

Wildlife Benefits from Conservation Tillage

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Abstract

Conservation tillage benefits wildlife by retaining vegetative residues on the surface. These residues provide food above the soil surface, cover for nesting, and protective cover during winter. Greater numbers of insects in no-till fields enhance food supplies for young birds during summer. Reduction in mechanical disturbances from summer tillage reduces nest destruction, loss of flightless young, and mortality of incubating hens. Off-site benefits accrue principally to aquatic ecosystems from reduced sediment losses and transportation of agricultural chemicals. Data-based wildlife research literature is too meager to permit wide-ranging evaluation of long-range benefits of conservation tillage.

The amount and quality of wildlife habitat on private lands has trended sharply downward over the last several decades (Carlson 1985, Vance 1976). Conventional agricultural practices traditionally have been regarded as competitive with or destructive to efforts to manage wildlife habitat. Land managers desiring to provide wildlife habitat on farm lands have often found it necessary to idle some cropland. They may expect reduced farm income and often a high unit price for wildlife produced on these diverted acres (Soutiere 1984). As a consequence, wildlife is usually given low priority on private lands, particularly those which are highly arable and fertile. Those species whose ecological requirements are best met by a combination of croplands and idle lands suffered the greatest habitat loss, and offered wildlife managers the least hope of reversing the trend on private farm lands.

Agricultural programs which subsidize farmers for retiring crop lands into permanent herbaceous or woody cover offer wildlife some relief from the downward spiral. Clearly, several provisions of the "Food Security Act of 1985" are having tremendous impact upon the farm environment in the United States; their benefits to many forms of wildlife are notable.

Similarly encouraging to wildlife managers is the development of agriculture technology which has a potential for benefiting wildlife habitat rather than destroying it. Succinctly stated by Soutiere (1984), "*Wildlife's only hope on prime farmland is to ride on the "coattails" of farm practices, programs, and policies that bring reduced costs or added income to the individual farmer, and the conservation of soil and water to the nation.*" Conservation tillage in its many diverse forms is just such a practice. It is a new farming technology

with potential for reversing the historical trend of modern agriculture to erode and degrade America's wildlife habitat base (Carlson 1985).

Wildlife Benefits

The potential benefits of conservation tillage to wildlife include on-site benefits, which are often immediately realized in the form of increased food and cover, and off-site benefits, particularly to aquatic ecosystems, which may be cumulative over somewhat longer time spans as a result of significantly reduced soil erosion. At present, the bulk of literature addressing wildlife benefits of conservation tillage is speculative and hypothetical. The few research reports primarily emphasize relationships between tillage methods and birds using farm lands for nesting and/or winter habitat.

On-site Habitat Modification

The biological profile of a crop field is dramatically altered by many, if not all, forms of conservation tillage. This is particularly true for no-till vs. conventional tillage for row crops such as corn and soybean.

No-till crop fields may retain 90 percent or more of crop residues and other herbaceous vegetation over the entire annual cycle, whereas conventionally tilled fields turned in the fall remain barren of vegetative cover and wildlife food resources up to 6 months of each year. Castrale (1985) reported that no-till corn or soybean fields retained a minimum of 60 percent residue, but conventional fields retained less than 15 percent. Conservation tillage, then, provides direct onsite benefits to many species of wildlife in the form of nesting cover, brood-rearing habitat, available winter food resources, and winter cover at least sufficient to improve access to the residual food supply. The expansion of acreage suitable for nesting and winter cover into croplands may also dilute predator pressure on wildlife using permanent cover units such as woodlots, fencerows, and waterways.

Nesting Habitat and Nest Success

The benefits of conservation tillage to nesting birds varies by geographic region, species of bird, and characteristics of prevailing agriculture and land use. Minser and Dimmick (1988) located 31 northern bobwhite (*Colinus virginianus*) nests on agricultural and idle land in western Tennessee (Table I). Of 12 nests in crop fields, 11 (92%) were in no-till fields and 1 in a conventional wheat field. Bobwhites nested in no-till fields, fallow fields, and idle field edges, but not tilled crop fields, in proportion to their availability. Among no-till

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crop fields, they preferred soybeans planted in the previous year's stubble and residue. Basore (1984) observed 12 species of birds nesting in no-till corn and soybeans in Iowa compared with 3 in conventionally tilled crops; overall nest density was 7.5 times greater in no-till. Major species using no-till fields included ringnecked pheasants (*Phasianus colchicus*), mourning doves (*Zenaida macroura*), and several non-game birds. Nesting density of mourning doves in no-till approached or exceeded that in strip cover, but pheasant nest densities were much lower in no-till than in adjacent strip cover, and very low when compared with other cover types.

