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The Conservation Reserve Program and Duck and Pheasant Production in St. Croix County, Wisconsin

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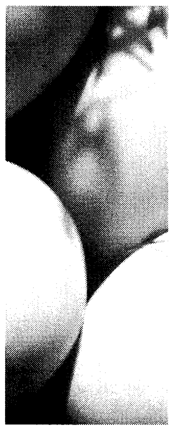
PHOTOS: BRUCE BACON

Abstract

More than 18,600 ha of retired agricultural cropland were entered into the Conservation Reserve Program (CRP) in St. Croix County, Wisconsin during 1985-95. Nearly all the vegetative cover of the CRP entries was undisturbed grasses and forbs, potential habitat for nesting ducks and Ring-necked Pheasants (*Phasianus colchicus*). An evaluation of the CRP habitat compared duck and pheasant nests and numbers in CRP cover and in nearby Waterfowl Production Area (WPA) nesting cover. Cable-chain drag devices were used to annually search more than 400 ha each of CRP and WPA nesting cover for duck and pheasant nests. Vegetation measurements showed that the forb-dominated CRP nesting cover became more grassy and diverse over time. Mean Mayfield nest success for Blue-winged Teal (*Anas discors*) and Mallards (*A. platyrhynchos*) in CRP fields was above the level needed for population stability and did not differ from Blue-winged Teal and Mallard nest success in WPAs. However, duck production was lower in CRP fields due to lower estimated nest densities. Pheasant indices in CRP habitat compared favorably with WPA habitat and were 10-fold higher than in surrounding private farmland. Other wildlife species also benefited from the grassland habitat created on CRP lands.

Cover photos: Top: Marked Blue-Winged Teal flushing from nest.
Bottom: Blue-winged Teal nest.


PHOTOS: LEFT-DNR PHOTO, CENTER-BRUCE BACON, RIGHT-RON GATTI

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Ring-necked Pheasant nest.

PHOTOS: BRUCE BACON

Mallard nest with eggs hatching.

Introduction

The Conservation Reserve Program (CRP) was a provision of the 1985 Federal Food Security Act ("Farm Bill") designed primarily to remove highly erodible lands from production, slow production of farm commodities, and secondarily, to improve water quality and wildlife habitat (U.S. Congress, House, Committee on Appropriations 1986). The 10-year program provided annual payments to farmers to convert highly erodible cropland to permanent grass or trees. During 1985-93, about 14.8 million ha were enrolled in CRP nationwide (Osborn 1993) and 302,600 ha were enrolled in Wisconsin (Soil Conserv. Serv. 1993). Expected net benefits were estimated to be $3-11 billion for the 10 years of the program (Young and Osborn 1990).

Approximately 18,600 ha, representing 18% of the cropland in St. Croix County, were entered in the CRP by 1993 at an average annual cost of $150/ha (Soil Conserv. Serv. 1993). About 12% was planted to trees, with most of the balance (16,200 ha) placed in some type of undisturbed grassy cover for the 10-year contract period. Most entries were nearly equally divided between conservation practice CP-1 (planted cool season grass mixture) and CP-10 (already established grassy vegetative cover); the latter was usually retired hay fields and pastures. Most fields were entered in the CRP in 1987, first planted or idled in 1988, and were believed to have developed sufficient residual vegetative cover to be attractive to nesting ducks and pheasants by 1989.

Past long-term federal land retirement programs such as the Agricultural Conservation Program (1936-42), Soil Bank (1956-72) and Cropland Adjustment Program (1966-77) had been responsible for increases in grassland wildlife populations in the Midwest (Langner 1989). The CRP acreage increased grassland wildlife habitat in St. Croix County by nearly 10-fold. Recognizing its potential for increasing duck and Ring-necked Pheasant production, I initiated a 3-year evaluation of CRP habitat in 1989. The objective of this study was to compare the vegetation and wildlife use of CRP fields and nearby U.S. Fish and Wildlife Service waterfowl production area (WPA) fields.

Study Area and Methods

Evrard and Lillie (1987) described characteristics of St. Croix County. Briefly, soils are sandy loams derived from glacial till overlying sandstone and dolomitic limestone bedrock (Langton 1978). The climate is characterized by cold, snowy winters and warm, humid summers with a mean annual precipitation of 74.9 cm and a mean temperature of 6.8° C.

Much of the pre-settlement prairie and woodland were converted to agriculture. Today, 75% of the county is intensively farmed for corn, soybeans, oats and alfalfa, with emphasis on dairy production. Of the remaining land area, 13% is wetlands and 11% is woodlands. Approximately 2,800 ha or 2% of the county are in state and federal wildlife management areas managed until recently by the Wisconsin Department of Natural Resources (DNR).

