legislation

Authorizing legislation	Flood management	Land reclamation	Water suply	Timber productivity	Watershed protection	Wind erosion	Pasture, range productivity	Water quality	Waste management	Irrigation water management	Drainage	Cropland productivity	Habitat development	Outdoor recreation
Public Law 74-46 Soil Conservation and Domestic Allotment Act	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Public Law 83-566 Watershed Protection and Flood Prevention	x		x	x	x	x	x	x	x	x	x	x	x	x
Public Law 78-534 Flood Control Act of 1940	x		x	x	x	x	x	x	x	x	x	x	x	x
Public Law 81-516 Flood Control Act of 1950					x									
Public Law 87-703 Food and Agriculture Act of 1962	x		x	x	x			x	x	x	x	x	x	x
Public Law 84-1021 Amendment Soil Conservation and Domestic Allotment Act	x		x	x	x	x	x	x	x	x		x	x	
Public Law 92-419 Rural Development Act of 1972	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Public Law 95-217 Clean Water Act of 1977					x	x		x	x	x				
Public Law 95-87 Surface Mining Conservation and Reclamation Act of 1977		x		x	x	x	x	x	x			x	x	x
Public Law 91-559 WaterBank Act	x		x		x	x		x					x	x
Public Law 85-58 Third Supplemental Appropriation Act of 1957	x	x	x		x	x	x	x	x	x	x	x	x	
Public Law 79-733 Agricultural Marketing Act of 1946	x	x	x		x	x	x	x	x	x	x	x		x
Public Law 95-313 Cooperative Forestry Assistance Act of 19' m	x	x	x	x	x			x	x				x	x
Public Law 70-466 McSweeny-McNary Act, 1928	x	x	x	x	x	x	x	x	x				x	x
24 Stat. 440 Hatch Act, 1887		x	x	x	x	x	x	x	x	x	x	x		x
Public Law 63-95 Smith-Lever Act. 1914	x	x	x		x	x	x	x	x	x	x	x		

- Landowner assistance on conservation practices to adequately protect between 16 million and 20 million hectares (40 million to 50 million acres) of non-Federal land.
- Inventories and monitoring to provide soil, water, and related resource data for a wide variety of uses, including a periodic report on resource conditions.
- Soil surveys to inventory the Nation's basic soil resources and to determine land capabilities and conservation treatment needs.
- Snow survey and water forecasting from winter high mountain snow pack data to provide estimates of annual water availability for summer stream flow in the Western States and Alaska.
- Operation of Plant Material Centers to assemble, test, and encourage increased use of plant species which show promise for use in the treatment of conservation problem areas, including potential wildlife habitat improvement.
- The Great Plains Conservation Program (Public Law 84-1021, as amended). The objective of this act is to help bring about a long-term solution to problems resulting from drought and cultivation of land unsuited for sustained crop production in the 10 Great Plains States.
- The Resource Conservation and Development Program (Public Law 87-703). This Act provides authority to assist local sponsors of projects to conduct programs of land conservation, especially to add economic and rural development opportunities to the people in the area designated for acceleration of present conservation activities. Many of the nearly 200 projects have active fish and wildlife committees to enhance the habitat for wild living resources in that region of the Nation.

Small Watershed Projects

One of the more controversial programs" over the past three decades has been the watershed Protection and Flood Prevention Operations (Public Law 83-566, as amended) administered by SCS. The "Works of Improvement" planned by USDA (SCS) and approved by Congress to reduce erosion, floodwater, and sediment damage can benefit fish and wildlife. However, channel construction and stream rehabilitation proposals have led to the potential for increased drainage of adjacent lands. This in turn has caused several years of delay in the implementation of the plans—and in the more sensitive projects—has caused considerable modification of the original plans to satisfy the need for fish and wildlife improvements. Projects have been improved. The Forestry Incentives Program (Public Law 95-313) encourages the development, management, and protection on nonindustrial forestlands. The technical assistance and cost-sharing provided through a long-term agreement with private landowners can have a favorable impact of fish and wildlife habitat.

