THE VALUE OF FARM PROGRAMS FOR PROVIDING WINTER COVER AND FOOD FOR MINNESOTA PHEASANTS

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SUMMARY OF FINDINGS

The purpose of this study was to determine how much winter habitat is needed to sustain local populations of ring-necked pheasants (*Phasianus colchicus*) over a range of winter conditions. We estimated relative abundance of pheasant populations on 36 study areas using roadside surveys. In addition, we estimated amounts of winter cover, winter food, and reproductive cover on each study area by cover mapping to a geographic information system (GIS). During 2003-2007, pheasant population indices varied in association with weather and habitat. A preliminary evaluation indicated that mean pheasant indices were positively related to habitat abundance (r^2 = 0.115; P = 0.02) for all study areas combined, but this relationship was not significant for all regions. Five consecutive mild winters have hampered our ability to estimate winter habitat needs. Future work will include improved estimates of habitat abundance, and more complex analysis of the association between pheasant indices and habitat parameters. Final products of this project will include GIS habitat models or maps that managers can use to target habitat development efforts where they may yield the greatest increase in pheasant numbers.

INTRODUCTION

Preferred winter habitat for ring-necked pheasants in the Midwest includes grasslands, wetlands, woody cover, and a dependable source of food (primarily grain) near cover (Gates and Hale 1974, Trautman 1982, Perkins et al. 1997, Gabbert et al. 1999). However, emergent wetlands and woody habitats that are large enough to provide shelter during severe winters have been extensively removed from agricultural landscapes, and grasslands and grain stubble are inundated by snow during some years. During severe winters, pheasants without access to sufficient winter habitat are presumed to perish or emigrate to landscapes with adequate habitat. Birds that emigrate >3.2 km (2 miles) from their breeding range are unlikely to return (Gates and Hale 1974).

Over 400,000 ha (1 million acres) of cropland in Minnesota's pheasant range are currently retired under the Conservation Reserve Program (CRP). Wetland restorations, woody habitats and food plots are eligible cover practices in the CRP, but most appear inadequate in size, design, or location to meet pheasant habitat needs. Furthermore, small woody plantings sometimes established on CRP lands may reduce the quality of adjacent grass reproductive habitat without providing intended winter cover benefits.

Pheasants use grasslands for nesting and brood rearing, and we previously documented a strong relationship between grassland abundance and pheasant numbers (Haroldson et al. 2006). However, information is lacking on how much winter habitat is needed to sustain pheasant populations during mild, moderate, and severe winters. The purpose of this study is to quantify the relationship between amount of winter habitat and pheasant abundance over a range of winter conditions. Our objectives are to: (1) estimate pheasant abundance on study areas with different amounts of reproductive cover, winter cover, and winter food over a time period capturing a range of winter severities (≥5 years); (2) describe annual changes in availability of winter cover as a function of winter severity; and (3) quantify the association between mean pheasant abundance (over all years) and amount of reproductive cover, winter cover, and winter food.

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METHODS

We selected 36 study areas of contrasting land cover in Minnesota's core pheasant range to ensure a wide range of habitat configurations. Study areas averaged 23 km^2 (9 $miles^2$) in size, and were selected to vary in the amount of winter cover, winter food, and reproductive cover. We defined winter cover as cattail (*Typha* spp.) wetlands ≥4 ha (10 acres) in area (excluding open water), dense shrub swamps ≥4 ha (10 acres) in area, or planted woody shelterbelts ≥0.8 ha (2 acres) in area, ≥60 m (200 feet) wide, and containing ≥2 rows of conifers (Gates and Hale 1974, Berner 2001). Winter food was defined as grain food plots left unharvested throughout the winter and located ≤0.4 km (1/4 mile) from winter cover (Gates and Hale 1974). Reproductive cover included all undisturbed grass cover ≥6 m (20 feet) wide. To facilitate pheasant surveys, we selected study areas that were square in shape and contained a uniform distribution of roads through the study area interior. Nine study areas were selected in each of 4 regions located near Marshall, Windom, Glenwood, and Faribault, Minnesota (Figure 1).