A 3-person DNR crew measured the vegetation and searched for duck and pheasant nests in 25 CRP fields that averaged 16 ha (range = 4-31) on 13 farms in Erin Prairie and Stanton townships, St. Croix County (Fig. 1). The same fields were sampled each year but the total area sampled varied slightly, 426 ha in 1989, 420 ha in 1990, and 423 ha in 1991. Some fields were adjacent each other whereas others were isolated in cropland. The criteria used to select CRP fields included grassy vegetative cover, permanent wetlands in or within 0.4 km of the CRP field, and landowner permission to search the fields for nests. More than 25 CRP fields met these criteria, but time constraints limited the area searched to approximately 425 ha.

Another 3-person DNR crew measured the vegetation and searched upland nesting cover in 437 ha in 1989 and 440 ha in 1990 in eight WPAs in Stanton and adjacent townships in St. Croix and Polk counties (Fig. 1). Nest searches of WPA fields were not conducted in 1991 due to budget reductions. The same WPA fields were sampled in 1989 and 1990, but the area searched varied slightly. WPA field size averaged 7 ha (range = 1-20). All fields were located within 0.4 km of permanent wetlands. In all cases, wetlands were more numerous near WPA fields than CRP fields.

PHOTO: JIM EVRARD

Nesting cover at Flaters Waterfowl Production Area.

PHOTO: BRUCE BACON

Ducks at Kunze Pond, land in the Conservation Reserve Program in St .Croix County.