Warburton and Klimstra (1984) reported significantly more birds in a southern Illinois no-till cornfield than in a conventionally tilled field during April - September, though specific use of the fields for nesting was not mentioned. Bobwhites were common in the no-till field, and uncommon in the conventional field. Castrale (1985) reported 32 percent more species of birds using no-till fields in southern Indiana. Among those considered as probable nesters was the northern bobwhite.

Few studies have related success rates of nests in no-till vs. conventional fields. Minser and Dimmick (1988) noted that nest success of bobwhites in no-till crops and associated idle lands (16%, n = 19) was not markedly different from that in conventional crop and cover associations (18%, n = 11), where most nests were situated on idle lands. Their sample size was small, but the success rate was similar to that reported by Dimmick (1974) for 1,571 nests (11%) on an adjacent bobwhite management unit with excellent nest habitat. Basore (1984) reported that pheasant nests in no-till crop fields and adjacent strip cover failed predominantly because of predation; crop fields incurred greater rates of nest loss in 2 of 3 years. Woolly et al. (1985), extrapolating from Basore's data, concluded that pheasant production on no-till fields in Iowa was so low that "... it is not likely to solve Iowa's pheasant problems."

Rodgers (1983), however, noted that in Kansas surface tillage for spring weed control in the wheat-fallow system destroys all nests and flightless young in the wheat stubble, whereas undercutters used without mulch treaders saved 53 percent of the ground nests and many flightless young. Pheasant, bobwhite, mourning dove, and songbird nests were evaluated.

The scarcity of quantitative data does not encourage wide ranging conclusions regarding the value of no-till for the production of upland birds. Bobwhites make good use of no-till for nesting (Minser and Dimmick 1988) and probably for summer feeding areas (Basore 1984, Castrale 1985, Warburton and Klimstra 1984). Predation rates may be as high or higher in no-till fields as in adjacent strip cover (Basore 1984), but losses to farm machinery are reduced or avoided when surface tillage during the nesting season is reduced or eliminated (Higgins 1975, Rodgers 1983). Though some herbicides used in no-till, particularly paraquat, may negatively influence some aspects of reproduction (Bauer 1985), it seems unlikely that no-till crop fields will serve as reproductive "traps" comparable to that which pheasant nests and broods often experience in mowed hayfields (Gates and Hale 1975).

Winter Habitat

High quality winter habitats for upland birds, particularly gallinaceous game birds in farmland, are frequently more complex than breeding habitats. The degree of interspersion, the diversity of cover types, and the quality of those cover types typically determine the winter carrying capacity for bobwhites, ringnecked pheasants, and similar species. Protective cover, travel lanes, and feeding areas often are provided by strikingly different vegetative communities.

Whereas the quality and quantity of nesting and chick-rearing cover may influence the annual surplus available to hunters, in temperate and cold climates it is the winter food and cover resource which determines the size and condition of the breeding population. It may be in this context that conservation tillage likely yields its greatest contribution to farmland habitat. It does so through the preservation of available surplus grain, and retention of crop residues and surface litter. Warner et al. (1985) noted that the abundance of waste corn and soybeans in intermediate tilled fields in Illinois was 74 to 90 percent less than in untilled fields. The major decline in waste grain and plant residues during winter was related to an increase in post-harvest tilling practices. In Indiana, 31 species of birds were observed in crop fields during winters of 1983 and 1984 (Castrale 1985). The mean number of species and frequency of occurrence using no-till corn stubble was nearly double those using no-till soybeans and tilled fields. The critical factor was the greater height and ground cover of corn residue which offered protection against wind and concealment from predators. In Tennessee, for example, we observed two coveys of bobwhites in no-till corn stubble 70 and 100 yards from woody cover on a bright December mid-day. Untilled corn stubble and johnsongrass

Table 1. Number of bobwhite quail nests found per cover type and amount of each cover type searched, no-till bobwhite quail study, Ames Plantation, TN, 1984-1986 (Minser and Dimmick 1988).