Water Bank Program

An indication of concern for wetland values by USDA was the successful enactment and funding of the Water Bank Program (WBP), administered by the Agricultural Stabilization and Conservation Service (ASCS). This action (Public Law 91-599) resulted from intense pressure on USDA to be in a position to offer the landowner an alternative to draining, filling, or burning the important fish and wildlife habitat on their farms and ranches. USDA offers to lease those areas from qualified landowners in designated counties. These can be both wetlands and adjacent (or associated) upland habitat, Leases run for 10 years with the option to renew (or terminate). Payments are made annually. In 1980, Congress amended the original WBP. The amended law directed the Secretary to adjust contract payments every 5 years, and to adjust the contract rates for contracts that had been in effect for 5 years or more in 1980. This followed from a recommendation made by the General Accounting Office (GAO) in 1979 to adjust WBP rates "to counter the high rate of terminations that seem to be caused by inflationary pressures. " The Act also was expanded in scope by adding wetland types 7 and 8 to the program (the original law included types 1 through 5 only). The intent was to extend WBP to the shrub and wooded swamps of the Delta to protect winter habitat for waterfowl. The amended Act could include "such other wetland types as the Secretary may designate. "

One hundred fifty-six counties (156) in ten States were participating in the 1983 program. Three states—Minnesota, North Dakota, and South Dakota— accounted for 72 percent of the WBP agreements entered into between 1972 and 1981, as well as 72 percent of the acreage and 78 percent of the annual payments. The program has been funded at an annual rate of $20 million. This despite the fact that the law authorized $30 million in the 1980 amendments. ASCS should now have an evaluation system to try to quantify the benefits or lack of value, paid for by the WBP. The SCS assists in evaluating the proposed acreage as to vulnerability to drainage and the value as wildlife habitat. It has been good for conservation.

Coupled with the Water Bank Program, USDA incentives for drainage of wetlands have been curtailed drastically in the past decade, Language in the Agricultural Conservation Program annual appropriations obviates cost-sharing for drainage of most types of wetlands, However, the draining and clearing of wetlands have proceeded in the past in the absence of any government incentives, and may well continue in the future. There are some incentives in the Federal income tax code for wetlands conversion expenses. It is clear that there are serious conflicts in present national policies that affect wetlands and impact wildlife habitat.

Other USDA Conservation Activities

Many activities of the USDA agencies involved in research, extension, credit, cost-sharing, and technical assistance are dedicated to improving the condition of pasture, range and forested lands. The total Federal budget each year for traditional USDA conservation actions is nearly $1 billion. However, the impacts of past agricultural change—diversified farming to clean cultivated, row crop monoculture—has, based on intensive wildlife research, drastically reduced farm wildlife populations. That situation apparently persists today over the majority of the intensively used U.S. cropland. A National Conservation Tillage Conference just completed in early October 1984, examined the value of reduced tillage for soil erosion benefits, energy saving, yield improvement, and the impact on fish and wildlife. Conservation tillage results in less disturbance of the soil and, as a consequence, seems to promise some positive benefits to and for environmental quality. Conservation tillage, in its various forms, relies heavily on chemicals for weed and other pest control. At this point more research is needed to determine the impact of these chemicals on wild living resources. Answers are needed.

Above all, the USDA, as it carries out the "Farm Policy" of the Nation, has a most profound effect on the way land is used, especially the acres in crop. The estimated 170 million hectares (420 million acres) of land that produces basic commodities such as wheat, corn, soybeans, cotton, and the feed for livestock has a potential for favorable fish and wildlife habitat or an adverse impact of severe proportions for wild living resources, That option is in the hands of the farmer.

FUTURE POLICIES

At the "North American Resources Conference" in March of 1984, a check list of opportunities to help retain, restore, and maintain fish and wildlife habitat was presented. Items for action include:

- protect prime agricultural lands,
- encourage practices that retain vegetation,
- support targeting resources to erosive lands,
- encourage alternative farming methods,

- obtain cross-compliance policy,
- assure that set-asides benefit wildlife,
- increase incentives to land users,
- expand Federal and State programs, and
- identify critical habitat areas for action.

There are several groups at work to develop specific ways in which commodity and conservation objectives and results can and should be more closely linked. The Farm Bill of 1985 could provide USDA with programs and policies to impact fish and wildlife in a more favorable manner than at any time in the last 50 years. The challenge to the conservationists will be to understand what a Farm Bill is, and how it has been drafted, debated, and enacted in the past. The 1981 Farm Bill should be examined in detail with the objective of incorporating into most of the 18 titles the type of language that would serve. to link the commodity, and other policies, with the issues that relate to those identified by the fish and wildlife, water quality, soil erosion, pasture, range, and forestry interests. Some of these issues were addressed in the 1981 Farm Bill and also debated in the last few years by Congress. However, the 99th Congress begins in January 1985 with a clean slate.