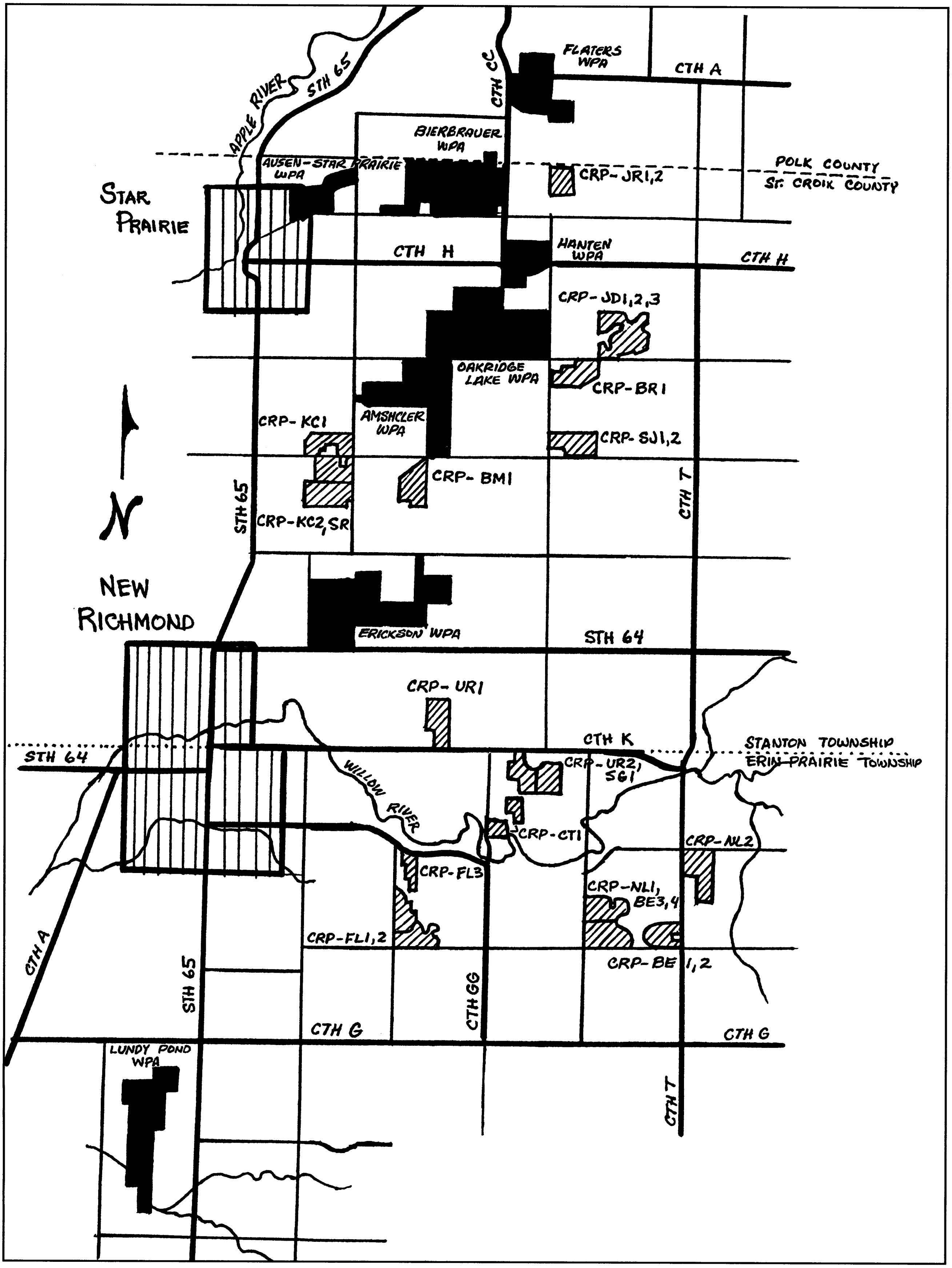


Figure 1. *Study area map showing location of CRP and WPA fields studied.*

The quality and quantity of residual vegetation in CRP and WPA fields was determined by measuring the height-density or 100% visual obstruction (Robel et al. 1970) height and litter depth in the spring following snowmelt and in the late summer after plant growth had ceased. Ten circular plots (3 m in diameter) were regularly spaced by pacing on an imaginary line running diagonally across the length of each field. In each plot, eight visual obstruction measurements (VORs) (four in and four out) were taken on two Robel poles, one placed at the center of the plot and the other at each cardinal direction on the plot edge.

In the late summer, nesting cover VORs were measured a second time and ten 0.25 m^2 rectangular quadrates (Daubenmire frames) were placed at the center of each 3-m circular plot in each field to calculate importance values (Curtis 1959). Importance values (IVs) were the sum of the relative frequency and cover of each plant species divided by 2. Species richness, expressed as the total number of species recorded in a field and the number of species per quadrate, were developed for the CRP and WPA fields.

Three nest searches (Klett et al. 1986) were conducted, one each in May, June and July. A cable-chain drag stretched between two vehicles was used to flush duck and pheasant hens from their nests (Higgins et al. 1969). Nests (containing ≥1 egg) were marked with a 1 m stake located 3 m north of each nest and eggs were candled (Weller

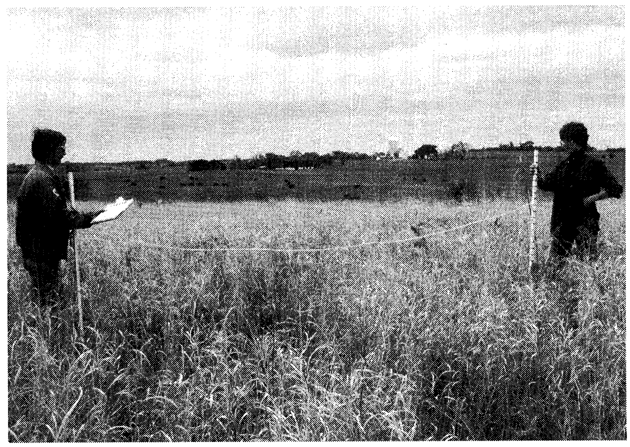
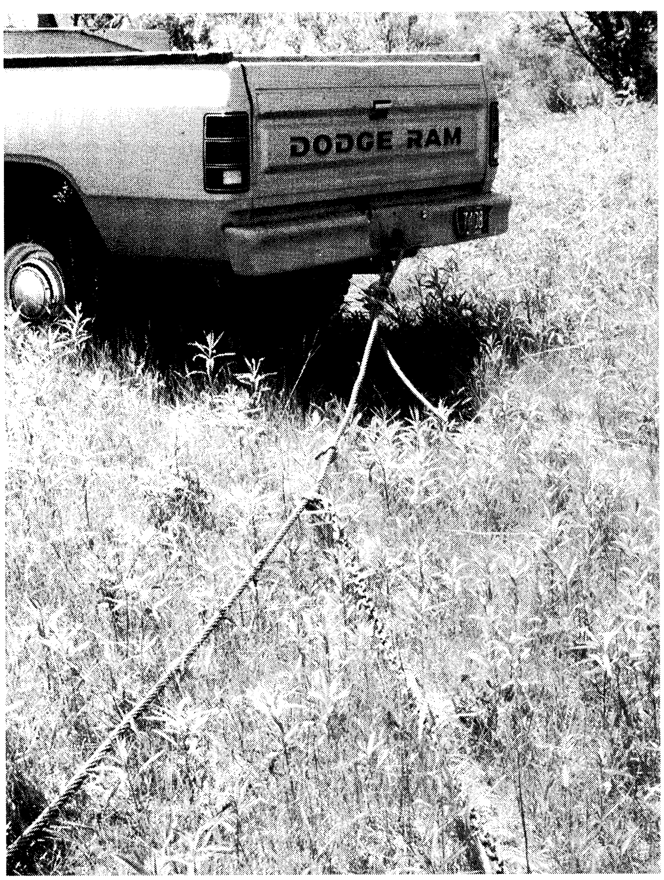


PHOTO: JIM EVRARD

Field workers determining the quality and quantity of residual vegetation by measuring visual obstruction heights.



