Body Weights of Ohio Ruffed Grouse (*Bonasa umbellus*)[1]

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ABSTRACT. Average annual winter (December-February) body weights of Ohio ruffed grouse (*Bonasa umbellus*) from both the glaciated northeast and the more southern unglaciated hill country ranges showed only small deviations from the 4-year (1974-1977) mean. Hill country grouse were heavier ($P < 0.05$) than northeastern birds in winter, but not in fall (October-November). Year-around (1969-1982) body weights were obtained only for hill country grouse. Both sexes showed rapid weight gains in the fall; juveniles (4.5-12 months of age) appeared to gain weight faster than adults. Peak weights were achieved in November and held through winter. With the onset of breeding in March, males lost weight rapidly. Lowest weights for males and probably females occurred in late spring and summer and were about 100 g (14 and 17%, respectively) below winter weights. Male grouse were consistently heavier than females; adults were usually heavier than juveniles of the same sex. Wild-trapped grouse chicks showed steady weight gains averaging about 30 g per week from hatching through 16 weeks of age. Male chicks generally averaged 6-14% heavier than female chicks after 10-17 weeks of age. Comparisons among different areas suggested that ruffed grouse from the more southerly latitudes were heavier in winter and spring, but that summer and perhaps fall weights were similar. The results suggest that body weight is not a good index of condition and reproductive success in ruffed grouse.

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INTRODUCTION

The continental range of the ruffed grouse (*Bonasa umbellus*) extends from Labrador to northern Georgia in the east and from central Alaska south into Utah in the west (Johnsgard 1973), making it the most widespread nonmigratory native game bird in North America. Regional and annual variations in weight have been examined for other grouse species, but are poorly documented for ruffed grouse. Monthly weights of ruffed grouse have been reported only from New York (Bump et al. 1947) and Ontario (Thomas et al. 1975). Seasonal weights have been reported from West Virginia (Uhlig 1953) and southwestern Virginia (Norman and Kirkpatrick 1984). To our knowledge, these are the only published data on weights from the southern part of the species' range. Recent studies (e.g., Davis and Stoll 1973, Stoll et al. 1980) in Ohio provided opportunities to collect live weights of ruffed grouse. This paper summarizes regional, annual, and monthly weights of the ruffed grouse from the southern part of its range.

OHIO GROUSE RANGE

In Ohio, ruffed grouse occur in the rolling glaciated northeast (NE) and rugged hill country (HC) of the unglaciated eastern Allegheny Plateau (Fig. 1). Most of the NE lies within the beech-maple forest association; the HC lies within the mixed mesophytic forest association (Braun 1961).

The climate of Ohio's grouse range is mesothermal with relatively moderate temperatures (Gordon 1969). The average frost-free period decreases progressively from 170 d in the southern portion of the range to 150 d in the north. Annual snowfall is generally light (NE = 100-200 cm, HC = 50-100 cm) and, except in the NE, accumulations are usually not sufficient to force grouse into prolonged arboreal feeding or snow roosting. Annual precipitation averages about 100 cm.

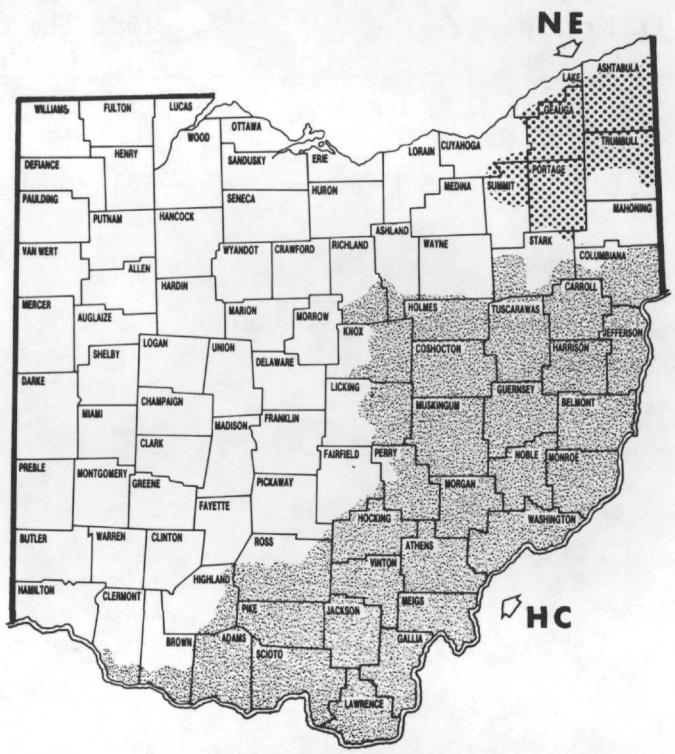

FIGURE 1. Distribution of ruffed grouse in Ohio (Stoll and McClain 1986). NE, northeast range; HC, hill country range.