We estimated amounts of winter cover, winter food, and reproductive cover on each study area by cover mapping to a GIS using recent (2003, 2004, 2005, and 2006) aerial photographs. In addition, we mapped large habitat patches within a 3.2-km (2-mile) buffer around study area boundaries to assess the potential for immigration to and emigration from study areas. We used Farm Service Agency GIS coverages of farm fields (Common Land Units) as base maps, and edited field boundaries to meet the habitat criteria of this project. Cover types were verified by ground-truthing all habitat patches visible from roads. Because cover mapping of cattail wetlands, shrub swamps, and undisturbed grasslands is still in progress, for this progress report we made preliminary estimates of the amounts of these habitats from GIS coverages of the National Wetlands Inventory (NWI), Wildlife Management Areas (WMAs), Waterfowl Production Areas (WPAs), and CRP enrollments. We recognize that not all cattail wetlands, shrub swamps, and undisturbed grasslands are included in these GIS coverages.

We used historical climate summaries (Minnesota Climatology Working Group, http://climate.mn.edu) to calculate an index to winter severity for each year (2003-2007) and region. Our winter-severity index was based on Evrard (1996) and was calculated as the sum of the number of days with minimum temperature $\leq$–18 °C (0^{o}F) and number of days with snow depth $\geq$15 cm (6 inches). We defined winter for a given year as 1 December of the previous year to 31 March.

We estimated relative abundance of pheasant populations on each study area using roadside surveys (Haroldson et al. 2006). Roadside surveys consisted of 16–19 km (10–12 mile) routes primarily on gravel roads (≤ 6 km [4 miles] of hard-surface road). Observers drove each route starting at sunrise at an approximate speed of 24 km/hour (15 miles/hour) and recorded the number, sex, and age of pheasants observed. Surveys were repeated 10 times on each study area during spring (20 April – 20 May) and summer (20 July – 20 August). Surveys were conducted on mornings meeting standardized weather criteria (cloud cover <60%, winds ≤16 km/hour [10 miles/hour], temperature ≥0^{o}C [32^{o}F], dew present) 1–2 hours before sunrise. Surveys were completed even if conditions deteriorated after the initial weather check. We attempted to survey all study areas within a region on the same days, and observers were systematically rotated among study areas to reduce the effect of observer bias.

Observers carried Global Positioning System receivers while conducting roadside surveys to record their time and position throughout each survey (track logs), and to record the location of observed pheasants (waypoints). We inspected all track logs for each observer to ensure that surveys were conducted at the correct time, location, and speed of travel.

For each study area and season, we calculated a population index (pheasants counted/route) from the total number of pheasants counted/total survey distance driven over all 10 repetitions. We standardized the index to pheasants/161 km (pheasants/100 miles) to adjust for variation in survey distance among study areas. We evaluated temporal trends in pheasant abundance by calculating mean percent change in population indices by region and in total. We interpreted trends as statistically significant when 95% confidence intervals of percent change did not include 0.

To evaluate the effect of habitat on pheasant abundance, we calculated a cover index for each study area:

$$CI = [(UG/Max)x4 + (WCwFP/Max)x4 + (WCwoFP/Max)x2 + (FP/Max)] / 11$$

Where; UG = undisturbed grass (% of study area)
WCwFP = winter cover near a food plot (number of patches)
WCwoFP = winter cover without a nearby food plot (number of patches)
FP = food plot (number of patches)
Max = maximum observed value among all 36 study areas.

The cover index combined the effects of reproductive cover, winter cover, and winter food into a single weighted average (weight based on a preliminary estimate of relative importance). Potential values of cover index ranged from 0.0 (poorest habitat) to 1.0 (best habitat). We acknowledge that the cover index is an oversimplification, and we used it only to make simple, 2-dimentional plots for this early progress report. We evaluated the association of cover indices to pheasant population indices using simple linear regression.

RESULTS

We identified and mapped 355 patches of winter cover on the 36 study areas and surrounding 3.2-km (2-mile) buffers. Number of winter cover patches varied from 0-6 patches on study areas and 0-12 patches in surrounding buffers, totaling 0-18 patches on combined study areas and buffers.

Severity of winter weather was relatively mild during all 5 winters (2003-2007) of this study. Ranked winter severity indices (with rank of one being most severe) ranged from twenty-fifth to fifty-seventh for the 59-year period 1949-2007. Deep snow rendered the least robust patches of winter cover (e.g., 4-ha [10-acre] cattail wetlands) unavailable to pheasants for no more than 2 weeks during any of the 5 winters of this study.