PHOTOS: JIM EVRARD

A cable-chain drag stretched between two vehicles was used to flush duck and pheasant hens from their nests.

1956) to determine projected hatch dates. Nests were revisited after projected hatch to determine their fates (Rearden 1951, Einersen 1956). A nest was considered successful if one egg hatched. I used the modified Mayfield method of Johnson (1979) to calculate nest success. Observations of other wildlife species made while nest searching were systematically recorded.

Crowing cock pheasants were located by triangulation (Burger 1966, Gates 1966, Hutchison 1981, Petersen et al. 1982) on and within 0.4 km of each CRP field that were searched for nests. These data were compared to those obtained from a similar combination of WPAs and adjacent private lands to determine if relative densities of crowing cocks in the CRP fields differed from those in WPA fields.

I conducted roadside transects for crowing cocks (Kimball 1949, Kimball et al. 1956) twice in Stanton Township, Erin Prairie Township, and three adjoining townships at a rate of one transect per township in late April and early May in 1989, 1990 and 1991 (Evrard 1996). Beginning 0.5 hour before dawn on calm days, I stopped every 1.6 km along each 24 km road transect, stepped away from the vehicle, and counted the number of crowing cocks heard during 2 minutes. The sampling sequence was reversed during the second run of each transect in an attempt to equalize the effects of time of day on crowing rates. All crowing cocks were counted within each 24 km^2 belt transect. I compared crowing cock densities obtained from the transects with densities from CRP and WPA fields to see if relative densities of crowing cocks differed from that of surrounding agricultural cropland.

I used the Epistat statistical package (Gustafson 1984) to calculate the paired *t* statistic to determine if differences existed between nesting cover VOR and IV means and diversity indices. I used the nonparametric Kaplan-Meyer estimate (SAS Institute 1989) to test differences in CRP and WPA duck nest survival curves. An exponential regression of 34 variables measured at or about the nest was used to determine what factors, if any, affected nest success. Results were considered significant at $P < 0.05$.

Results and Discussion

CRP Nesting Cover

Mean spring VORs for CRP nesting cover increased from 1989 (10.5 cm) to 1990 (16.4 cm) after a virtually snowless winter and above-normal spring and summer rains ($t = 4.347889$, 24 df, $P = 0.0002$). No federal drought emergencies were declared so nesting cover remained undisturbed except for replanting part of one field and mowing small patches in another field for weed control, about 1% of the fields examined. Following the more normal yet relatively mild winter of 1990-91, mean spring VORs declined in 1991 (12.2 cm; $t = 3.68179$, 24 df, $P = 0.002$). A second field was replanted to control weeds, and several other fields were mowed after the nesting season to control weeds and invading woody plants.

Mean annual summer VORs in 1989 (47.4 cm), 1990 (45.6 cm) and 1991 (37.5 cm) were comparable to those found in other recent CRP evaluations in the Midwest. Luttschwager et al. (1994) and Kantrud (1993) reported mean midsummer VORs of 49 cm in South Dakota, 55 cm in Minnesota and 36 cm in North Dakota. No attempt was made in my study or the North Dakota, South Dakota or Minnesota studies to relate VORs to nest success.

Based upon 1989 IVs, CRP vegetation in my study areas was dominated by forbs, including red clover (*Trifolium pratense*), alfalfa (*Medicago sativa*) and weed species such as horseweed (*Conyza canadensis*) and common dandelion (*Taraxacum officinale*). Grasses were cool-season introduced species, such as erect brome (*Bromus erectus*), orchard grass (*Dactylis glomerata*), quackgrass (*Elytrigia repens*) and foxtail grasses (*Setaria* spp.).

