———, AND P. A. VOHS, JR. 1984. Distribution and habitat use of waterfowl wintering in Oklahoma. J. Wildl. Manage. 48:51–61.

KRAPU, G. L. 1981. The role of nutrient reserves in mallard reproduction. Auk 98:29–38.

LAGRANGE, T. G. 1985. Habitat use and nutrient reserves dynamics of spring migratory mallards in central Iowa. M.S. Thesis, Iowa State Univ., Ames. 81pp.

———, AND J. J. DINSMORE. 1988. Nutrient reserve dynamics of female mallards during spring migration through central Iowa. Pages 287–297 *in* M. W. Weller, ed. Waterfowl in winter. Univ. Minnesota Press, Minneapolis.

SHEARER, L. A., B. J. JAHN, AND L. LENZ. 1969. Deterioration of duck foods when flooded. J. Wildl. Manage. 33:1012–1015.

STEWART, R. E., AND H. A. KANTRUD. 1971. Classification of natural ponds and lakes in the glaciated Prairie Pothole Region. U.S. Fish Wildl. Serv. Resour. Publ. 92. 57pp.

TINER, R. W., JR. 1984. Wetlands of the United States: current status and recent trends. U.S. Fish Wildl. Serv. Natl. Wetlands Inventory, Washington, D.C. 59pp.

U.S. DEPARTMENT OF AGRICULTURE. 1983. Des Moines River Basin study drainage report. U.S. Dep. Agric., Soil Conserv. Serv., Des Moines. 120pp.

WELLER, M. W., editor. 1988. Waterfowl in winter. Univ. Minnesota Press, Minneapolis. 624pp.

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WINTER BODY-WEIGHT PATTERNS OF FEMALE MALLARDS FED AGRICULTURAL SEEDS

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Abstract: During winter 1986–87, 4 exclusive agricultural seeds or a complete diet were fed to captive, wild-strain female mallards (*Anas platyrhynchos*) in an outdoor aviary in east-central Mississippi to test the hypothesis that their body weights (standardized for structural size) would be similar among diets over time. Analysis of variance indicated that diet and sampling date influenced the standardized weight (SW) of female mallards with interaction ($P < 0.001$). For all dates, the SW of females fed soybeans was less ($P < 0.01$) than for females fed the complete diet. For 5 of 6 initial sampling dates, the SW of females fed corn was lower ($P < 0.04$) than for females fed the complete diet; thereafter, there was no difference. The SW of females fed rice or millet did not differ ($P > 0.05$) from that of females fed the complete diet. Exclusive corn or soybean diets appear nutritionally sub-optimal or inadequate for female mallards, respectively, implicating a dietary need for supplemental natural foods from wetlands to offset nutritional deficiencies of diets primarily composed of these agricultural seeds. When switched to the complete diet in late winter, female mallards previously fed agricultural seeds recovered rapidly (1 week), emphasizing their physiological resiliency in the presence of abundant, quality food.

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Waterfowl in North America have encountered reduced and altered natural wetlands (Forsythe and Gard 1980, Forsythe 1985). For example, <46% of the original 87 million ha of wetlands remain in the contiguous United States, and an additional 182,000 ha are lost annually (Barton 1986). Agriculture is responsible for 87% of this loss (Tiner 1984). The conversion of natural wetlands to croplands has influenced some dabbling ducks (*Anas* spp.) to exploit waste agricultural seeds (Bossenmaier and Marshall 1958, Baldassarre and Bolen 1984, Delnicki and Reinecke 1986, Miller 1987). Dabbling ducks do not feed exclusively on agricultural seeds, but their diets often are dominated by such foods during autumn and winter (Jorde et al. 1983, Delnicki and Reinecke 1986, Miller 1987).

Croplands attract large numbers of waterfowl. Although agricultural seeds generally are

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abundant and relatively high in metabolizable energy, they may not satisfy the daily requirements of waterfowl for certain inorganic elements, amino acids, and vitamins (Baldassarre et al. 1983, Delnicki and Reinecke 1986). Thus, experimental provision of exclusive diets of agricultural seeds is necessary to determine the effect of such diets on mallard winter body-weight dynamics. Because we did not know a priori the body-weight responses of mallards to different exclusive agricultural seed diets, we tested the general null hypothesis that the SW's of captive, wild-strain female mallards fed exclusive agricultural-seed diets would be similar on average throughout winter to the SW's of a control group of females fed a balanced, completely nutritious food.

