EFFECT OF DROUGHT AND AGRICULTURE ON RING-NECKED PHEASANT ABUNDANCE, NEBRASKA PANHANDLE

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NOTES

EFFECT OF DROUGHT AND AGRICULTURE ON RING-NECKED PHEASANT ABUNDANCE, NEBRASKA PANHANDLE -- Regional declines in ring-necked pheasant (*Phasianus colchicus*; RNP) abundance have been documented from the late 1960's to the mid-1970's (Dahlgren 1988, Perkins et al. 1997) throughout the Northern Plains (Labisky 1976, Clark and Bogenschutz 1999) with Iowa (Farris et al. 1977), Kansas (Applegate and Williams 1998, Rodgers 1999), and Nebraska (Taylor et al. 1978), reporting declines. While region-wide declines in RNP abundance were reported, RNP abundance from all states reporting declines appear to have stabilized in the early 1980's. Declining RNP abundance has been attributed to multiple environmental factors, with weather (Snyder 1984, Riley et al. 1994, Riley 1995) habitat conversion (Taylor et al. 1978, Riley 1995, Clark and Bogenschutz 1999), and changing agricultural practices (Warner et al. 1982, Smith et al. 1999) the most frequently cited causes. While multiple studies exist on RNP, few studies on RNP abundance are available for Nebraska. At the peak of the Soil Bank Act, Nebraska had a total of 354,517 ha (876,000 acres) enrolled. When the act was repealed in 1965 the majority of enrolled hectares reverted back to agriculture, with decreased cereal grains; possibly contributing to declines in RNP abundance (Farrar 2000).

Frank and Woehler (1969) found a similar positive association between RNP abundance and hectares of cropland in Wisconsin. Unfortunately, specific crop types were not mentioned. Conversely, Taylor et al. (1978) and Smith et al. (1999) reported a negative relationship between hectares of row crops (e.g., milo and corn) and RNP abundance in south-central Nebraska.

Galliforms life histories (e.g., winter survival, nesting, and brood survival) are often affected by both habitat conversion and weather (Roseberry and Sudkamp 1998, Peterson et al. 2002). Exposure to severe weather conditions, specifically cold, wet, winter storms, might result in death due to hypothermia (Nelson and Janson 1949, Warner and David 1982). Spring and summer hail storms have been linked to hen mortality and destruction of unattended nests (Kimball 1945, Kozicky et al. 1955, Rodgers 1999). The effects of sustained periods of drought potentially can influence RNP survival, and ultimately abundance, as a result of starvation, decreased vegetation height and nesting/brood-rearing habitat (Riley et al. 1998), and increased exposure to predation (Gabbert et al. 1999, Homan et al. 2000). Habitat conversion also has been recognized as having direct and indirect impacts on RNP reproduction (Therres 1989, Smith et al. 1999). Direct effects of habitat conversion include a reduction in thermal cover, nesting/brood-rearing habitat, and available forage. Indirect effects of habitat conversion include increased exposure to predation (Gabbert et al. 1999, Homan et al. 2000). The objectives of my study were to determine the effects of drought (e.g., Palmer Modified Drought Severity Index; PMDI, Bridges et al. 2001) and/or agricultural practices (e.g., conversion) on RNP abundance in the Nebraska Panhandle (NP).

The NP consists of 11 counties in western Nebraska and is one of six districts managed by the Nebraska Game and Parks Commission (NGPC). Five Major Land Resource Areas (MLRAs), were present within the region. MLRAs ranged from the Central High Plains (Natural Resource Conservation Service 1998a), a community dominated by short and mixed-grass prairie vegetation (e.g., *Bouteloua gracilis*, *Buchloe dactyloides*, *Pascopyrum smithii*, *Aristida* spp., and *Sporobolus cryptandrus*), to Nebraska Sand Hills (Natural Resource Conservation Service 1998b) dominated by little bluestem (*Schizachyrium scoparium*), sand bluestem (*Andropogon hallii*), prairie sandreed (*Calamovilfa longifolia*), switchgrass (*Panicum virgatum*), Indian grass (*Sorghastrum nutans*), and needleandthread (*Hesperostipa comata*). Additional species present within the study area included prickly pear (*Opuntia* spp.), sand dropseed (*Sporobolus cryptandrus*), threadleaf sedge (*Carex filifolia*), sideoats grama (*Bouteloua curtipendula*), and various sedges (*Carex* spp.) and rushes (*Juncus* spp.). Annual precipitation was less than 38 cm and was distributed normally from January to December with precipitation peaks in May and June (National Oceanic and Atmospheric Administration 2004; www.ncdc.noaa.gov/oa/climate/research). Primary land uses in the NP were irrigated agriculture and ranching.