Grouse hunter success rates in the NE are about 10-20% higher than those in the HC (Ohio Dept. of Natural Resources, Division of Wildlife, unpubl. data). Fifteen years of spring census data on two study areas in the southern HC indicate that grouse densities range from 2.2 to 5.7 drumming males per 100 ha (Stoll and McClain 1986). This is about half the densities reported for more nothern states (Johnsgard 1973).

MATERIALS AND METHODS

Weights of ruffed grouse were obtained in Ohio from birds taken during the October-through-February grouse hunting seasons,

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1974-1977. Grouse weights were provided by cooperating hunters: one in the NE and two in the HC. The three cooperators were each provided with a platform scale and envelopes for enclosing wings and tails. They reported the location, date, and weight (to nearest 2 g) of each bird harvested. Weights for the nonhunting months (March-September) were obtained only for ruffed grouse from the HC range and in conjunction with studies conducted by the Division of Wildlife. Most of these weights (to nearest 14 g) were taken in the field with spring tube scales during the 1970s and early 1980s in Athens, Jackson, and Vinton counties. Gross or live weights were not adjusted for differences in crop contents.

Grouse ≥ 18 weeks of age were separated into four age and sex classes: adult males, adult females, juvenile males, and juvenile females. Age and sex were ascertained from feather measurements (Davis 1969), with birds of the year classified as juveniles and those older than one year as adults. Grouse < 18 weeks old (chicks) were classified to sex by eye patch pigmentation (Palmer 1959) and dots on the upper tail coverts (Roussel and Ouellet 1975); age in weeks was estimated from primary molt patterns (Davis 1968).

Mean weights were calculated for each age and sex class. Monthly weights for a given region and year were too few for meaningful analysis, as were pooled October and November weights. Therefore, grouse weights in December, January, and February were pooled, and the means were tested for differences among the four years (1974-1975 through 1977-1978) for each region. Because annual weight variation was small and samples for a given year and month were often few, weights for all years were combined for each month and in some cases groups of months in subsequent analyses. Analysis of variance, followed by the Student-Newman-Keuls test when a significant F-statistic was computed, was used to test for significance among multiple comparisons of three or more means. The t-test was used to identify differences between two means (Sokal and Rohlf 1969). The level for statistical significance was $P = 0.05$.

RESULTS

VARIATIONS AMONG YEARS. Yearly differences in mean winter weights were surprisingly small. In both regions, deviations from the 4-year mean (3-year mean for NE adult females) did not exceed 7% for any sex and age class (Fig. 2). In the NE, where samples were small, average weights of adult females for 1976-1977 were significantly ($P < 0.05$) lower than those for 1974-1975 and 1975-1976. No consistent pattern emerged to indicate that NE birds were heavier or lighter in a given year or years. In the HC, where samples were considerably larger, annual winter weight variation was more consistent, with average weights for all sex and age classes lowest in 1976-1977. However, differences in average winter weights were significant ($P < 0.05$) only for juvenile males, with 1976-1977 weights 28 and 26 g lighter than in 1975-1976 and 1977-1978, respectively.

VARIATIONS AMONG REGIONS. Weights for each age and sex class were combined for the four years and for October and November (fall) and December through February (winter), and tested for differences between regions. Mean fall weights were consistently, but not significantly ($P > 0.10$), lighter (range 15-25 g) for NE birds (Table 1). In contrast, mean winter weights for all age and sex classes were significantly ($P < 0.01$ for juvenile males and females; $P < 0.05$ for adult males and females) lower in the NE. On average, NE birds weighed about 28 g (range 25-31 g) less than their counterparts in the HC during winter.