Spring 2007 Surveys

Observers completed all 360 scheduled surveys (10 repetitions on 36 study areas) during the spring 2007 season. Despite strong efforts by surveyors to select days that best met weather standards, weather conditions were not consistent among surveys, ranging from excellent (calm, clear sky, heavy dew) to poor (wind >16 km/hour [10 miles/hour], overcast sky, no dew, or rain). Over all regions, 88% of the surveys were started with at least light dew present, which was similar to previous years (78-92%). Eighty-one percent of surveys were started under clear to partly cloudy skies (<60% cloud cover), 98% reported wind speeds <16 km/hour (10 miles/hour), and 100% of surveys were started on mornings with temperatures >0^{o}C (32^{o}F). Among regions, Faribault experienced the least dew (18% of surveys started with no dew) and most cloud cover (28% of surveys started with cloud cover ≥60%).

Pheasants were observed on all 36 study areas during spring 2007, but abundance indices varied widely among areas from 19.2–519.4 pheasants observed per route (Table 1). Over all study areas, the mean pheasant index was 202.0 birds/route, a 28% increase (95% CI: 10–46%) from spring 2006 and the highest observed during the 5 years of this study (Table 2). Total pheasants/route varied among regions from 77.6 in the Faribault region to 273.4 in the Marshall region (Table 2). Compared to 2006, total indices changed significantly only in the Glenwood region (101%; 95% CI: 57–145%; Table 2).

Hens were relatively abundant during spring 2007. The overall hen index averaged 120.5/route, a 31% increase (95% CI: 9–53%) from 2006 (Table 2). Among regions, the hen index ranged from 30.9/route in Faribault to 175.0/route near Marshall. Hen indices increased significantly from 2006 in Glenwood (121% increase; 95% CI: 70–172%) and Marshall (39% increase; 95% CI: 3–75%), remained unchanged in Windom, and decreased in Faribault (29% decrease; 95% CI: 14–44; Table 2). The observed hen:rooster ratio varied from 0.5 to 2.8 among study areas (Table 1). Fewer hens than roosters were observed on 1 study area in the Glenwood region and 8 areas in Faribault.

Summer 2007 Surveys

Observers completed all 360 scheduled surveys during the summer 2007 season. Weather conditions during the summer surveys ranged from excellent (calm, clear sky, heavy dew) to poor (light or no dew, overcast sky). Over all regions, 76% of the surveys were started with medium-heavy dew present, which was similar to 2006 (75%) but lower than 2005 (81%), 2004 (87%), and 2003 (81%). Prevelance of medium-heavy dew conditions this year were similar among the Faribault (83%), Marshall (81%), and Windom regions (82%), but much lower (56%) in Glenwood. For all regions combined, 73 percent of surveys were started under clear skies (<30% cloud cover), and 73% reported wind <6 km/hour (4 miles/hour). In comparison, 89% of the statewide August Roadside Surveys were started under medium-heavy dew conditions, 83% under clear skies, and 75% with winds <6 km/hour (4 miles/hour). The less desirable weather conditions reported in this study probably reflect the limited availability of 10 suitable survey days within the 31-day period.

Pheasants were observed on all 36 study areas during 2007, but abundance indices varied widely from 14.2–553.2 pheasants observed per route (Table 3). Over all study areas, the mean pheasant population index of 150.8 birds/route was not significantly different from 2006 (161.9 birds/route). Total pheasant indices varied among regions from 56.4 birds/route in the Faribault region to 281.3 birds/route in Marshall (Table 4). Regional indices of total pheasants were similar to 2006 (Table 4).

The overall hen index (28.8 hens/route) was similar to last year (28.7 hens/route), and varied among regions from 7.5 in the Faribault region to 53.1 near Marshall (Table 4). Hen indices decreased 31% (95% CI: –2 to–50%) in the Faribault region, but were not significantly changed from 2006 in the Glenwood, Faribault, or Windom regions (Table 4). The cock index increased significantly overall and in the Glenwood region (Table 4). The observed hen:rooster ratio varied from 0.2 to 3.7 among study areas (Table 3), and averaged 1.5 overall. Fewer hens than roosters were observed on 1 study area in the Windom region, 2 in the Glenwood region and 6 study areas in the Faribault region.