Rural Mail Carrier Surveys (RMCS) have been conducted annually in Nebraska since 1961 with carriers recording total observations of RNP, sharp-tailed grouse (*Tympanuchus phasianellus*), wild turkey (*Meleagris gallopavo*), black-tailed jackrabbit (*Lepus californicus*), and cottontail rabbits (*Sylvilagus floridanus* and *S. audubonii*) over their prescribed routes. RMCS have been correlated closely with other population indices (e.g., breeding bird counts, Christmas bird counts, hunter harvest; Wells and Sexson 1982, Applegate and Williams 1998). NGPC personnel compiled and summarized data from RMCS, with each species presented as number observed per 160 km of road driven (Scott Taylor, Nebraska Game and Parks Commission, personal communication). The accuracy of RMCS data is dependent in part on the number of cooperating mail carriers and the length of their delivery routes (Allen and Sargeant 1975). Several environmental factors have been shown to influence RMCS and other roadside survey techniques; including weather, seasonal activity, vegetation height, and non-replication of transects (Greeley et al. 1962, Saunders et al. 1971, Robinson et al. 2000, Williams et al. 2003). More recent survey techniques (e.g., August Roadside Survey) have instituted controls, mitigating these effects including surveying on clear, windless days, during early mornings, along pre-established transects that are replicated every year. Roadside vegetation height has been shown to influence detection probability of target species in many studies (Greeley et al. 1962, Saunders et al. 1971, Applegate 1997, Williams et al. 2003).

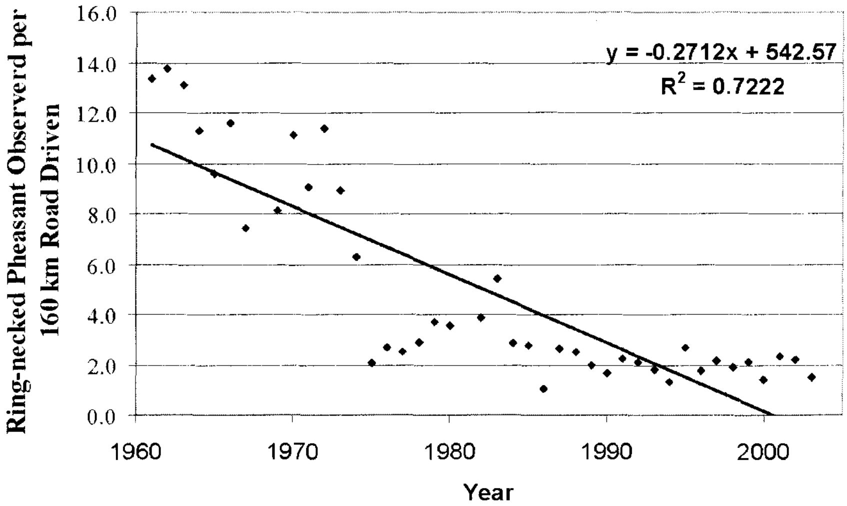

Figure 1. Simple linear regression of ring-necked pheasant observed per 160 km of Rural Mail Carrier Surveys route per year in the Nebraska Panhandle, 1961 through 2003.

I obtained summarized RMCS data for the NP, NGPC, District 1, from 1961 through 2003. Data from RMCS were plotted against year to determine population trends (Fig. 1). Drought (PMDI; monthly and annual precipitation) and agricultural data (annual hectares in production of row crops, cereal grains, and hay) were collected for the NP from the National Oceanic and Atmospheric Administration and National Agricultural Statistics Service, respectively. Kendall's tau-b tests were used to determine relationships between RCMS data and environmental variables. The Kendall's tau-b test is a non-parametric measure of correlation, where the sign indicates the direction of the relationship, with the absolute value indicating the strength of association (SPSS 2001). RMCS and hectares of individual crops were compared within a year. For oats, an over-winter crop, RMCS were compared to the previous year's production values. A correlation matrix was constructed to analyze interactions between weather variables and RMCS data. Monthly, seasonal, winter (year = n-1), and annual precipitation, drought indices, and monthly, seasonal, and annual temperatures were compared to RMCS data.

RMCS data showed declines in RNP observed from 1961-2003 ($R^2 = 0.72$; Fig. 1). Two periods, one of decline (1961-1974) and one of depressed RNP observations (1975-2003) (Fig. 2) were observed. Variation of RNP observed was greater from 1961 through 1974 ($\sigma^2 = 5.6$), than 1975 through 2003 ($\sigma^2 = 0.8$). While two distinct periods are present in the dataset, no difference was detected between