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STUDY AREA

Mallards were housed in an 8- × 37-m outdoor aviary exposed to ambient conditions and located on the MSU campus in east-central Mississippi. The quonset-shaped aviary contained 60 equal-sized pens (1.2 × 2.7 m), each housing a pair of mallards (Loesch 1988:6). Pens were divided further into 2 equal-sized subpens using a welded-wire-covered partition that allowed visual contact but separated pair members for independent feeding. Pens were covered on 3 sides with felt that precluded visual and physical contact between adjacent pairs.

METHODS

Mallards hatched from eggs collected from natural nests in Manitoba, Canada in 1984 and 1985 were reared at the Delta Waterfowl and Wetlands Research Station. Mallards were transported to MSU on 3–4 October 1986, and females were paired randomly to a male of the same age. Pairs were placed randomly in the 60 pens. Females were confined in subpens along the perimeter of the aviary.

Females were assigned randomly to 1 of 5 exclusive diets of ordinary field stocks of corn, cultivated rice, common soybean, Japanese millet (*Echinochloa crusgalli*), or a commercial, pelleted, completely balanced control diet (Table 1). Eleven or 12 females/diet treatment were available initially, but mortality decreased replicate numbers of females to 5–12 at the end of the experiment. All males were fed the control diet.

Diet treatments began 28 November 1986 and ended 25 February 1987. Food and water were provided ad libitum; approximately 150 g (air dry wt) of food were given daily to each bird. Food was never completely consumed between days, and remnant food was removed and replaced with a new ration. Whole-kernel corn was used, and soybeans and rice were soaked in water for 24 hours prior to feeding to avoid proventricular impaction from expanding soybeans and to reduce abrasiveness of rice hulls during ingestion. Grit was supplied weekly in each bird's water tub (43 cm diam × 11.5 cm deep).

Females were weighed (±10 g) weekly beginning 21 November 1986 and ending 19 March 1987 using a 2-kg spring scale (Douglas Homs Corp., Belmont, Calif.). Food was removed 5.5 hours before weighing to avoid bias from ingested food.

Female body weights were standardized for individual structural size variation by dividing body weight (g) by the length (mm) measured from the proximal end of the carpometacarpus to the distal end of the ninth primary covert. Usually, wing-cord length is used as the structural corrector in this equation (Owen and Cook 1977, Wishart 1979, Gordon 1981); however, the ninth primary of many females was damaged and could not be measured. Thus, we used the above wing measurement as a divisor because it was the strongest correlate of female wing-cord length among several other measured

Table 1. Nutrient composition of foods similar to those fed to captive, wild-strain female mallards 28 November 1986–25 February 1987, Mississippi State University, Starkville.

Nutrient	Control	Soybean	Corn	Rice	Japenese millet
Crude protein (%)	20.1	34.8	7.8	8.1	10.9
Crude fat (%)	2.9	10.9	4.5	2.7	5.7
Crude fiber (%)	4.9	17.6	3.6	10.4	12.0
Ash (%)		5.6	1.9	6.1	4.1
Moisture (%)	9.2	8.1	12.1	11.2	10.6
Nitrogen free extract (%)		23.0	70.1	61.5	56.7
Metabolizable energy (kcal/g)[a]	2.7[b]	2.7[c]	3.7[c]	3.3[c]	

[a] Estimates derived from M mallards.
[b] Purol (1975).
[c] Reinecke et al. (1989) and K. J. Reinecke (pers. commun.).

variables ($r = 0.71$, $P < 0.001$) (Loesch 1988: 10).

Repeated measures analysis of variance (ANOVA) with and without the final pre-treatment SW (28 Nov 1986) as a covariate was used to test the effects of diet and sampling date on variation in female SW. Female SW's were similar ($P = 0.09$) between year classes (Loesch 1988:14), hence SW data were pooled across year classes for analyses. Because variances of treatment combinations were heterogeneous ($P < 0.05$, Hartley's F-max test [Milliken and Johnson 1984]), SW's were transformed using natural logarithms making variances homogeneous ($P > 0.05$). Linear contrasts (Milliken and Johnson 1984) were used to compare weekly SW means for agricultural seed diets with control-group means.