SEASONAL WEIGHT VARIATIONS. Monthly grouse weights for the entire season were available only for the HC region. The pattern of weight gain and loss was similar to that of most gallinaceous birds (Figs. 3 and 4). Beginning in September, adult and juvenile grouse of both sexes showed rapid ($P < 0.01$) weight gains through November. Juveniles of both sexes appeared to gain weight more rapidly than adults. After November, monthly weight gains either slowed or stopped. Peak weights were obtained and held during late fall and win-

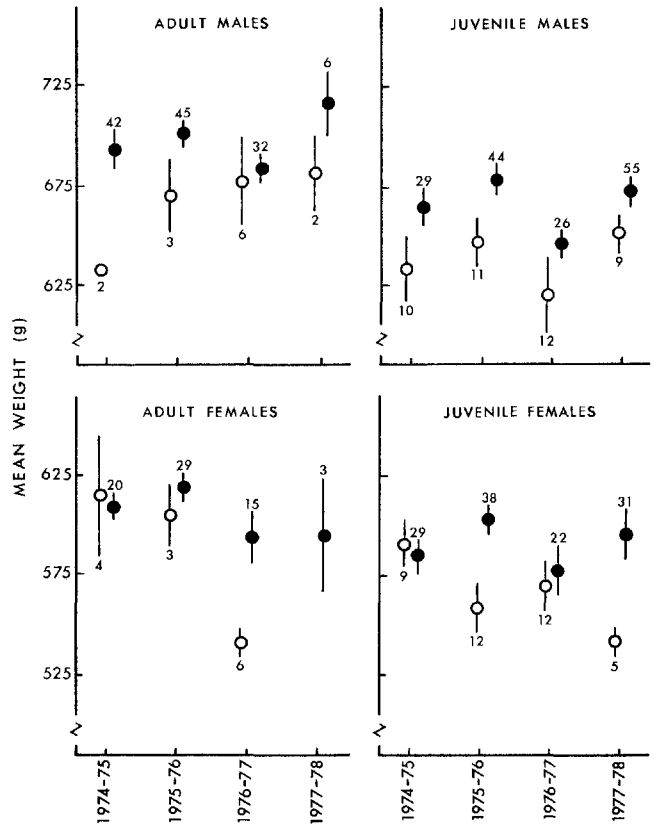

FIGURE 2. Winter (December–February) weights ($\bar{x} \pm$ SE) of Ohio ruffed grouse from the northeast (○) and hill country (●) grouse ranges. Sample size is shown above or below each vertical line.

TABLE 1

Fall and winter weights of ruffed grouse in the northeast (NE) and hill country (HC) regions of Ohio, 1974–1975 through 1977–1978.

	Oct–Nov		Dec–Feb	
Age and Sex	NE	HC	NE	HC
Adults				
Males				
$\bar{x}$	655	676	669	695*
SE	15	10	11	3
N	10	15	13	125
Females				
$\bar{x}$	589	614	579	610*
SE	18	17	13	4
N	5	9	13	67
Juveniles				
Males				
$\bar{x}$	639	656	636	667**
SE	7	8	8	3
N	29	31	42	154
Females				
$\bar{x}$	554	569	569	594**
SE	6	8	6	4
N	37	25	38	120

* Different ($P < 0.05$) from northeast mean for same season.
**Different ($P < 0.01$) from northeast mean for same season.

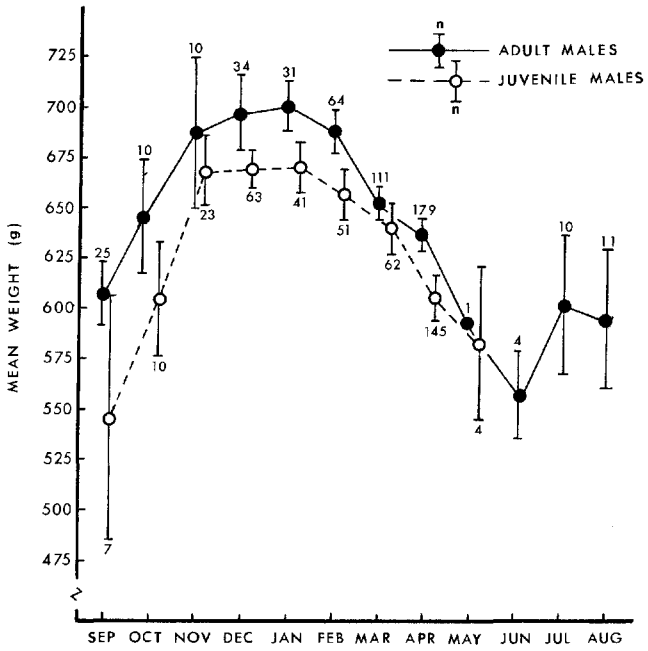

FIGURE 3. Monthly weights ($\bar{x}$ ± 95% confidence interval) of adult and juvenile male ruffed grouse from Ohio's hill country (1969–1982). Sample size is shown above or below each vertical line.