The 2007 overall brood index (21.0 broods/route) was similar to 2006 (23.1 broods/route), with regional indices ranging from 8.0 in Faribault to 37.2 in Marshall (Table 4). Regional brood indices were similar to 2006 except in Glenwood, where they decreased 24% (95% CI: -47 to -1%) (Table 4). Mean brood size averaged 4.9 chicks/brood overall, but varied among regions from 4.6 in Glenwood to 5.1 in Faribault. Mean brood size in 2007 increased 25% (95% CI: 9–41%) over that in 2006 in the Windom region and was similar to 2006 in Glenwood, Faribault, and Marshall (Table 4). On average, 20.5 broods were observed for every 100 hens counted during spring surveys, which was similar to last year. This brood recruitment index (broods/100 spring hens) varied among regions from 10.1 in Glenwood to 28.1 in Faribault. Brood recruitment indices decreased significantly only in the Glenwood region (95% CI: -36 to -78%) (Table 4).

Habitat Associations

For all study areas combined, the mean pheasant index (total pheasants/route averaged over summer 2003–2007) was significantly related to cover index ($r^2 = 0.15$; $P = 0.02$). Among regions, however, pheasant indices were significantly associated with cover indices for Marshall only ($r^2 = 0.72$; $P < 0.01$; Figure 2).

DISCUSSION

We expected a high spring hen population in 2007 given the relatively mild winter of 2007. The overall increase (all study areas combined) in hen indices was heavily influenced by the 121% increase in hens counted in the Glenwood region, where winter severity was mildest (2 periods of deep snow persisting only 2 weeks each). In contrast, winter severity was greatest in the Faribault region (11 weeks of persistent snow), where the hen index declined.

Weather during the reproductive period was warmer and drier than average, conditions conducive for increased nest success and chick survival. However, brood size increased only in the Windom region and the brood recruitment index (broods/100 spring hens) was relatively low, especially in the Glenwood region. Our study was not designed to determine cause for changes in population rates, but low recruitment during 2007 may have been a density-dependent response to high pheasant density (Berner 2001). Despite low rates of brood recruitment, total pheasant indices remained high due to above-average carryover of adults from 2006 plus average brood size in 2007.

At this early stage in our evaluation, we cannot explain the weak association between summer pheasant indices and habitat abundance (Figure 2). However, preliminary habitat estimates based on GIS coverages of the NWI, WMAs, WPAs, and CRP enrollments appear to have been incomplete, especially on the Glenwood and Faribault study areas. Habitat estimates will be improved as we complete cover mapping. In addition, future analyses of pheasant-habitat associations will use multiple regression models that treat reproductive cover, winter cover, and winter food as independent predictor variables.

Our study design called for at least 1 severe winter to estimate pheasant winter cover needs under the full range of Minnesota conditions. We expected pheasant populations to decline following severe winters, with the largest declines on study areas with the least amount of winter cover. However, 5 consecutive mild-moderate winters resulted in relatively high, stable pheasant populations on all study areas. Furthermore, the significant loss of CRP contracts expected during 2007-2009 will preclude an extension of this study. Thus, management implications resulting from this study may be limited to periods of mild-moderate winter weather.

We plan to complete annual cover mapping of all 36 study areas in 2008. Next, we will attempt to build a multiple regression model using data extracted from a previous pheasant habitat study (Haroldson et al. 2006) and test the model with data from this study. Finally, we will assess winter habitat availability in relation to snow depth and drifting during the next moderate-severe winter.

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Table 1. Pheasant population indices and sex ratios (female:male) after 10 repeated surveys (n) on 36 study areas in Minnesota, spring 2007.

			Birds/route[a]			
Region	Study area	n	Total	Cocks	Hens	F:M ratio
Marshall	1	10	437.3	156.0	281.3	1.8
	2	10	445.8	173.3	272.5	1.6
	3	10	364.1	152.4	211.7	1.4
	4	10	374.0	104.5	269.5	2.6
	5	10	251.7	99.6	152.1	1.5
	6	10	219.8	70.8	149.1	2.1
	7	10	173.6	46.8	126.8	2.7
	8	10	101.0	44.1	56.9	1.3
	9	10	93.4	38.2	55.3	1.4
Glenwood	10	10	100.0	42.5	57.5	1.4
	11	10	289.8	95.3	194.5	2.0
	12	10	306.7	139.5	167.1	1.2
	13	10	271.3	100.4	170.9	1.7
	14	10	250.4	115.5	134.9	1.2
	15	10	519.4	219.9	299.5	1.4
	16	10	139.0	71.0	68.1	1.0
	17	10	78.5	43.8	34.7	0.8
	18	10	282.4	108.3	174.1	1.6
Windom	19	10	430.5	114.7	315.8	2.8
	20	10	261.4	104.9	156.5	1.5
	21	10	164.2	62.6	101.6	1.6
	22	10	285.2	119.1	166.1	1.4
	23	10	269.3	110.4	158.9	1.4
	24	10	87.0	42.0	45.0	1.1
	25	10	92.5	30.4	62.1	2.0
	26	10	225.7	78.8	146.9	1.9
	27	10	58.3	27.4	30.9	1.1
Faribault	28	10	193.4	110.4	83.0	0.8
	29	10	50.5	32.2	18.3	0.6
	30	10	63.7	41.1	22.6	0.5
	31	10	111.8	71.1	40.7	0.6
	32	10	82.9	55.0	27.9	0.5
	33	10	80.2	42.2	37.9	0.9
	34	10	61.4	37.7	23.7	0.6
	35	10	35.4	21.2	14.2	0.7
	36	10	19.2	9.2	10.0	1.1