The assumption of independence among individual female's weekly SW was violated because of among-week correlation. Therefore, serial correlation analysis was used to determine the time lag within diets when sequential SW measurements were independent. Two weeks was determined to be the interval at which the SW of individuals were not correlated ($P > 0.05$). Weekly SW's for all surviving females were chosen randomly from week 1 or 2. Subsequently, each alternate week (i.e., 3, 5, 7, . . . or 4, 6, 8, . . .) of data was selected from the 13 weeks of data for use in partial correlation analysis. Partial correlation analysis was used to test for separate associations between weekly SW's of females within diets and ambient temperature (C) and precipitation (cm), as measured on the MSU campus. Temperature was computed as the weekly mean of daily median temperatures; precipitation was the weekly total of rain and/or snow.

RESULTS

Mortality

Eight females died during the treatment period; 5 fed soybean, 2 fed millet, and 1 fed rice. Females died from starvation 8–13 days ($\bar{x} = 11 \pm 0.65$ days) after initiation of the feeding trials because of their reluctance to consume assigned diets. Body weight of the 8 females declined a mean of 384 ± 24 g from pre-treatment weights. The number of days females survived post-treatment was correlated ($r = 0.87$, $P < 0.05$) with their pre-treatment SW.

Standardized Body-Weight Responses

Pre-treatment SW, the covariate, was related ($P = 0.03$) to weekly variation in diet-treatment SW's; however, the results of significance tests for main effects and interactions were the same for the ANOVA's with or without the covariate. Moreover, because the results of the ANOVA's using transformed and untransformed SW's were alike and transformation changed only 1 outcome in 48 linear contrast tests, only results from the ANOVA of untransformed data without a covariate are presented.

Diet and sampling date influenced variation in female SW's with interaction ($P < 0.001$). Females fed agricultural seeds decreased in weight following initiation of the feeding trials but females fed the control diet did not (Fig. 1, Appendix). Females fed soybeans, millet, or rice declined in SW for 1 week but increased thereafter; females fed corn declined for 3 weeks before increasing. Between 26 December 1986 and 29 January 1987, the SW of females decreased sharply for those fed soybeans and slightly for those fed other diets except corn; the latter fluctuated during this period. The SW