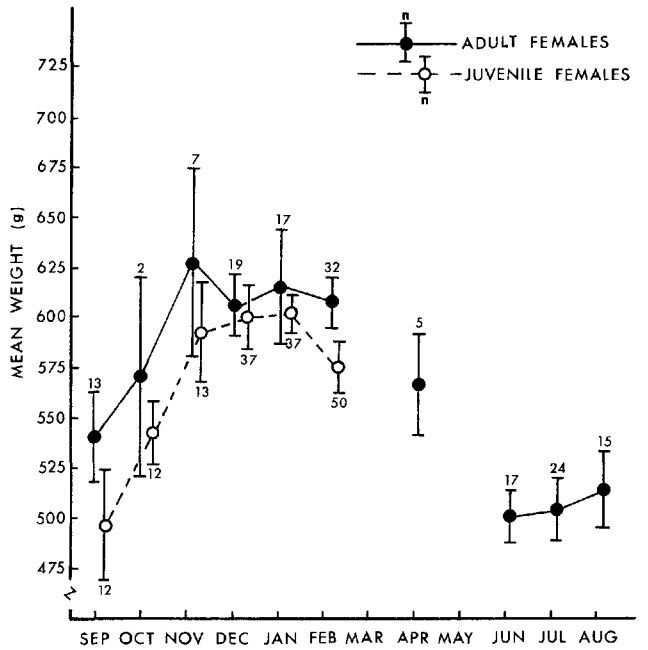

FIGURE 4. Monthly weights ($\bar{x}$ ± 95% confidence interval) of adult and juvenile female ruffed grouse from Ohio's hill country (1969–1982). Sample size is shown above or below each vertical line.

ter (November through February). With the onset of the breeding season in March, mean weights dropped precipitously to summer lows. For males, this weight loss was fairly direct from February to May, with lows achieved in May or June and held through August (Fig. 3). Small sample sizes, and classifying all birds except chicks as adults after May, did not permit a more precise assessment of May-August fluctuations in male weights. Females apparently also underwent a rapid February to June weight loss (Fig. 4). A probable increase in female body weight just prior to and during egg laying followed by a rapid weight decline during incubation (Beckerton and Middleton 1983, Pendergast and Boag 1973, Redfield 1973) could not be detected due to the paucity of samples from March to May. Mean weights for females in June, July, and August were similarly low. Weights of adult males and females in winter were about 100 g greater ($P < 0.001$) than in summer, representing a 14 and 17% loss of their respective winter weights.

VARIATIONS ACCORDING TO AGE AND SEX. There were major differences in mean monthly weights between sexes. For all months (September–May) with sufficient samples, male grouse in the HC were consistently heavier than adult and juvenile females (Figs. 3 and 4). Differences ($P < 0.01$, except in October and November when $P < 0.05$) in average monthly weights between adult males and adult females ranged from 61 to 91 g; those ($P < 0.01$) for adult males and juvenile females ranged from 96 to 116 g. Average weights for juvenile males were not significantly ($P > 0.05$) greater than those for adult females in September (4 g), October (38 g), and November (43 g); weight differences thereafter ranged from 42 to 64 g ($P < 0.01$ for December, January, and February; $P < 0.05$ for April). Juvenile males in September averaged 47 g heavier than juvenile females, but this difference was not significant ($P > 0.05$). From October through February, juvenile males averaged 65 to 85 g heavier ($P < 0.01$) than juvenile females. From June through August, when all birds other than chicks were considered adults, males averaged 59 to 100 g heavier ($P < 0.01$) than females.