[a]Route length standardized to 161 km (100 miles).

Table 2. Regional trends (% change) in pheasant population indices on 36 study areas in Minnesota, spring 2003–2007.

			Birds/route[a]					% change	
Region	Group	n	2003	2004	2005	2006	2007	2006-2007	95% CI
Marshall	Total pheasants	9	87.2	116.3	110.4	211.4	273.4	34	±34
	Cocks	9	43.1	47.4	47.7	78.2	98.4	29	±33
	Hens	9	44.1	68.9	62.7	133.2	175.0	39	±36
Glenwood	Total pheasants	9	100.9	113.0	84.5	126.3	248.6	101	±44
	Cocks	9	48.7	47.2	40.2	60.3	104.0	88	±51
	Hens	9	52.2	65.9	44.3	66.0	144.6	121	±51
Windom	Total pheasants	9	162.3	179.7	167.6	234.3	208.2	-8	±16
	Cocks	9	69.4	75.8	65.0	90.5	76.7	-11	±15
	Hens	9	92.9	103.9	102.6	143.9	131.5	-6	±18
Faribault	Total pheasants	9	70.3	86.0	57.3	91.1	77.6	-15	±15
	Cocks	9	37.1	47.1	33.5	44.3	46.7	2	±20
	Hens	9	33.2	38.8	23.8	46.8	30.9	-29	±15
All	Total pheasants	36	105.2	123.8	104.9	165.8	202.0	28	±18
	Cocks	36	49.6	54.4	46.6	68.3	81.5	27	±18
	Hens	36	55.6	69.4	58.3	97.5	120.5	31	±22

[a]Route length standardized to 161 km (100 miles).

Table 3. Pheasant population indices and sex ratios (female:male) after 10 repeated surveys (n) on 36 study areas in Minnesota, summer 2007.