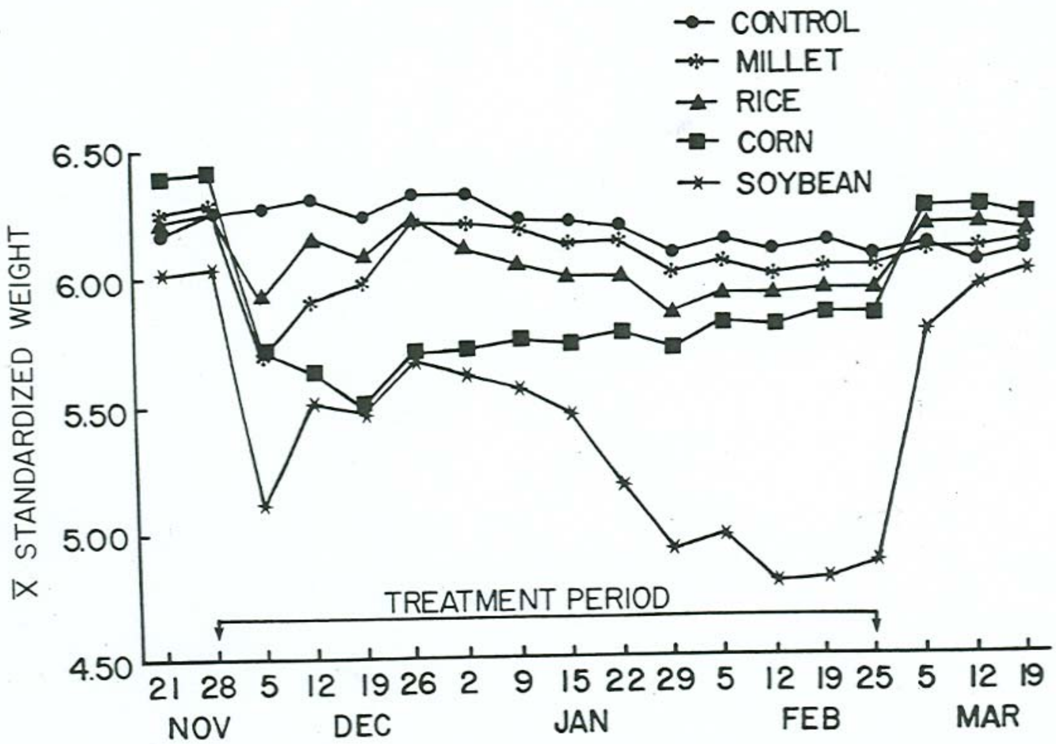

Fig. 1. Mean values of body weight (g) standardized for structural size for captive, wild-strain female mallards fed a control or 1 of 4 agricultural-seed diets between 28 November 1986 and 25 February 1987 at Mississippi State University, Starkville. Values for 21 and 28 November 1986 and 5–19 March 1987 are from pre- and post-treatment periods, respectively, when all birds were fed the control diet.

of females fed soybeans continued to decline in February to the lowest mean levels. In contrast, SW's of females fed the other diets generally remained constant during February.

The SW data for the first week of the experiment were not used in mean comparisons because reduced food consumption (C. R. Loesch, MSU, unpubl. data) by females fed agricultural seeds confounded diet effects on SW. For all treatment weeks, the SW of females fed soybeans was lower ($P < 0.01$) than for females fed the control diet. From 12 December 1986 to 2 January 1987 and on 15 January 1987, the SW of females fed corn was lower ($P < 0.04$) than for females fed the control diet. Thereafter, slight SW increases of females fed corn and concurrent SW declines of females fed the control diet resulted in similar SW levels ($P > 0.05$). Throughout the treatment period, the SW of females fed rice or millet did not differ ($P > 0.05$) from that of females fed the control diet.

Females fed agricultural seeds recovered in SW rapidly when switched to ad libitum amounts of the control diet during the post-treatment period (Fig. 1, Appendix). One week post-treatment, females fed agricultural seeds during winter increased in SW levels similar ($P > 0.05$) to their final pre-treatment SW. The most dramatic recovery was by females fed soybeans wherein mean body weight increased 146 g in 1 week; 1 individual increased 300 g. The SW of females fed the control diet did not change during the same period.

Climatic Relationships

Weekly mean SW's of females for control and treatment diets were not correlated ($-0.24 \leq r \leq 0.02$, $P > 0.05$) with temperature, except for females fed soybeans ($r = -0.49$, $P < 0.001$). This inverse relationship was an artifact of the significant diet × date interaction. Similarly, weekly mean SW's for females of all diets were uncorrelated ($-0.32 \leq r \leq 0.07$, $P > 0.05$) with precipitation.

DISCUSSION

Several other factors (i.e., palatability, food consumption, digestive efficiency) may have interacted with diet to produce the observed results, especially during the early weeks of the experiment. Nevertheless, an ad libitum agricultural-seed diet of soybeans or corn during winter did decrease the SW of females. In contrast, female mallards fed rice or millet were able to maintain weight at levels similar to the control group. Overall, however, an exclusive agricultural-seed diet may be sub-optimal nutritionally because mean SW's of females fed agricultural seeds were always less than that of the control group.

The SW of females fed soybeans differed most from that of females fed other diets. After remaining at a low SW for 7 weeks (5 Dec 1986–15 Jan 1987), the SW of females fed soybeans decreased to 35–40% of pre-treatment levels during the last 3 weeks of treatment (death occurred in 8 F among diets when SW's decreased a mean of 40 ± 1.66%). Mallards metabolize less energy from soybeans (2.65 kcal/g) than from other common cereal grains (>3.3 kcal/g) (Reinecke et al. 1989) and raw seeds contain a trypsin inhibitor that renders most of the protein within the soybeans unavailable for young broiler chickens (McNaughton and Reece 1980, McNaughton et al. 1981). The decreased metabolizable energy and possibly protein availability of raw soybeans may have caused females fed soybeans to meet nutritional demands through catabolization of lean tissue, which consequently resulted in their emaciated condition.