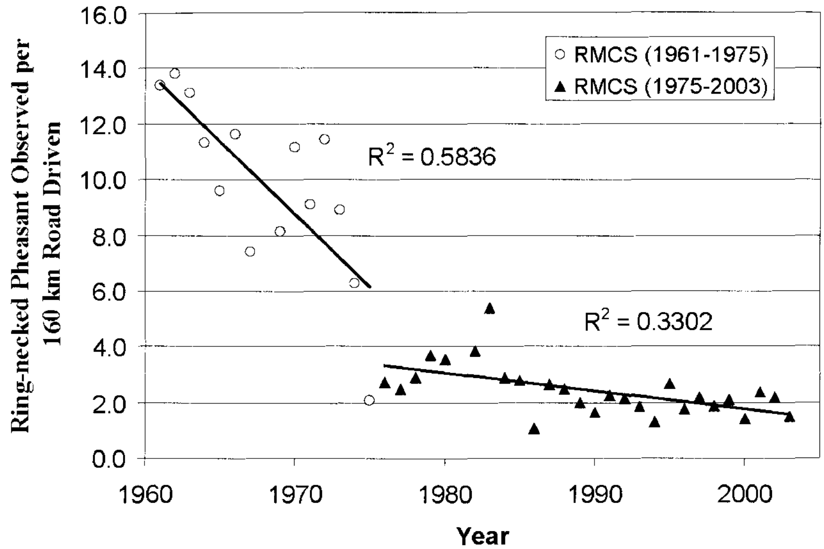

Figure 2. Simple linear regression of ring-necked pheasant observed per 160 km of Rural Mail Carrier Survey routes in the Nebraska Panhandle for the years of 1961 through 1974 and 1975 through 2003.

periods. As such, these periods were not separated for analysis. RMCS data were correlated positively with total hectares of oats and milo and correlated negatively with hectares of corn. No relationship was found between RMCS data and total hectares of wheat or hay (Table 1). A negative relationship was found between RMCS data and PMDI data for January, February, and April (Table 2). Declines in RNP abundance in the NP were similar to those reported from Kansas (Applegate and Williams 1998), Iowa (Farris et al. 1977), Illinois (Warner and David 1982), and Maryland (Smith et al. 1999).

Frank and Woehler (1969) found a similar positive association between RNP abundance and hectares of cropland in Wisconsin. Unfortunately, specific crop types were not mentioned. Conversely, Taylor et al. (1978) and Smith et al. (1999) reported a negative relationship between hectares of row crops (e.g., milo and corn) and RNP abundance in south-central Nebraska. I found no relationship between hectares of wheat and hay and declining RNP abundance in the NP. However, I did find a positive relationship between RNP abundance and hectares of oats and milo. Further, a negative relationship between RMCS and hectares of corn was observed. This also was observed in other states by Taylor et al. (1978), Warner et al. (1982), and Smith et al. (1999). In Wisconsin, corn stands, unless large, were of little value as an over-winter food source for ring-necked pheasant (Evrard 1996). I

Table 1. Correlation of Rural Mail Carrier Surveys and agricultural crops (ha) in the Nebraska Panhandle (1961-2003).

Agricultural Crops	Kendall's tau-b
Oats	0.592*
Milo	0.306*
Corn	-0.595*
Wheat	-0.085
Hay	0.113

*Significant at p = 0.05.

Table 2. Correlation of Rural Mail Carrier Surveys and drought as measured by the Palmer Modified Drought Severity Index (PMDI) in the Nebraska Panhandle (1961-2003).

Month	PMDI Range	Kendall's tau-b
January	-3.55–4.25	-0.279*
February	-3.10–3.67	-0.252*
March	-3.43–3.21	-0.200
April	-4.12–4.10	-0.225*
May	-3.73–4.21	-0.092
June	-5.40–4.89	-0.069
July	-6.66–5.24	-0.015
August	-4.97–5.24	-0.092
September	-4.93–5.04	-0.097
November	-4.28–5.49	-0.045
December	-4.11–4.36	-0.122

*Significant at p = 0.05.

found RNP abundance was associated positively with oats and milo. These finding are supported by Warner (1984), who reported RNP broods selected oat fields in greater proportion than their availability. Taylor et al. (1978) reported declining RNP abundance in south-central Nebraska with a positive relationship between spring RNP hen densities and kilometers of fence rows, hectares of pasture and hay, and wheat and wheat stubble.

My RNP survey data were found to be correlated negatively to drought condition (PMDI) in January, February, and April. This was supported by Snyder (1984) and Riley (1995), both of whom reported that decreased precipitation in spring affected RNP production in the western Great Plains and Iowa, respectively. Late winter and early spring drought affect subsoil moisture and decrease primary production (Kiesselbach et al. 1930, Passioura 1991), reduce nesting cover (Riley 1995), and reduce invertebrate availability (Riley et al. 1994).

Based on the findings of my research, several potential management strategies could be implemented by the NGPC to increase RNP abundance in the NP. An adaptive management model, similar to the North American Waterfowl model, could be parameterized based in part on my findings. Additional parameters should be considered in potential model development including: nesting rate, chick survival, over-winter survival, and agricultural production. Changes in agricultural crop selection in the NP were shown to affect RNP abundance in the NP. Increasing agricultural production of specific crops (e.g., oats and milo) through state-level incentive programs could potentially increase RNP abundance.

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