Region	Study area	n	Birds/route[a] Total	Cocks	Hens	F:M ratio	Chicks/ route[a]	Broods/ route[a]	Chicks/ brood	Broods/100 Summer hens	Broods/100 Spring hens
Marshall	1	10	553.2	52.3	89.2	1.7	411.7	74.8	5.5	0.838	0.266
	2	10	477.5	72.1	81.3	1.1	324.2	55.0	5.9	0.677	0.202
	3	10	145.6	24.8	49.0	2.0	71.8	21.4	3.4	0.436	0.101
	4	10	265.0	26.0	53.0	2.0	186.0	34.0	5.5	0.642	0.126
	5	10	406.7	50.8	57.5	1.1	298.3	50.0	6.0	0.870	0.329
	6	10	175.5	16.0	41.5	2.6	117.9	29.2	4.0	0.705	0.196
	7	10	315.5	26.4	66.4	2.5	222.7	43.6	5.1	0.658	0.344
	8	10	116.8	12.4	26.2	2.1	78.2	17.8	4.4	0.679	0.313
	9	10	75.7	13.2	14.1	1.1	48.4	9.1	5.3	0.645	0.165
Glenwood	10	10	58.0	5.0	10.0	2.0	43.0	8.0	5.4	0.800	0.139
	11	10	66.9	14.0	13.1	0.9	39.8	13.6	2.9	1.032	0.070
	12	10	124.8	27.1	32.9	1.2	64.8	20.0	3.2	0.609	0.120
	13	10	52.2	12.6	10.9	0.9	28.7	8.7	3.3	0.800	0.051
	14	10	183.3	14.0	31.6	2.3	137.7	27.2	5.1	0.861	0.202
	15	10	141.7	24.1	33.3	1.4	84.3	21.3	4.0	0.639	0.071
	16	10	66.7	6.2	16.7	2.7	43.8	8.6	5.1	0.514	0.126
	17	10	20.7	7.4	6.6	0.9	6.6	0.8	8.0	0.125	0.024
	18	10	128.7	23.6	22.7	1.0	82.4	19.4	4.2	0.857	0.112
Windom	19	10	214.7	17.4	59.5	3.4	137.9	36.8	3.7	0.619	0.117
	20	10	260.6	25.2	41.7	1.7	193.6	37.1	5.2	0.889	0.237
	21	10	147.4	10.0	28.9	2.9	108.4	25.3	4.3	0.873	0.249
	22	10	169.7	35.2	53.2	1.5	81.2	19.9	4.1	0.373	0.120
	23	10	175.2	24.3	39.1	1.6	111.9	25.7	4.3	0.658	0.162
	24	10	150.0	19.0	27.0	1.4	104.0	21.0	5.0	0.778	0.467
	25	10	83.2	12.6	14.5	1.1	56.1	9.3	6.0	0.645	0.150
	26	10	315.8	24.1	48.7	2.0	243.0	42.1	5.8	0.865	0.287
	27	10	28.7	10.4	2.6	0.3	15.7	3.5	4.5	1.333	0.113
Faribault	28	10	84.9	12.3	7.5	0.6	65.1	14.2	4.6	1.875	0.170
	29	10	19.8	5.0	1.0	0.2	13.9	3.0	4.7	3.000	0.162
	30	10	35.5	6.5	5.6	0.9	23.4	4.8	4.8	0.857	0.214
	31	10	116.7	13.7	16.7	1.2	86.3	14.7	5.9	0.882	0.361
	32	10	42.3	11.3	6.8	0.6	24.3	7.2	3.4	1.067	0.258
	33	10	72.0	2.6	9.5	3.7	59.9	10.4	5.8	1.091	0.275
	34	10	64.9	7.9	13.2	1.7	43.9	7.0	6.3	0.533	0.296
	35	10	57.5	9.7	6.2	0.6	41.6	8.8	4.7	1.429	0.625
	36	10	14.2	3.3	0.8	0.3	10.0	1.7	6.0	2.000	0.167

[a]Route length standardized to 161 km (100 miles)

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Table 4. Regional trends (% change) in pheasant population indices on 36 study areas in Minnesota, summer 2003–2007.

Region	Group	n	Birds/route[a] 2003	2004	2005	2006	2007	% change 2006-2007	95% CI
Marshall	Total pheasants	9	142.6	114.9	190.5	280.9	281.3	11	±49
	Cocks		12.7	13.5	10.5	26.2	32.7	38	±43
	Hens		25.6	20.5	32.3	49.1	53.1	21	±50
	Broods		22.3	16.8	35.0	38.9	37.2	–3	±30
	Chicks/brood		4.6	4.8	4.2	5.0	5.0	2	±15
	Broods/100 spring hens		59.9	29.8	77.2	35.9	22.7	–24	±27
Glenwood	Total pheasants	9	139.9	57.9	135.7	132.1	93.7	–17	±26
	Cocks		9.2	8.3	8.0	11.8	14.9	34	±33
	Hens		23.5	12.3	20.7	20.8	19.7	18	±38
	Broods		20.2	8.3	17.2	19.2	14.2	–24	±23
	Chicks/brood		5.0	4.1	6.1	5.2	4.6	–6	±25
	Broods/100 spring hens		44.7	14.7	42.8	29.3	10.1	–57	±21
Windom	Total pheasants	9	283.5	179.8	187.0	152.8	171.7	19	±29
	Cocks		25.9	23.6	13.8	25.9	19.8	–14	±21
	Hens		50.9	36.2	37.4	32.7	35.0	9	±23
	Broods		36.2	24.2	29.4	23.0	24.5	10	±30
	Chicks/brood		5.4	5.0	4.6	3.9	4.8	25	±16
	Broods/100 spring hens		47.1	29.1	30.2	18.7	21.1	32	±53
Faribault	Total pheasants	9	164.6	54.4	90.5	81.7	56.4	–10	±52
	Cocks		9.5	13.0	8.0	7.8	8.0	16	±44
	Hens		23.6	13.1	14.8	12.2	7.5	–31	±29
	Broods		23.6	6.8	12.6	11.4	8.0	12	±91
	Chicks per brood		5.5	5.0	5.5	5.3	5.1	–1	±15
	Broods/100 spring hens		85.4	18.6	71.0	27.6	28.1	77	±157
All	Total pheasants	36	182.6	101.7	150.9	161.9	150.8	1	±18
	Cocks		14.3	14.6	10.1	17.9	18.8	18	±17
	Hens		30.9	20.5	26.3	28.7	28.8	4	±17
	Broods		25.6	14.0	23.6	23.1	21.0	–1	±23
	Chicks/brood		5.1	4.7	5.1	4.8	4.9	5	±9
	Broods/100 spring hens		59.3	23.1	55.3	27.9	20.5	7	±39

[a]Route length standardized to 161 km (100 miles).