The SW declines of females fed corn may in part have resulted from decreased gut size and weight due to the low-fiber corn diet consumed over an extended period (Miller 1975, Whyte and Bolen 1985). Corn is relatively high in metabolizable energy and seems adequate as a staple food for wintering mallards (Jorde et al. 1983, Baldassarre and Bolen 1984). However, the comparatively low, stable SW's of females fed corn may reflect the deficiency of corn in certain vitamins, minerals, and amino acids (Baldassarre et al. 1983). Supplemental foods (e.g., invertebrates, natural plant seeds) with these nutrients seem vital for mallards and other waterfowl that consume primarily corn (Baldassarre et al. 1983, Jorde et al. 1983).

The lack of associations between mallard SW and the climatic variables may be the result of ad libitum food availability. Any additional energy costs due to decreasing temperature could have been compensated by increased food consumption with little additional foraging cost. Also, precipitation falling in the aviary did not influence food availability as it does under natural conditions (Delnicki and Reinecke 1986, Miller 1986).

MANAGEMENT IMPLICATIONS

This study implies that soybeans, corn, and perhaps other agricultural seeds do not provide a complete diet for mallards and probably other waterfowl (Joyner et al. 1987). Thus, to insure completeness of diet, in conjunction with agricultural crops, wetlands should exist for waterfowl to provide natural plant and invertebrate foods to supplement primarily agricultural-seed diets. Further, habitat management should endeavor to provide a complex of natural wetlands and agricultural croplands. Habitat diversity provides a variety of food and cover needed to meet the physiological and social needs of ducks during winter (Heitmeyer 1985, Turnbull and Baldassarre 1987, Thompson and Baldassarre 1988, Reinecke et al. 1989). Increased diversity can be attained by preservation and management of moist-soil areas, emergent wetlands, hardwood bottomlands, and by planting a diversity of agricultural crops. Millets and grain sorghum are more drought resistant than corn, but all 3 crops produce high energy seeds. Requiring consideration for management use are new agricultural seed hybrids (e.g., high lysine varieties of corn) that may overcome nutritional deficiencies among standard varieties (Raloff 1988). However, additional experiments are necessary to evaluate waterfowl use and effects on body weight and condition, and cost-benefit ratios.

Regardless of inherent nutritional deficiencies of individual agricultural seeds, they may suffice for body maintenance while precluding weight gains. This suggestion is evidenced by the lack of significant increases in SW for birds fed high-energy, agricultural-seed diets of rice, millet, and corn. If this is the case, mallards in good condition when feeding on agricultural seeds may remain in stable condition. In contrast, mallards in poor condition would remain as such unless supplemental natural foods were available.

Decreases in body weight from poor quality diets and environmental conditions during winter may have immediate and cross-seasonal impacts. For example, wetland conditions on the wintering grounds appear to affect body condition of mallards (Whyte and Bolen 1984, Delnicki and Reinecke 1986, Whyte et al. 1986) and ultimately survival (Hepp et al. 1986, Reinecke et al. 1987) and recruitment rates (Heitmeyer and Fredrickson 1981, Kaminski and Gluesing 1987).

Female mallards showed astounding recuperative capabilities when switched to a completely nutritious diet. This ability to recover rapidly from decreased weights seems adaptive. It may allow mallards to exploit food resources as they become available; perhaps an adaptation critical for survival in dynamic environments. If wintering waterfowl are able to maintain adequate body condition for survival, despite foraging primarily on agricultural seeds, lipid and protein reserves important for migration and reproduction could potentially be acquired during spring migration (LaGrange and Dinsmore 1988), assuming quality foraging areas are encountered. This emphasizes the need to provide quality habitats throughout the annual range of waterfowl.

Future research should acclimate experimental birds to agricultural seeds prior to diet treatments and determine the effects of exclusive diets on body composition. These would provide insight into the physiological mechanisms surrounding decreased SW's of females fed agricultural seeds in this study.

LITERATURE CITED

BALDASSARRE, G. A., AND E. G. BOLEN. 1984. Field-feeding ecology of waterfowl wintering on the southern High Plains of Texas. J. Wildl. Manage. 48:63–71.

———, R. J. WHYTE, E. E. QUINLAN, AND E. G. BOLEN. 1983. Dynamics and quality of waste corn available to postbreeding waterfowl in Texas. Wildl. Soc. Bull. 11:25–31.

