Variations in Nutritional Indices of Texas Ring-Necked Pheasants[1]

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Abstract: Gizzard fat (GF), wing fat (WF), eviscerated body weight (BW) spleen weight, and thyroid weights were analyzed in 84 ring-necked pheasants (*Phasianus colchicus*) to determine area, sex, and seasonal variations. Birds were collected from 2 study areas in the Texas Panhandle during 4 seasons. Area differences in major grain crops and food habits were not reflected in the nutritional indices examined. However, differences in pheasant densities between areas were detected. Gizzard fat and WF were greater in hens than in cocks. Highest values for GF and BW occurred in February; lowest values occurred in August. In May, a drastic decline in WF and GF occurred in cocks, and probably reflected reproductive/territorial activities. Spleen weights were greater in males than females, and were greater in August and November than in February. In juveniles, no differences between sexes in WF were detected, but GF was greater in hens than cocks. Sex × Month and Area × Month interactions were detected in the GF analysis.

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Total body fat has been used as an index of nutritional status in birds (Blem 1976). Migratory waterfowl store large amounts of fat just prior to spring to sustain them through migration, reproduction, and molt (Raveling 1979). Passerines also demonstrate winter fattening (Blem 1976). In upland game birds, body weights and fat deposits increase prior to breeding, incubation, and molt (West and Meng 1968, Anderson 1972, Dabney and Dimmick 1977).

Pheasant populations vary substantially in the Texas Panhandle (Guthery et al. 1980). Additionally, agricultural practices vary widely throughout this region (Texas Crop and Livestock Reporting Service 1981). This study

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was conducted to test the hypothesis that nutritional status is a contributing factor to these different pheasant population densities. The effects of sex and season on fat indices and spleen and thyroid weights also were examined. We thank the Caesar Kleberg Foundation for Wildlife Conservation for funding this study.

Methods

Pheasant habitat in the Texas High Plains is centered primarily around playa lake basins, which are natural wind-eroded depressions comprised of a variety of vegetative communities (Guthery et al. 1982). The playa basins used in this study had been modified as catchment basins for tailwater from irrigation, and generally held water in excavated portions year-around.

Two study areas, about 96 km (60 mi) apart, were selected; one (Area A) included parts of Deaf Smith, Castro, and Parmer counties, Texas. The other (Area B) was in Hale County. The 2 study areas had different agricultural practices, with wheat being the predominant crop on Area A, and cotton being predominant on Area B (Table 1). One week prior to each collection period, a 48-km (30-mi) roadside census was conducted on both areas, beginning at sunrise and travelling at 40 km/hour (25 mi/hour). Attempts were made to collect 1 cock and 1 hen pheasant from each of 6 playa basins in each study area. Collections were made with shotguns during 4 periods in 1981: 28 February–1 March; 27 May–4 June; 26 August–5 September; and 28–29 November.

After collection, birds were placed on ice. Later, eviscerated body weights were determined, and the right wing, gizzard, and crop were removed and frozen. The thyroid glands and spleen were removed, stored in 10% formalin, and weighed later.

Gizzard fat was considered to be the fat that adhered directly to the gizzard. The gizzard fat and fascia tissue surrounding the organ were removed and weighed. The gizzard was emptied and weighed. Percent gizzard fat was calculated as: (gizzard fat weight ÷ gizzard weight) × 100.

Table 1. Major Agricultural Cash Crops Grown on 2 Areas in the Texas Panhandle. (Data Are Expressed as a Percentage of the Total Acreage Cultivated)[a]

Crop	Area A (%)	Area B (%)
Corn	26	24
Wheat	41	10
Sorghum	13	5
Cotton	13	55

[a] Percentages calculated from data in Texas Crop and Livestock Reporting Service (1981).

The right wings were plucked, extended fully, and cut where the humerus meets the radius and ulna, and at the junction of the ulnare and radiale to the ulna and radius. The radius and ulna then were stripped of skin, muscle, tendons, and fat, and the fat from these parts was extracted in a Soxhlet apparatus for 20 hours (Warren and Kirkpatrick 1978). Percent wing fat was calculated on a wet-weight basis as: (fat weight ÷ pre-extracted wing weight) × 100.

Crop contents were oven-dried for 4 hours at 80 C, identified, separated, and weighed. Food habits data were expressed as percent frequency and percent weight as adapted from Swanson et al. (1974). Kulczynski's similarity index (Oosting 1956:77) was used to compare food habits between areas.

Statistical analyses were conducted (Barr et al. 1976) using a split-plot design (2 × 2 × 4 factorial with 6 replications) to determine differences between areas, sexes, and months, as well as all 2- and 3-way interactions. A Pearson product-moment correlation analysis was used to determine correlations among nutritional indices.