Monthly differences between age classes for the same sex were not as apparent as differences between the sexes. From September through April, mean monthly weights of HC adult males were consistently greater than weights of juvenile males, with differences ranging from 13 to 63 g (Fig. 3). These differences were significant ($P < 0.05$) only in December, January, February, and April. For females, mean adult weights were also consistently higher than for juveniles, with differences ranging between 6 and 43 g from September through February (Fig. 4). Significant differences occurred, however, only in September (43 g, $P < 0.05$), when juveniles would have been only 18 to 22 weeks old, and in February (37 g, $P < 0.01$), when sample sizes for both age classes were largest. Fall and winter weight variation attributable to age and sex in HC grouse was also evident for NE grouse (Table 1).

GROWTH OF CHICKS. Mean weights of grouse chicks were plotted by weekly age intervals (Fig. 5). We were unable to confidently classify sex of chicks <10 weeks of age. Thus, mean weights for chicks <10 weeks are for males and females combined, whereas those ≥10 weeks are separated by sex. Chicks showed steady weight gains, averaging about 30 g per week, through approximately 16 weeks of age. With the exception of age 14 weeks, males were consistently 6 to 14% heavier than females.

INDIVIDUAL VARIATION. Maximum and minimum weights recorded for individual grouse are reported only for adults. The heaviest male in this study weighed 794 g. The lightest male weighed 482 g and was 28 g

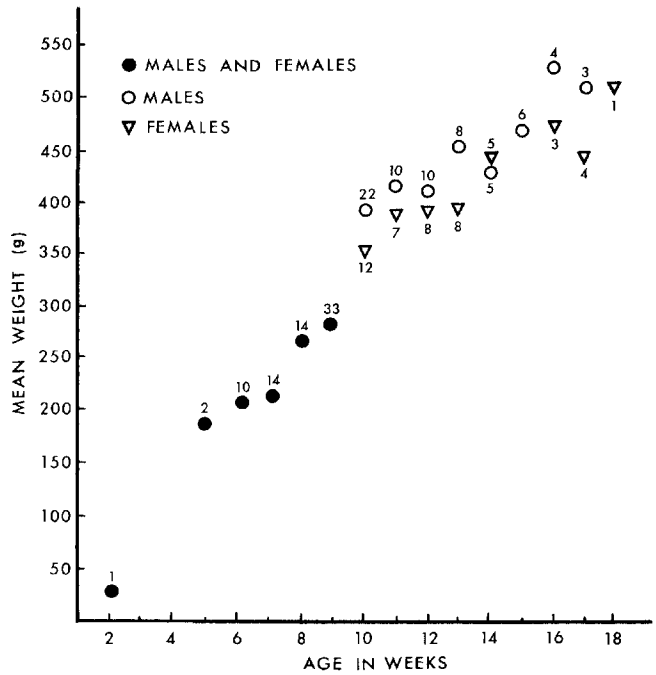

FIGURE 5. Mean weekly weights (with sample sizes) of wild-trapped ruffed grouse chicks from Ohio's hill country.

lighter than any other adult male recorded. This bird may have been in poor health; it died of unknown causes immediately after release. The record for the next lightest was shared by three males at 510 g. The heaviest female weighted 737 g; only one other female exceeded 700 g. Two females shared the lightweight record of 439 g. Bump et al. (1947) reported that birds weighing over 794 g were reported (presumably for New York) nearly every year.

FEMALE WEIGHTS AND GROUSE POPULATIONS. For Ohio grouse range, we compared mean winter weights for females with indices of productivity (% juveniles in fall harvest) and fall populations (grouse hunter flushes/100 h) (Table 2). We hypothesized that higher mean female weights in winter would be reflected in higher productivity and population sizes the following fall. Within regions, however, these limited comparisons did not support this hypothesis. Comparisons between regions suggested just the opposite. Productivity and population indices were higher and weights were lower in the NE than in the HC range.

TABLE 2

Percent juvenile grouse in the harvest and grouse hunter flushes per 100 h compared with mean female weights (g) for the preceding winters (December–February).

Region	Winter			
	1974-75	1975-76	1976-77	1977-78
NE*				
Percent juveniles	73.9	63.4	83.0	—
Flushes/100 h	109	129	123	167
Mean weight: Adult ♀♀	615	606	542	—
Juvenile ♀♀	592	560	572	544
HC**				
Percent juveniles	55.9	52.2	69.2	—
Flushes/100 h	99	102	123	135
Mean weight: Adult ♀♀	609	620	593	597
Juvenile ♀♀	587	606	580	598

* Sample size: percent juveniles = 69-88 grouse; flushes/100 h = 343-440 hunting hours; mean weight from Table 1.