By 1991, grasses had become dominant with mean IVs increasing significantly from 1989 (0.044) to 1991 (0.518; $t = 2.456403$, 24 df, $P = 0.02$). Importance values for forbs decreased reciprocally. Foxtail grasses, horseweed and alfalfa declined while quackgrass and red clover maintained their dominance. Erect brome and goldenrod (*Solidago* spp.) became increasingly abundant. Orchard grass, dandelion and ragweed (*Ambrosia* spp.) maintained a low but stable presence. The replacement of forbs by grasses was also reported by Hays et al. (1989) for a large sample of CRP fields throughout the nation and by Furrow (1994) in CRP fields in Michigan. The vegetative composition of CRP fields studied by Johnson and Schwartz (1993) was similar with about 50% grasses.

The CRP vegetation also became more diverse. The mean number of species found in each CRP field increased significantly from 1989 (12.1) to 1991 (14.8; $t = 2.455905$, 23 df, $P = 0.02$). The mean number of species per sample quadrate also appeared to increase in that same period.

Duck Production

Mallard (*Anas platyrhynchos*) and Blue-winged Teal (*A. discors*) nests found in CRP fields increased from 1989 (18) to 1990 (31), then dropped in 1991 (22). The ratio of Blue-winged Teal to Mallard nests increased from 2:1 in 1989 to 3:1 in 1990, and to 4:1 in 1991. No nests of other duck species were found nesting in the CRP fields.

Nest success in CRP fields varied among years ($X^2 = 9.23$, df = 2, $P = 0.001$), dropping drastically from 52% (24.1-100%) to only 13% (5.6-29.8%) in 1990 but rising again to 34% (17.7- 6.3%) in 1991. Of the 34 habitat variables measured at the nest, only three significantly affected nest success. Nests further from the edges of CRP fields ($X^2 = 9.85$, df = 1, $P = 0.002$) and nests with surrounding vegetation dominated by forbs ($X^2 = 3.93$, df = 1, $P = 0.05$) had higher rates of nest destruction. Mammalian predation, mainly by red fox (*Vulpes vulpes*), striped skunk (*Mephitis mephitis*) and common raccoon (*Procyon lotor*), was the major cause of nest failures. Mean 1989-91 Mayfield nest success was 27% (17.7-41.9%) and compared favorably with a mean success rate of 23% for CRP nests in North Dakota and Minnesota (Kantrud 1993) and 22% in South Dakota (Luttschwager et al. 1994). The mean Mayfield nest success in my study was above the 20% level calculated by Gatti (1987) needed to maintain stable breeding Mallard populations in Wisconsin and by Klett et al. (1988) for Blue-winged Teal in the prairie pothole region of North America.

The mean 1989-91 nest density of 2.2 nests/40.5 ha (100 acres) in CRP fields was apparently lower than a mean 1989-90 density of 16.1 Mallard and Blue-winged Teal nests/40.5 ha for idled CRP fields in South Dakota (Luttschwager et al. 1994). However, the mean nest density in my study was apparently only slightly lower than the mean density of 3.3 Mallard and Blue-winged Teal nests/40.5 ha for idled CRP fields in Minnesota and higher than the mean density of 1.3 nests/40.5 ha for the two duck species found in North Dakota CRP entries during 1989-91 (Kantrud 1993).

Despite CRP nest densities more than doubling in my fields from 1989 to 1990 (Table 1), duckling densities at hatch remained essentially the same (Table 2). In 1991, more ducklings were produced from fewer CRP nests compared to 1990. By comparison, I found 68 duck nests on WPAs in 1989 and 78 in 1990. The ratio of Blue-winged Teal nests to Mallard nests remained essentially the same in both years, approximately 2:1. Related nest densities were 7.3 nests/40.5 ha in 1989 and 8.1 nests/40.5 ha in 1990, more than twice that of CRP fields (Table 1). Kantrud (1993) reported 1989-91 mean densities of 7.6 Mallard and Blue-winged Teal nests/40.5 ha in Minnesota WPAs and 7.0 nests/40.5 ha in North Dakota WPAs.

Mean 1989-90 Mayfield nest success in WPA fields in my study was 21% (18-24.9%) and was not significantly different than nest success in CRP fields ($X^2 = 0.67$, df = 1, $P = 0.41$). Reynolds et al. (1994) also reported no differences in nest success in CRP and WPA nest cover in North and South Dakota during 1992-93. Mayfield nest success in my study appeared to be higher, 16% (6.8-28.8%) in 1989 and 19% (11.7-30.9%) in 1990, than the mean Mayfield nest success of 8% reported by Kantrud (1993) for Minnesota and North Dakota WPAs, but lower than that reported by Reynolds et al. (1994). Duckling densities increased from 1989 to 1990 and were 2-3-fold greater in my WPA fields than in CRP fields (Table 2) despite lower nest success in the WPAs.