The major thrust should be to help enact a four-year "Farm Program" that will work, is fiscally responsible, and meets the short- and long-range goals of those many constituents served by both elected and appointed public officials. The timing for this new generation of "farm policy" that will mesh the new objectives of "soil conservation, water quality, and the survival of wild and living organisms" with the established "commodity price and farmer income" objectives has never seemed more opportune. A "band aid" approach will not solve the problems. However, improvements in the USDA programs that can impact fisheries and wildlife habitat in a positive manner and also aid both present and developing technologies to serve more than one interest can produce an environment with higher quality. The Nation and its "wild living resources" deserves that effort. The next decade and century are within the time horizon of those concerned about the renewable natural resources of the United States.

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Agricultural Policies Related to Fish and Wildlife Habitat

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INTRODUCTION

Fish and wildlife' are products of the land and as such may be considered as agricultural products or outputs. They have commodity value as harvest game. In addition, they have amenity value—value associated with experiencing (seeing, hearing) them. Both the tools used in agricultural practices and the policies that govern agriculture impact on wildlife positively and negatively.

I Fish are one form of aquatic wildlife, therefore when wildlife is used in this discussion it includes fish and other aquatic forms of wildlife.

AGRICULTURAL TOOLS

All of the tools or techniques used in the production of crops have more impact (both positive and negative) on wildlife habitat than do the tools used in wildlife management. Wildlife specialists tend to agree that the application of today's agricultural tools have had a most deleterious effect on many species of wildlife, especially those species associated with mixed farming such as bobwhite quail, cottontail rabbits, and ring-necked pheasants. Agricultural tools such as the axe (timber harvesting), the plow (turning over the soil), the match (controlled burning), and the cow (grazing) all affect wildlife habitat in generally the same way, by keeping vegetation in a younger stage of development rather than letting it mature.

The axe (or chainsaw) is the principal management tool of the forest wildlife manager. Its use depends on the wildlife species under consideration. Recognizing the impact of such a tool on wildlife habitat needs to be more clearly defined in U.S. Forest Service legislation as well as administrative regulation. A recent GAO report (RCED-84-96) criticizes the U.S. Forest Service for below-cost timber sales and implies that timber sales are for the single purpose of adding funds to the Treasury. This approach totally ignores the wildlife management potential (positive and negative) of all timber sales and the multiple-use mandate of the U.S. Forest Service to manage wildlife as well as for timber production.

No single tool has a greater cumulative impact (good and bad) on wildlife habitat than the plow or similar cultivating equipment. The plow followed the axe in the settlement of America and produced food not only for settlers but also for wildlife.

The match and the cow (along with mowing and fertilization) are principle management tools used in pasture and native grassland management. Prescribed fire is a technique for maintaining productivity of native grasslands, emulating the natural fires under which these grasslands were developed. Prescribed fire also is a management tool in the management of some forest types, again emulating the ecological conditions under which these forest types developed, Certain wildlife forms were developed in association with different vegetative types. Wildlife species associated with grasslands (e.g., prairie chickens and upland sandpipers) depend on a mixture of fire and grazing animals (along with mowing and fertilization) to maintain their habitat.

Unfortunately some of these ecological processes are not clearly defined in the education of wildlife or agricultural professionals. Consequently, many professional biologists recognize only the negative impacts of the axe, the plow, the match, and the cow. Equally lacking is the ecological consideration of impacts on wildlife from these tools in the education of agricultural professionals, It is paradoxical that agricultural professionals may well have the greatest ecological impact on the wild living resources of the Nation and never had the benefit of one course in ecology, Both professions—wildlife and agriculture—could benefit from course work in each other's fields. Achievement of this cross-fertilization could best be accomplished working through the universities and the professional societies.