**Sample size: percent juveniles = 479-687 grouse; flushes/100 h = 3,683-4,564 hunting hours; mean weight from Table 1.

DISCUSSION

Average annual winter weights of ruffed grouse from both the NE and HC ranges showed only small deviations from the 4-year mean. In the NE, mean winter weights for each age and sex class showed no consistent annual trends, but sample sizes were small. In the HC, mean winter weights for grouse of all age and sex classes were lowest in 1976–1977, significantly so for juvenile males. During winters 1976–1977 and 1977–1978, the HC experienced 20 to 36 cm of continuous snow cover for 50 and 56 d, respectively, beginning in early January. During a "normal" Ohio winter in this range, snow accumulations are usually light and seldom last more than two weeks. If the harsh winter of 1976–1977 was responsible for the lower mean winter weights in the HC, then lower weights should also have been evident during winter 1977–1978; this was not the case. Bump et al. (1947) found no yearly variation in New York ruffed grouse weights from 1939 to 1941. Annual variations in weight, however, have been demonstrated for other species of grouse (e.g., Zwickel et al. 1966, Redfield 1973) and for ring-necked pheasants (*Phasianus colchicus;* Edwards et al. 1964, Gates and Woehler 1968). We consider our results inconclusive. Sample size constraints required us to combine December, January, and February weights for each year, possibly masking significant annual variations for a given month.

Geographic variation in body weight is not well documented for ruffed grouse. Uhlig (1953) believed that weights of West Virginia ruffed grouse were greater than those reported by Bump et al. (1947) for New York. Bump et al. (1947), however, found no significant differences in grouse weights among three New York regions. In the present study, birds of all age and sex categories from the HC range were significantly heavier in winter, but not in fall, than birds in the NE range. Unfortunately, spring and summer weight data from both Ohio regions were not available for comparison. Mean weekly weights of Ohio grouse chicks were similar to those of wild-trapped chicks from Wisconsin (Kubisiak 1985), but considerably lighter than those of captive-reared chicks in New York (Bump et al. 1947), Minnesota (Maxson 1978), and Michigan (Fay 1963). Regional weight differences have been documented for sage grouse (*Centrocercus urophasianus;* Beck and Braun 1978), blue grouse (*Dendragapus obscurus;* Zwickel et al. 1966), and spruce grouse (*Dendragapus canadensis;* Ellison and Weeden 1979). Generally, body size in warm-blooded species increases with decreasing mean temperature of the habitat or, in practice, with increasing latitude or altitude (Bergmann's rule; Van Tyne and Berger 1965). Ellison and Weeden (1979) reported a south-north trend of increasing weight in spruce grouse.

To obtain greater insight into possible regional weight variations for ruffed grouse, we compiled published and unpublished weights from different areas and subspecies (Fig. 6). From this compilation, some reasonable specu-

lation is possible. Males are heavier than females from the same geographical area, and the differences in mean body weight between the sexes are generally similar within seasons. Mean winter ruffed grouse weights appear higher for birds from the more southern latitudes with higher mean annual temperatures. This difference appears to hold into the spring; by summer, however, mean weights are similar among areas. Fall weights also appear similar among the different areas, but differences in the months for which weights were obtained make comparisons difficult. The available weights from different regions agree reasonably well with the fall and winter regional differences documented for Ohio birds (i.e., similar fall weights in both the NE and HC, but significantly heavier winter weights in the more southerly HC range). Ruffed grouse collected during winter from Parry Sound District, Ontario (about 45°N latitude), contained only 7 to 8% carcass fat (Thomas et al. 1975). In contrast, winter carcass fat values for birds from southwestern Virginia (about 37°N latitude) were 13.6% for males and 19.0% for females (Norman and Kirkpatrick 1984). Higher winter fat values for more southerly grouse populations cannot be generalized, however. Servello and Kirkpatrick (1987) found that North Carolina (35°–36° 30′ N latitude) ruffed grouse had predicted winter carcass fat levels (5.0–9.8%) that were much lower than those from southwestern Virginia. They felt that the difference may have been due to a wider variety and higher quality diet (acorns) for the Virginia birds. Ellison and Weeden (1979) noted that Alaskan spruce grouse and other galliforms appeared to lose weight in winter. This was not the case for ruffed grouse from Ohio's comparatively snow-free southern HC, where peak weights were achieved and held through winter. Even during winter, fruits, seeds, and green leaves comprise the bulk of the diet of HC ruffed grouse (Stoll et al. 1980). Birds from more northerly latitudes subsist almost exclusively on woody browse (buds and twigs) during late fall and winter when snow cover is continuous (Brown 1946, Bump et al. 1947, Svoboda and Gullion 1972). The apparently heavier winter weights noted for ruffed grouse at the more southerly latitudes (Fig. 6) and the consistently high monthly winter weights for Ohio's HC grouse may reflect these environmental differences. The degree to which subspeciation contributes to these latitudinal differences is unknown. In any event, body size of ruffed grouse does not appear to increase with decreasing mean temperature (Bergmann's rule), based on the range of comparisons available to us.