Type of Cover Searched	Nests Found		Hectares Searched	
	n	%	n	%
No-till area, crop fields	11	35.5	21.8	28.0
No-till area, fallow fields, and idle edge	9	29.0	15.3	20.0
Conventional areas, crop fields	1	3.2	16.2	21.0
Conventional areas, fallow fields, and idle edge	10	32.3	24.1	31.0
TOTALS	31	100.0	78.0	100.0

provided food and security unavailable in disked or plowed fields. More significant, however, was our discovery (Minser and Dimmick 1988) that conventionally tilled fields associated with good surrounding habitat yielded bobwhite densities equivalent to no-till fields when fall plowing was not practiced (Table 2). Lowest densities occurred on conventionally managed farmland where crop lands were turned in autumn. Intermediate densities were the rule on moderately good habitat with fields managed by no-till.

We interpreted our results to mean that where protective cover is well dispersed, preservation of winter food supplies by eliminating fall plowing is sufficient to maintain a high density of bobwhites. Where cover is less adequate, no-till fields add to the quantity of this resource, and along with preservation of winter food, permit higher densities than conventional tillage (Minser and Dimmick 1988).

Off-Site Benefits

The most readily recognized off-site benefits to wildlife are those resulting from dramatically reduced soil erosion and its consequences to aquatic ecosystems. For example, the sediment yield from a single, intense rainstorm on single crop no-till soybeans in west Tennessee's highly erodible soil was 309 pounds per acre, vs. 22,785 pounds per acre from single crop conventionally tilled soybeans (Shelton et al. 1982). The reduction in sediment yield was attributed to the presence of plant residue on the crop field. In Clark County, Kentucky, a 31-mm November rainfall yielded 6 tons per hectare soil loss from a conventionally tilled cornfield, but no loss from a no-till field (Moldenhauer et al. 1983).

Table 2. Bobwhite quail population densities* on no-till and conventionally planted areas on Ames Plantation, TN, December 1983-85 (Minser and Dimmick 1988).

Area		Bobwhite quail/100 ha			
		1983**	1984	1985	1986
No Till A	No-till field trial area	290	351	274	198
Control A	Conventionally planted field trial area	215	247	308	235
No Till B	No-till (nesting study area)	115	101	137	130
Control B	Conventionally planted	24	93	81	91
Control C	Conventionally planted, fall plow	41	40	103	61

* Bobwhite quail numbers determined by flush census, adjusted by doubling birds flushed to account for birds not observed (Dimmick et al. 1982).

** The 1983 census was conducted before no-till or other agricultural practices relative to this study had been implemented.

Retention of soil on site and reduction of runoff should also reduce contamination of off-site ecosystems with agricultural chemicals transported with the sediment. Though chemical transportation, and consequent contamination of the downstream ecosystem, do not necessarily parallel sedimentation losses, one must almost assume that reductions of sediment transport are desirable (Baker and Laflen 1983).

Quantifying the benefits to wildlife of reducing non-point source pollution is difficult. Databased literature on this topic is scanty or non-existent, but much needed. At present, our aquatic ecosystems are among those most endangered; their preservation and upgrading are high priority national conservation goals.

Conclusions

Conservation tillage offers potential benefits to many species of wildlife, though translating these benefits into increased species population density or community diversity has only rarely been accomplished. The engineering, chemical, and application technologies of conservation tillage are dynamic; we can expect a significant lag between the development of a new technology and our grasp of its impact upon the wildlife community of affected farmlands.

Present technology benefits wildlife directly through preservation of crop and other vegetative residues, and by reduction of disturbance to the field surface. Residue provides (1) food in the form of waste grain on the soil surface, (2) diverse structure for protective cover, and (3) residual vegetation used for constructing nests. No-till corn provides vegetative structure not unlike that provided by untilled idle lands, creating habitat suitable for birds accustomed to weedy and brushy habitats. The added structure permits edge-loving species, such as the northern bobwhite, to penetrate farther into crop field interiors, using food resources less available to them in conventionally tilled fields, particularly where fall plowing or disking are common practices.

Conservation tillage practices which reduce surface disturbance during the nesting and brood-rearing period unquestionably save many nests, chicks, and nesting hens. The proportionate contribution of young to the population resulting from nests constructed in no-till fields, however, is virtually unknown.

The quantity of wildlife research involving conservation tillage is meagre, and the quality of that research is deficient. There is presently no justification for wide-ranging prognostication of the long-range benefits to wildlife to come from the developing technology of conservation tillage.

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