AGRICULTURAL POLICIES

Agricultural policies frequently have more impact—usually negative with some exceptions such as soil bank or water bank—than do wildlife policies. Annual acreage set-asides for the past two decades have averaged approximately 20 percent of the total cropland base, Had this program been established on a long-term basis and required seeding of the set-aside lands to protective cover such as grass or trees, we would have enjoyed 20 years of exceptional wildlife habitat and erosion control. For example, the Payment-in-Kind Program of 1983 idled 43,333,319 acres in 12 Midwestern States, but only 14 percent were considered valuable wildlife cover in a survey made by the 12 State fish and wildlife agencies. Future programs should require vegetative cover for erosion control and wildlife benefits and should be for multiple years instead of per annum. If a 20 percent set-aside was established on a long-term basis requiring vegetative cover for erosion control and wildlife habitat it would provide benefits equal to the old Soil Bank Program.

Tax Policies

For the reasons noted above, any legislation that affects agriculture also affects wildlife. Tax policies that provide preferential treatment of capital gains encourage the movement of nonfarm capital into farming for speculative tax reasons. This is the main reason that fragile grasslands are being plowed under for farms and are then eroding away, Treatment of income gained when the land is sold as regular income rather than as capital gains would remove the incentive to destroy wildlife habitat to increase wheat production for an already depressed market, which eventually erodes the soil. If this economic incentive (capital gains) did not exist, there probably would be no reason even to consider "sodbuster" legislation. In fact, it is not clear that passage of "sodbuster" or similar legislation would stem the flow of capital into this type of farming activity. Denial of Federal price support and similar activities may not be a sufficient disincentive to override the incentive of capital gains treatment and other incentives in existing income tax regulations.

This movement of nonfarm capital into farming ventures adversely effects wildlife habitat on the land involved and indirectly adversely effects wildlife habitat on land of legitimate farmers who are caught in the cost/price squeeze by the competition with crops produced by nonfarm investors. The legitimate farmer intensifies his own farm operation to improve his financial situation, thus clearing and plowing land that for reasons of erodibility should be maintained in trees and grasses, thereby eliminating additional wildlife habitat.

Additional tax provisions that tend to have the same negative effect on agriculture and wildlife by attracting nonfarming investors include: Cash Accounting, Expense Methods of Depreciation, Accelerated Depreciation Allowance, Investment Credits, Leasing, and Single Purpose Agriculture Structures. It also should be noted that these factors having a negative impact on the fish, forest, and wildlife resources of the Nation generally tend to have a negative impact on the soil. Soil erosion not only negatively impacts wildlife through sedimentation but literally eliminates the basic structure (the soil) on which tomorrow's agriculture, food production, and wildlife must depend.

Small Watershed Proiects

The Public Law 566 program (Small Watershed Projects) of the Soil Conservation Service seeks to improve or maintain water quality and to prevent downstream damages within watersheds. In some cases, these projects have been structure-oriented and detrimental to wildlife habitat; e.g., stream channel modification. Thus more emphasis should be placed on land treatment measures and nonstructural approaches to lands in the watershed as well as nonstructural emphasis on stream channel problems, Land treatments that should be encouraged for application in upland watersheds include contour farming, strip cropping, grass or tree establishment, conservation tillage, and lastly, terraces and grassed waterways. Stream channel problems could be treated in a nonstructural fashion by minimum snag removal and establishment of a riparian corridor. Treating the uplands and lowlands in this fashion would achieve a long-term goal of balancing upland and lowland hydrologic factors. This goal could be further pursued through the ASCS' Acreage Conservation Program, applying different cost-share rates to structural or nonstructural practices and land treatment.

Nonpoint Source Pollution

Section 208 of the Clean Water Act deals with "nonpoint" sources of water pollution. Nonpoint sources are those which cannot be traced to a particular source such as sewer outfall. Agricultural activities are a major contributor to nonpoint sources of water pollution. In the Midwest, soil (by volume) is the major water pollutant and these sediments along with their associated phosphates and nitrates have a serious negative impact on fish and other forms of aquatic life. Successfully dealing with the intent of Section 208 would have positive benefits to agriculture by preserving the soil base, to terrestrial wildlife by providing food and cover, and to aquatic wildlife by protecting our streams, lakes, and wetlands from sedimentation and eutrophication. The most satisfactory approach to the nonpoint sources of water pollution is land treatment using BMPs (Best Management Practices) in the uplands and stabilization of the lowlands by the protection of the riparian corridor.

NEPA

Finally, it is paradoxical tht the National Environment Policy Act (Public Law 91-190), promulgated to protect the public's environmental interest in the face of Federal action, has never called for an environmental assessment or impact statement on the most impactive of Federal actions; the laws, policies, rules and regulations governing agriculture.