Results and Discussion

Area A had higher pheasant populations than Area B (Table 2). Greater pheasant abundance in Area A has been reported previously (Guthery et al. 1980) and probably reflects the higher percentage of grain crops and more extensive irrigation in that area.

Food habits between areas were relatively similar (Table 3). Pheasants on Area A consumed less corn and more sorghum than on Area B, which probably reflected differences in the availability of these crops between areas (Table 1). However, consumption of wheat was similar between areas (Table 3), in spite of the fact that wheat was substantially more available on Area A than on Area B (Table 1). Similarity indices for diets between areas were 69% (based on percent frequency data) and 61% (based on percent weight data).

Table 2. Roadside Counts of Ring-necked Pheasants on 2 Study Areas in the Texas Panhandle

Month	Area A (*N*/48km)	Area B (*N*/48km)
Feb	134	23
May	49	12
Aug	113	18
Nov	109	30

Table 3. Major Foods of Ring-necked Pheasants on 2 Areas in the Texas Panhandle

Food Item	Area A ($N = 50$) % Frequency	Area A ($N = 50$) % Weight	Area B ($N = 34$) % Frequency	Area B ($N = 34$) % Weight
Corn	36	45	50	72
Sorghum	28	19	18	9
Wheat	8	5	6	2
Oats	2	tr[a]		
Rye			3	tr
Sunflower seeds	6	13		
Black-eyed peas			12	12
Vegetable seeds			3	1
Grass seeds	8	tr	9	tr
Forb seeds	22	8	9	tr
Leafy matter	34	2	18	tr
Animal matter	26	7	30	3

[a] tr = <1%.

No significant ($P > 0.05$) differences between areas were detected for any of the nutritional indices examined. Thus, pheasants in this study appeared to adapt population size, rather than individual nutritional status to food availability.

Adult male pheasants weighed more than females (Table 4), a result that has been reported previously (Anderson 1972, Barrett and Bailey 1972). Hens averaged more GF than cocks (23.0% vs. 9.1%, respectively); WF also was greater in hens (23.0%) than in cocks (14.4%), year-around (Table 4). Anderson (1972) compared fat strips and visceral fat and found that wild hen pheasants in Illinois had more fat than cocks on a percent body weight basis. Barrett and Bailey (1972) found that pen-raised hens in Ontario had at least twice the fat of cocks.

Fat deposits in male and female pheasants reportedly peak during the winter and prebreeding seasons and are at their lowest level during molt (Breitenbach and Meyer 1959, Anderson 1972). Kabat et al. (1956) and Anderson (1972) believed that the annual fluctuations in body weights are primarily because of changes in fat deposits. Gizzard fat and BW in our study both showed these trends. Gizzard fat and BW averages (Table 4) were highest during February (22.6% and 1,008 g, respectively), and lowest during August (3.1% and 903 g, respectively). In contrast, lowest mean WF levels were observed in May (15.7%); highest levels occurred in February (20.3%).

A significant Sex × Month interaction was detected in the WF analysis (Table 4). This resulted from the fact that WF in cocks decreased drastically in May, but remained unchanged in hens. Gizzard fat in May also declined

Table 4. Eviscerated Body Weights (BW), Gizzard Fat (GF), and Wing Fat (WF) of Adult Ring-necked Pheasants from 2 Areas in the Texas Panhandle

				BW[a] (g)		GF[b,c] (%)		WF[b,c,d] (%)	
Area	Sex	Month	*N*	$\bar{X}$	SE	$\bar{X}$	SE	$\bar{X}$	SE
A	M	Feb	5	1,146	25	12.7	4.5	17.7	1.4
		May	5	1,093	31	7.1	3.0	8.8	2.2
		Aug	1	1,169		4.9		16.7	
		Nov	3	1,075	15	5.6	1.8	13.9	0.5
	F	Feb	6	857	26	25.7	3.8	22.8	0.7
		May	5	865	69	34.8	6.3	22.9	1.7
		Aug	2	752	22	4.3	2.2	17.6	0.8
		Nov	4	802	24	21.8	4.2	22.8	0.5
B	M	Feb	5	1,188	19	19.7	6.4	18.0	1.1
		May	3	1,101	89	2.0	0.6	9.4	3.1
		Aug	1	1,082		1.6		15.5	
		Nov	3	1,059	19	3.1	0.6	16.1	2.2
	F	Feb	5	873	15	31.8	7.0	22.2	1.0
		May	3	810	97	19.4	6.5	21.5	4.6
		Aug	2	832	3	1.8	0.6	22.7	1.3
		Nov	3	871	46	20.4	7.9	20.3	2.0