BARTON, K. 1986. Federal wetlands protection programs. Pages 373–411 *in* R. L. DiSilvestro, ed. Audubon wildlife report 1986. The Natl. Audubon Soc., New York, N.Y.

BOSSENMAIER, E. F., AND W. H. MARSHALL. 1958. Field-feeding by waterfowl in southeastern Manitoba. Wildl. Monogr. 1. 32pp.

DELNICKI, D., AND K. J. REINECKE. 1986. Mid-winter food use and body weights of mallards and wood ducks in Mississippi. J. Wildl. Manage. 50:43–51.

FORSYTHE, S. W. 1985. The protection of bottomland hardwood wetlands of the lower Mississippi Valley. Trans. North Am. Wildl. and Nat. Resour. Conf. 50:566–572.

———, AND S. W. GARD. 1980. Status of bottomland hardwoods along the lower Mississippi River. Trans. North Am. Wildl. and Nat. Resour. Conf. 45:333–340.

GORDON, D. H. 1981. Condition, feeding ecology and behavior of mallards wintering in north-central Oklahoma. M.S. Thesis, Oklahoma State Univ., Stillwater. 68pp.

HEITMEYER, M. E. 1985. Wintering strategies of female mallards related to dynamics of lowland hardwood wetlands in the Upper Mississippi Delta. Ph.D. Thesis, Univ. Missouri, Columbia. 378pp.

———, AND L. H. FREDRICKSON. 1981. Do wetland conditions in the Mississippi Delta hardwoods influence mallard recruitment? Trans. North Am. Wildl. Nat. Resour. Conf. 46:44–57.

HEPP, G. R., R. J. BLOHM, R. E. REYNOLDS, J. E. HINES, AND J. D. NICHOLS. 1986. Physiological condition of autumn-banded mallards and its relationship to hunting vulnerability. J. Wildl. Manage. 50:177–183.

JORDE, D. G., G. L. KRAPU, AND R. D. CRAWFORD. 1983. Feeding ecology of mallards wintering in Nebraska. J. Wildl. Manage. 47:1044–1053.

JOYNER, D. E., B. N. JACOBSON, AND R. D. MCARTHUR. 1987. Nutritional characteristics of grains fed to Canada geese. Wildfowl 38:89–93.

KAMINSKI, R. M., AND E. A. GLUESING. 1987. Density- and habitat-related recruitment in mallards. J. Wildl. Manage. 51:141–148.

LAGRANGE, T. G., AND J. J. DINSMORE. 1988. Nutrient reserve dynamics of female mallards during spring migration through central Iowa. Pages 287–297 *in* M. W. Weller, ed. Waterfowl in winter. Univ. Minnesota Press, Minneapolis.

LOESCH, C. R. 1988. Weight and body-condition dynamics of captive, wild-strain mallards during winter. M.S. Thesis, Mississippi State Univ., Mississippi State. 62pp.

MCNAUGHTON, J. L., AND F. N. REECE. 1980. Effect of moisture content and cooking time on soybean meal urease index, trypsin inhibitor content, and broiler growth. Poult. Sci. 59:2300–2306.

———, ———, AND J. W. DEATON. 1981. Relationships between color, trypsin inhibitor contents, and urease index of soybean meal and effects on broiler performance. Poult. Sci. 60:393–400.

MILLER, M. R. 1975. Gut morphology of mallards in relation to diet quality. J. Wildl. Manage. 30: 168–173.

———. 1986. Northern pintail body condition during wet and dry winters in the Sacramento Valley, California. J. Wildl. Manage. 50:189–198.

———. 1987. Fall and winter foods of northern pintails in the Sacramento Valley, California. J. Wildl. Manage. 51:405–414.

MILLIKEN, G. A., AND D. E. JOHNSON. 1984. Analysis of messy data. Vol. 1. Designed experiments. Life and Learning Publ., Belmont, Calif. 473pp.

OWEN, M., AND W. A. COOK. 1977. Variations in body weight, wing length, and condition of mallard *Anas platyrhynchos* and their relationship to environmental changes. J. Zool. (London) 183: 377–395.