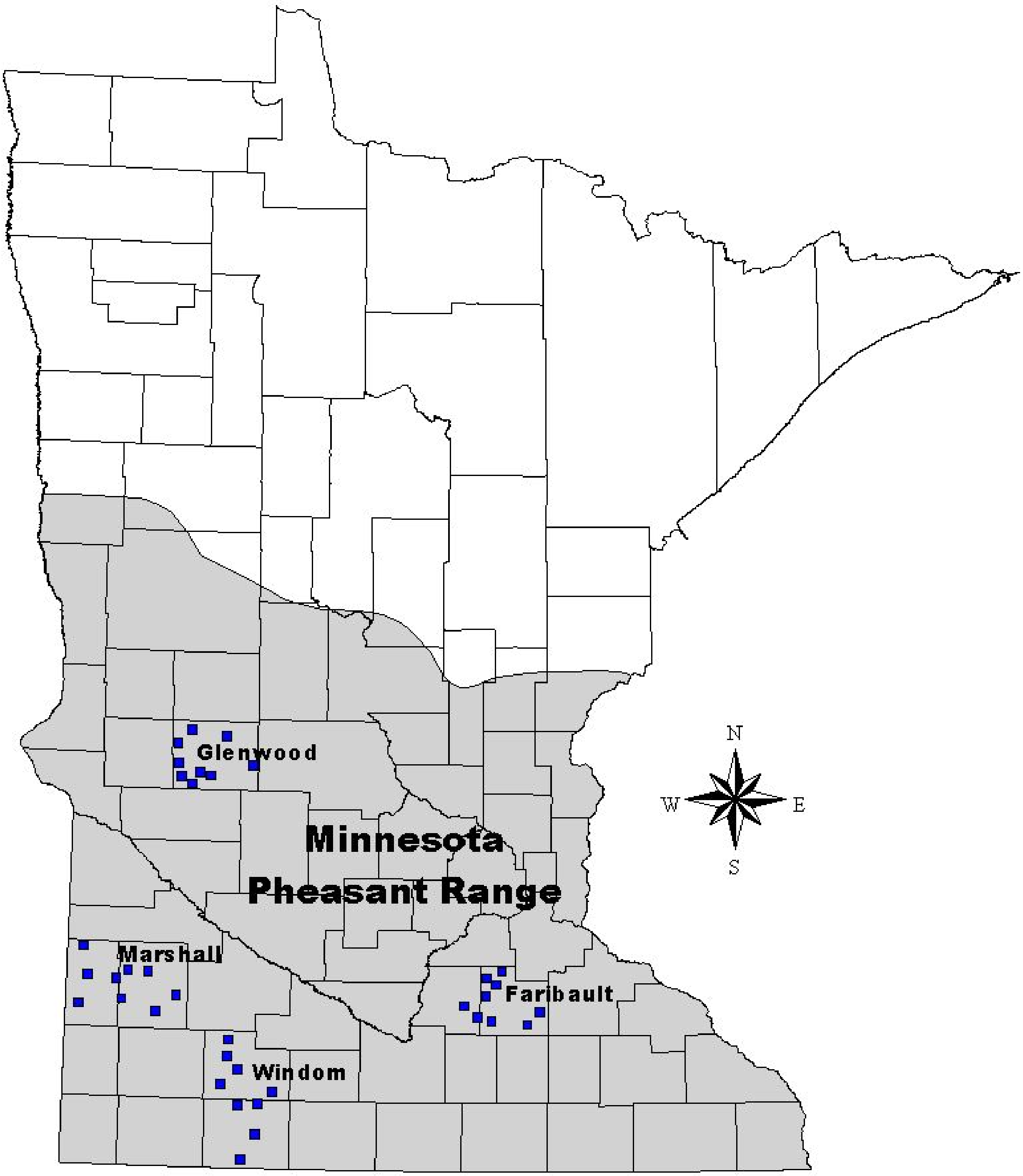

Figure 1. Locations of winter-habitat study areas within Minnesota's pheasant range, 2003-2007.