[a] $P < 0.0001$, *F*-test (M vs. F).
[b] $P < 0.005$, *F*-test (M vs. F).
[c] $P < 0.01$, *F*-test (Month variation).
[d] $P < 0.01$, *F*-test (Sex X Month interaction).

substantially more in males than females, but the Sex × Month interaction was not significant, probably because of high variability. Barrett and Bailey (1972) reported that males lost a considerable amount of weight during the prebreeding period and had very little fat by the end of May. These data suggest that subcutaneous fat deposits in males are depleted substantially by May, which may be related to reproductive/territorial activities. Kirkpatrick (1944) came to this same conclusion when examining BW in male pheasants.

Juvenile pheasants were collected in August and November. As expected, BW and fat reserves were greater in November than in August (Table 5) because the birds were growing and putting on fat. Males tended to be heavier than females (Table 5). Again, GF data showed that hen pheasants had more fat stores than cocks (9.2% vs. 4.2%, respectively). Anderson (1972) reported fat reserves steadily build through the fall and winter and prebreeding period, which is evident in our GF data (Table 5). Significant Sex × Month and Area × Month interactions were detected for GF. We believe these interactions resulted because GF in males from Area A did not change from August to November, whereas in all other birds a substantial increase in GF occurred during the same period. Wing fat in juveniles (Table 5) did not show any significant differences between months or sexes. Mesen-

Table 5. Eviscerated Body Weights (BW), Gizzard Fat (GF), and Wing Fat (WF) of Juvenile Ring-necked Pheasants from 2 Areas in the Texas Panhandle

			BW[a,b] (g)			GF[c,d,e,f] (%)			WF (%)		
Area	Sex	Month	N	$\bar{X}$	SE	N	$\bar{X}$	SE	N	$\bar{X}$	SE
A	M	Aug	3	674	150	3	3.0	0.5	3	15.1	2.0
		Nov	3	1,007	49	2	3.2	0.2	3	16.2	1.1
	F	Aug	6	626	27	5	6.1	1.8	6	17.1	1.7
		Nov	2	765	48	2	14.7	1.9	2	19.2	3.3
B	M	Aug	1	836		3	2.9	0.7	2	15.3	1.4
		Nov	1	1,047		1	14.1		1	21.3	
	F	Aug	5	493	114	4	4.8	0.8	5	18.1	1.6
		Nov	1	947		1	31.6		1	24.8	

[a] $P = 0.08$, F-test (M vs. F).
[b] $P = 0.08$, F-test (Month variation).
[c] $P < 0.005$, F-test (M vs. F).
[d] $P < 0.01$, F-test (Month variation).
[e] $P < 0.05$, F-test (Sex X Month interaction).
[f] $P < 0.05$, F-test (Area X Month interaction).

teric fat (GF) may be deposited prior to subcutaneous fat (WF). Thus, significant WF levels may not develop until a later age.

No area differences in spleen or thyroid weights were observed. Anderson (1969) also did not observe differences in spleen or thyroid weights in pheasants from good, fair, or poor range in Illinois. Male pheasants averaged heavier ($P < 0.005$) spleen weights (0.57 g) than females (0.40 g). Spleen weights were heavier ($P < 0.05$) in August (0.56 g) and November (0.55 g) than in February (0.41 g). No differences in thyroid weights were detected. Greeley (1953) and Harclerode and Dropp (1966) reported seasonal variations and differences between sexes in thyroid weights of pen-reared pheasants. No differences in juvenile spleen or thyroid weights were detected.

Correlation analyses of all pheasants revealed a significant relationship between BW and GF ($r = 0.65$; $P < 0.001$; $N = 76$). The correlation coefficient changed very little when juveniles ($r = 0.61$; $P < 0.005$; $N = 20$) and adults ($r = 0.67$; $P < 0.001$; $N = 56$) were analyzed separately. Body weights and WF did not covary in any of the analyses. Wing fat and GF were correlated significantly ($P < 0.005$) in adults ($r = -0.39$; $N = 56$) but not in juveniles.

In summary, GF could be a reliable nutritional index in ring-necked pheasants. Variations in GF followed trends of fat deposition that have been reported by other researchers. Data on WF raised questions concerning the fat deposition and utilization trends in pheasant. Norman and Kirkpatrick (1981) found significant correlations between WF and total carcass fat in ruffed grouse (*Bonasa umbellus*) in Virginia. However, their method for determining WF differed from ours. Obviously, more research needs to be conducted on the physiology of fat deposition and utilization in pheasants to perfect a reliable nutritional index that is obtained easily from hunter-killed birds.

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