PUROL, D. A. 1975. Metabolizable energy of cellulose, three natural foods, and three diets for mallards. M.S. Thesis, Michigan State Univ., East Lansing. 39pp.

RALOFF, J. R. 1988. Cornucopious nutrition. Sci. News 134:104–105.

REINECKE, K. J., R. M. KAMINSKI, D. J. MOOREHEAD, J. D. HODGES, AND J. R. NASSAR. 1989. Mississippi alluvial valley. *In* L. M. Smith, R. L. Pederson, and R. M. Kaminski, eds. Habitat management for migrating and wintering waterfowl in North America. Texas Tech Univ. Press, Lubbock. In Press.

———, C. W. SHAIFFER, AND D. DELNICKI. 1987. Winter survival of female mallards in the lower Mississippi Valley. Trans. North Am. Wildl. and Nat. Resour. Conf. 52:258–263.

THOMPSON, J. D., AND G. A. BALDASSARRE. 1988. Postbreeding habitat preference of wood ducks in northern Alabama. J. Wildl. Manage. 52:80–85.

TINER, R. W., JR. 1984. Wetlands of the United States: current status and recent trends. U.S. Fish Wildl. Serv. Natl. Wetlands Inventory, Washington, D.C. 59pp.

TURNBULL, R. E., AND G. A. BALDASSARRE. 1987. Activity budgets of mallards and American wigeon wintering in east-central Alabama. Wilson Bull. 99:457–464.

WHYTE, R. J., G. A. BALDASSARRE, AND E. G. BOLEN. 1986. Winter condition of mallards on the southern High Plains of Texas. J. Wildl. Manage. 50: 52–57.

———, AND E. G. BOLEN. 1984. Impact of winter stress on mallard body composition. Condor 86: 477–482.

———, AND ———. 1985. Variation in mallard digestive organs during winter. J. Wildl. Manage. 49:1037–1040.

WISHART, R. A. 1979. Indices of structural size and condition of American wigeon (*Anas americana*). Can. J. Zool. 57:2369–2375.

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Appendix. Mean ± (SE) body weights (g) of captive, wild-strain female mallards fed a control diet or 1 of 4 agricultural seeds between 28 November 1986 and 25 February 1987, Mississippi State University, Starkville. Weights for 21 and 28 November 1986 and 5–19 March 1987 are from pre- and post-treatment periods, respectively, when all mallards were fed the control diet.

Date	Control			Rice			Japanese millet			Corn			Soybean		
	$\bar{x}$	SE	n	$\bar{x}$	SE	n	$\bar{x}$	SE	n	$\bar{x}$	SE	n	$\bar{x}$	SE	n
21 Nov	959	27	12	967	20	11	953	21	11	995	18	11	931	20	11
28 Nov	974	27	12	975	22	11	957	21	11	999	18	11	934	21	11
5 Dec	976	28	12	920	29	11	867	23	11	891	65	11	792	27	11
12 Dec	981	24	12	958	27	10	899	32	9	876	40	11	853	39	6
19 Dec	971	28	12	945	26	10	909	22	9	855	43	11	847	30	6
26 Dec	983	27	12	970	26	10	946	25	9	889	36	11	877	23	6
2 Jan	984	28	12	949	27	10	943	27	9	890	37	11	867	24	6
9 Jan	967	27	12	941	28	10	940	24	9	897	31	11	860	22	6
15 Jan	967	25	12	930	24	10	930	22	9	894	31	11	845	20	6
22 Jan	963	25	12	932	22	10	933	24	9	899	30	11	800	23	6
29 Jan	947	24	12	910	25	10	913	22	9	890	26	11	760	23	6
5 Feb	955	24	12	921	23	10	919	20	9	905	29	11	770	23	6
12 Feb	947	24	12	921	24	10	912	20	9	903	24	11	740	25	6
19 Feb	953	23	12	924	24	10	916	19	9	910	26	11	742	29	6
25 Feb	945	25	12	923	22	10	916	20	9	911	24	11	746	41	5
5 Mar	951	25	12	964	24	10	927	20	9	974	19	11	886	20	5
12 Mar	941	26	12	963	25	10	924	22	9	976	17	11	914	14	5
19 Mar	948	25	12	959	29	10	931	21	9	972	17	11	922	7	5