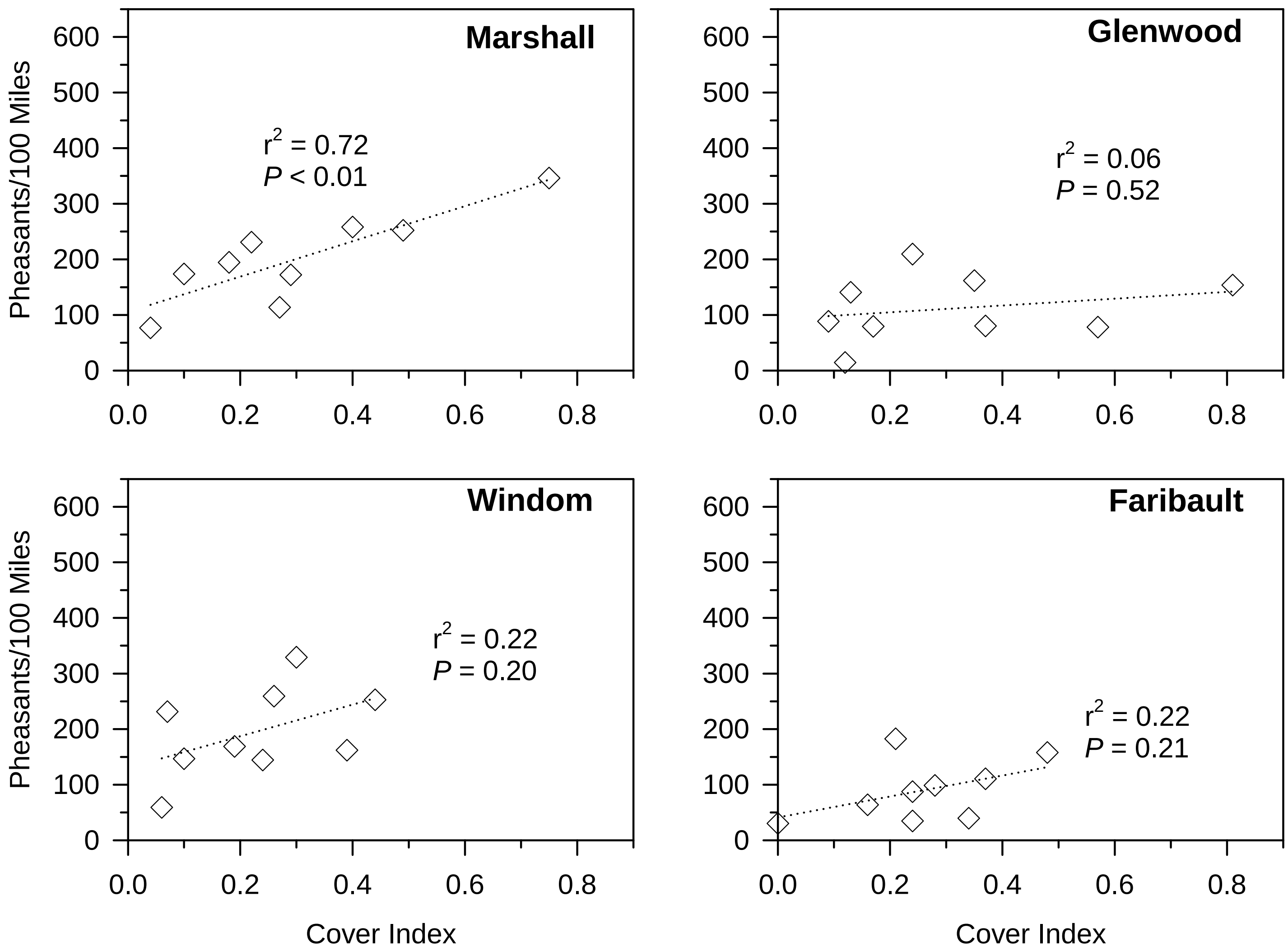

Figure 2. Relationship between relative pheasant abundance (pheasants counted/route) and amount of habitat (cover index) on 9 study areas in 4 regions in Minnesota during summer 2003-07. Route length was standardized to 161 km (100 miles).