Kantrud (1993) found higher nest success in CRP nest cover than in WPA nest cover. He speculated that the reason for the higher CRP nest success could be greater distance from water (and from nest predators) and larger field or patch size. However, a lower nest density negated the higher nest success in CRP cover in some years in my study when compared to WPA nest success and density.

Table 1. *Estimated mean duck and gallinaceous bird nest densities (total nests found/40.5 ha) in CRP and WPA fields, 1989-91.*

	1989		1990		1991[a]
Species	**CRP**	**WPA**	**CRP**	**WPA**	**CRP**
Mallard	0.7	2.5	0.8	3.0	0.4
Blue-winged Teal	0.6	4.7	2.3	5.1	1.7
Ring-necked Duck	0.0	0.1	0.0	0.0	0.0
All Duck Species	1.3	7.3	3.1	8.1	2.1
Ring-necked Pheasant	0.0	0.4	0.3	0.6	1.0
Gray Partridge	0.0	0.0	0.0	0.1	0.0
All Species	1.3	7.7	3.4	8.8	3.1

[a] No nest searching was conducted in WPAs in 1991.

Table 2. *Estimated mean duckling densities (total ducklings at hatch/40.5 ha) in CRP and WPA fields, 1989-91.*

	1989		1990		1991[a]
Species	**CRP**	**WPA**	**CRP**	**WPA**	**CRP**
Mallard	3.2	5.2	1.0	14.6	1.4
Blue-winged Teal	5.3	14.3	7.7	12.1	11.2
Total	8.5	19.5	8.7	26.7	12.6

[a] No nest searching was conducted in WPAs in 1991.

Pheasant Indices

Due to observed behavior of pheasant hens running from their nests before being flushed by the cable-chain drag, few nests were found (Table 1). In 1989, Ring-necked Pheasants were flushed from CRP fields while nest searching at a density of 0.1 adults/40.5 ha (Table 3). Two broods were seen. This increased to 1.1 adults flushed/40.5 ha in 1990 with four broods seen. Comparable flush densities for WPAs were 0.6 adult pheasants in 1989 and 1.2 in 1990. In 1991, pheasant flush densities for CRP entries rose to 1.6 adults/40.5 ha with 19 broods seen. Flush densities for pheasants in South Dakota CRP fields in 1989 and 1990, were 6.2 and 15.1, respectively (Luttschwager and Higgins 1992).

Crowing cock numbers on WPA and CRP fields in 1989 were similar. On 437 ha of WPA and 435 ha of contiguous private land, I found a density of one crowing cock/km^2. The same density of one crowing cock was found on 426 CRP ha and 434 ha of contiguous private land. In 1990, crowing cocks increased to 1.7/km^2 on WPAs and 2/km^2 on CRP fields. In 1991, crowing cocks increased further to 2.2/km^2 on WPAs and 2.3/km^2 on CRP entries.

Densities of crowing cocks were up to 10-fold higher on the CRP and WPA lands than in surrounding cropland. Road transects in Stanton and Erin Prairie Townships and 3 adjoining townships yielded densities from 0.2 crowing cocks/km^2 in 1989 to 0.5 crowing cocks/km^2 in 1991. No more than 3% of the total land area in any of the five townships was dedicated wildlife habitat (CRP and WPA). Hutchinson (1981) in southern Minnesota has similarly reported higher pheasant densities on and adjacent to wildlife management properties than in surrounding private cropland. Riley (1995) found that Iowa pheasant numbers increased in response to the CRP.

Other Wildlife

The CRP fields searched provided habitat for many other wildlife species including gray partridge (*Perdix perdix*), white-tailed jackrabbits (*Lepus townsendii*) and white-tailed deer (*Odocoileus virginianus*) fawns (Table 3). Luttschwager and Higgins (1992) also flushed numerous deer fawns from South Dakota CRP fields.

Although anecdotal in nature, we found two northern harrier (*Circus cyaneus*) and two short-eared owl (*Asio flammeus*) nests while nest searching one 56-ha CRP field in 1991. We also found a coyote (*Canis latrans*) den containing three pups and observed an adult red fox and three rough-legged hawks (*Buteo lagopus*) hunting in the field (Evrard et al. 1991). Through snap-trapping (Zippen 1958, Yang et al. 1970), we determined that the raptors and mammalian predators were responding to a population eruption of meadow voles (*Microtus pennsylvanicus*) in the CRP grassland. The catch/effort (CE) ratio (Nelson and Clark 1973) for small mammals, 95% meadow voles, was 19.37 in 1991. This was very high compared to a mean CE of 6.8 (range 0-24.7) for 106 WPA fields trapped during 1982-90 (Evrard 1993). Furrow (1994) also reported relatively high numbers of meadow voles in CRP fields in Michigan.