Body weight is a conventional index to health and vigor in wildlife. For Ohio grouse range, mean female weights in winter did not appear to be directly related to productivity or grouse abundance the following fall (Table 2). Productivity, as indicated by percent juveniles (if that in fact is a good index of productivity; Davis and Stoll 1973) and grouse abundance (Johnsgard 1973), are typically lower for Ohio and areas of similar latitude than for areas farther north. Thus, the heavier winter and spring weights reported for ruffed grouse in Ohio and other southern latitudes (Fig. 6) appear to have little demographic significance.

Quinn and Keppie (1981) concluded that there was little empirical evidence to support the common use of body weight to indicate condition of grouse. It has been hypothesized that condition of the female prior to egg laying has an effect on subsequent reproductive success in galliforms (Edwards et al. 1964, Redfield 1973, Quinn and Keppie 1981). Redfield (1973) and Quinn and Keppie (1981) concluded for blue grouse and spruce grouse, respectively, that female weights prior to egg laying were either not a good measure of condition, or that factors other than weight were responsible for variation in reproductive success. We believe that similar conclusions may be appropriate for ruffed grouse.

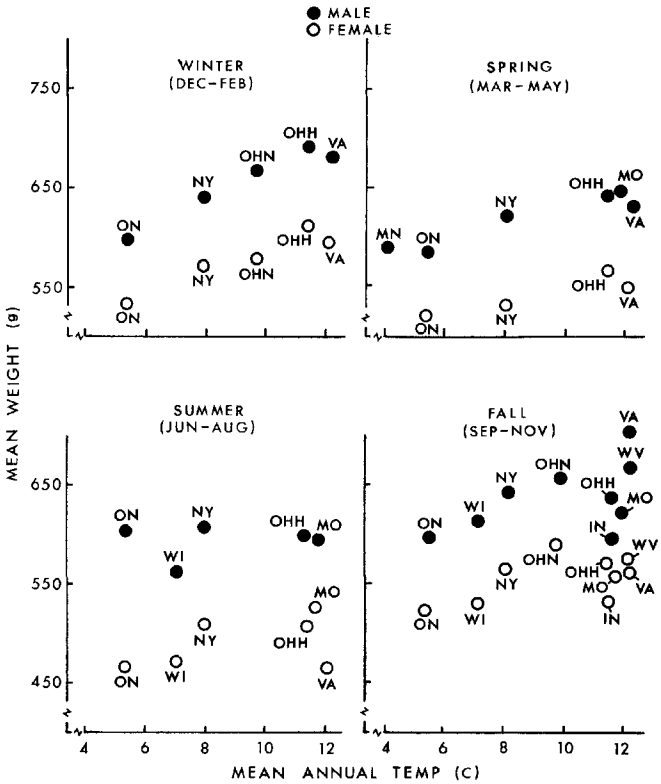

FIGURE 6. Comparison of seasonal adult ruffed grouse weights from different areas in relation to mean annual temperatures (J. Skindlove, pers. comm.) for those areas. Weight data obtained or calculated from the following sources: Minnesota (MN) = Gullion (1970); Ontario (ON) = Thomas et al. (1975), adult and juvenile weights for fall and winter; Wisconsin (WI) = Kubisiak (1985); New York (NY) = Bump et al. (1947); Ohio northeast (OHN) and hill country (OHH) = this study; Indiana (IN) = M. Reeves and D. Major (pers. comm.); Missouri (MO) = W. Hunyadi (pers. comm.); West Virginia (WV) = Uhlig (1953); Virginia (VA) = Norman and Kirkpatrick (1984), adult and juvenile weights (less crop contents) for fall and winter.

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