Table 3. *Mean Ring-necked Pheasant, Gray Partridge, white-tailed jackrabbit and white-tailed deer flushed/40.5 ha searched in CRP and WPA fields, 1989-91.*

	1989		1990		1991[a]
Species	**CRP**	**WPA**	**CRP**	**WPA**	**CRP**
Ring-necked Pheasant					
Adult Males	<0.1	0.1	0.3	0.2	0.3
Adult Females	0.1	0.5	0.8	1.0	1.3
Total Adults	0.1	0.6	1.1	1.2	1.6
Broods	0.1	0	0.2	0.3	0.9
Gray Partridge					
Adults	0.4	<0.0	0.1	0.3	0.2
Broods	<0.1	0.0	0	0	0
White-tailed Jackrabbit					
Adults	0.5	0	0.2	0	0
White-tailed Deer					
Fawns	0.4	0	0.2	0.3	0.4

[a] No nest searching was conducted in WPAs in 1991.

Conclusions

Grasses became more dominant, replacing forbs, and species richness increased over time in the vegetation of CRP fields. Mallard and Blue-winged Teal nest density and nest success fluctuated in what appeared to be an inverse relationship from year to year in CRP nest cover. Although mean duck nest success in nearby WPAs was not different than in CRP fields, WPA nest density was greater. As a result, 2-3-fold more ducklings were produced in WPA fields than in CRP fields. Pheasant index numbers were similar in the WPAs and the CRP fields, but up to 10-fold higher than adjacent cropland. CRP fields also provided habitat for a variety of other wildlife, enhancing wildlife populations in the agriculturally dominated landscape.

Literature Cited

Burger, G.V.
1966. Observations on aggressive behavior of male ring-necked pheasants in Wisconsin. *Journal of Wildlife Management* 30:57-64.

Curtis, J.T.
1959. *The Vegetation of Wisconsin: An Ordination of Plant Communities*. Univ. Wisconsin Press, Madison. 657 pp.

Einersen, A.S.
1956. *Determination of Some Predator Species by Field Signs*. Studies in Zoology, Oregon State Monographs. Oregon State College, Corvallis. 34 pp.

Evrard, J.O.
1993. Small mammal populations of managed grasslands in St. Croix County, Wisconsin. Paper presented at annual St. Croix River Research Rendezvous, Marine on Saint Croix, MN. 19 October 1993.

Evrard, J.O.
1996. Winter weather and pheasant populations and harvests in northwestern Wisconsin. Wis. Dept. Nat. Resourc. *Research Report* (171):1-20. [PUBL-RS-571-96]

Evrard, J.O. and R.A. Lillie.
1987. Duck and pheasant management in the pothole region of Wisconsin. Interim Rept. Study 316. Wisconsin Dept. Nat. Resourc. Pittman-Robertson Wisconsin Proj. W-141-R. Madison. 115 pp.

Evrard, J.O., D.A. Snobl, P.B. Doeneir and J.A. Dechant.
1991. Nesting short-eared owls and voles in St. Croix County. *Passenger Pigeon* 53:223-226.

Furrow, L.T.
1994. The influence of field age on mammalian relative abundance, diversity, and distribution on Conservation Reserve Program lands in Michigan. MS Thesis. Michigan State Univ., East Lansing. 132 pp.

Gates, J. M.
1966. Crowing counts as indices to cock pheasant populations in Wisconsin. *Journal of Wildlife Management* 30:735-744.

Gatti, R.C.
1987. Duck production: The Wisconsin picture. Wisconsin Dept. Nat. Resourc. *Research/Management Findings* (1):1-4.

Gustafson, T.L.
1984. *Epistat, Statistical Package for the IBM Personal Computer,* Version 3.1. Distributed by the Author. Round Rock, TX.

Hays, R.L., R.P. Webb and A.H. Farmer.
1989. Effects of the Conservation Reserve Program on wildlife habitat: Results of 1988 monitoring. *Transactions of the North American Natural Resources Conference* 54:365-376.

Higgins, K.F., L.M. Kirsch and I.J. Ball, Jr.
1969. A cable-chain device for locating duck nests. *Journal of Wildlife Management* 33:1009-1011.

Hutchinson, C.
1981. Effects of wildlife management areas on spring pheasant population size in southern Minnesota. *Minnesota Wildlife Research Quarterly* 41:71-76.

Johnson, D.H.
1979. Estimating nest success: The Mayfield method and an alternative. *Auk* 96:651-661.

Johnson, D.H. and M.D. Schwartz.
1993. The Conservation Reserve Program: Habitat for grassland birds. *Great Plains Research* 3:273-295.

Kantrud, H.A.
1993. Duck nest success on Conservation Reserve Program land in the prairie pothole region. *Journal of Soil and Water Conservation* 48:238-242.

Kimball, J.W.
1949. The crowing count pheasant census. *Journal of Wildlife Management* 13:101-120.

Kimball, J.W., E.L. Kozicky and B.A. Nelson.
1956. Chapter 5 - Pheasants of the plains and prairies. Pp. 204-263 In D.L. Allen (ed.). *Pheasants in North America*. Stackpole Co. and Wildl. Manage. Inst., Harrisburg, PA and Washington, DC. 490 pp.

Klett, A.T., H.F. Duebbert, C.A. Faanes and K.F. Higgins.
1986. Techniques for studying nest success in upland habitats in the Prairie Pothole Region. U.S. Fish and Wildl. Serv. *Resour. Publ.* 158. 24 pp.

Klett, A.T., T.L. Shaffer and D.H. Johnson.
1988. Duck nest success in the prairie pothole region. *Journal of Wildlife Management* 52:431-440.

Langner, L.L.
1989. Land-use changes and hunter participation: The case of the Conservation Reserve Program. *Transactions of the North American Wildlife and Natural Resources Conference* 54:382-390.

Langton, J.E.
1978. *Soil Survey of St. Croix County, Wisconsin.* USDA Soil Conserv. Serv., Washington, D.C.

Luttschwager, K.A., K.F. Higgins and J.A. Jenks.
1994. Effects of emergency haying on duck nesting in Conservation Reserve Program fields, South Dakota. *Wildlife Society Bulletin* 22:403-408.

Luttschwager, K.A. and K.F. Higgens.
1992. Nongame bird, game bird, and deer use of Conservation Reserve Program fields in eastern South Dakota. *Proceedings of the South Dakota Academy of Sciences* 71:31-36.

Nelson, L. and F.W. Clark.
1973. Correction for sprung traps in catch/effort calculations of trapping results. *Journal of Mammalogy* 54:295-298.

Osborn, T.
1993. The Conservation Reserve Program: Status, future, and policy options. *Journal of Soil and Water Conservation* 48:271-278.

Petersen, L.R., M.A. Martin, J.M. Cole, J.R. March and C.M. Pils.
1982. Evaluation of waterfowl production areas in Wisconsin. Wisconsin Dept. Nat. Resourc. *Technical Bulletin* (135):1-32.

Rearden, J.D.
1951. Identification of waterfowl nest predators. *Journal of Wildlife Management* 15:386-395.

Reynolds, R.E., T.L. Shaffer, J.R. Sauer and B.G. Peterjohn.
1994. Conservation Reserve Program: Benefit for grassland birds in the northern Great Plains. *Transactions of the North American Wildlife and Natural Resources Conference* 59:328-336.

Riley, T.Z.
1995. Association of the Conservation Reserve Program with ring-necked pheasant survey counts in Iowa. *Wildlife Society Bulletin* 23:386-390.

Robel, R.J., J.N. Briggs, A.D. Dayton and L.C. Hulbert.
1970. Relationships between visual obstruction measurements and weight of grassland vegetation. *Journal of Range Management* 23:295-297.

SAS Institute.
1989. *SAS/STAT User's Guide*. Vol. 2, Ver. 6.08, Fourth ed. SAS Institute, Inc., Cary, NC. 943 pp.

Soil Conservation Service.
1993. Conservation Reserve Program — Total county acres enrolled. U.S.D.A., Soil Conserv. Serv., Madison.

U.S. Congress. House. Committee on Appropriations.
1986. *Agriculture, Rural Development and Related Agencies Appropriations for 1987. Part 3, Agricultural Programs. Hearing before a Subcommittee of the Committee on Appropriations.* 99th Cong., 2nd sess.

Weller, M.W.
1956. A simple field candler for waterfowl eggs. *Journal of Wildlife Management* 20:111-113.

Yang, C.K., C.J. Krebs and B.L. Keller.
1970. Sequential live-trapping and snap trapping studies of *Microtus* populations. *Journal of Mammalogy* 51:517-526.

Young, C.E. and C.T. Osborn.
1990. Costs and benefits of the Conservation Reserve Program. *Journal of Soil and Water Conservation* 45:370-373.

Zippen, C.
1958. The removal method of population estimation. *Journal of Wildlife Management* 22:82-90.

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