

Carcass Mass and Nutrient Dynamics of Mottled Ducks during Remigial Molt

Author(s): Thomas E. Moorman, Guy A. Baldassarre, Thomas J. Hess, Jr.

Source: *The Journal of Wildlife Management*, Vol. 57, No. 2 (Apr., 1993), pp. 224-228

Published by: [Allen Press](#)

Stable URL: <http://www.jstor.org/stable/3809417>

Accessed: 14/12/2010 10:13

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at <http://www.jstor.org/page/info/about/policies/terms.jsp>. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at <http://www.jstor.org/action/showPublisher?publisherCode=acg>.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.



Allen Press is collaborating with JSTOR to digitize, preserve and extend access to *The Journal of Wildlife Management*.

CARCASS MASS AND NUTRIENT DYNAMICS OF MOTTLED DUCKS DURING REMIGIAL MOLT

THOMAS E. MOORMAN,¹ Environmental and Forest Biology, College of Environmental Science and Forestry, State University of New York, Syracuse, NY 13210

GUY A. BALDASSARRE, Environmental and Forest Biology, College of Environmental Science and Forestry, State University of New York, Syracuse, NY 13210

THOMAS J. HESS, JR., Louisiana Department of Wildlife and Fisheries, Route 1, Box 20-B, Grand Chenier, LA 70643

Abstract: Proper management of waterfowl requires knowledge of their physiological requirements during molt. Thus, we collected data on carcass mass and nutrient dynamics of flightless mottled ducks (*Anas fulvigula*) in Louisiana in July and August 1988, to determine if they used endogenous reserves to meet energetic and nutritional demands during remigial molt. As remex length increased, carcass mass decreased ($r^2 = 0.37$) in males, but both males ($r^2 = 0.25$) and females ($r^2 = 0.45$) used lipid reserves. Carcass protein did not change ($P > 0.05$) in either sex during molt, but the breast mass of males declined ($r^2 = 0.29$). We estimated that the lipid reserves of mottled ducks provided existence energy for only 33% (9 days) of the 27-day flightless period. Use of reserves may allow mottled ducks to reduce activities and exposure to predators, but exogenous nutrients apparently fulfill the bulk of their requirements during remigial molt. This suggests a need for management plans that result in habitat that provides both dense cover and food. Manipulative experiments should be designed to test hypotheses regarding regulation of nutrient reserve mass during remigial molt.

J. WILDL. MANAGE. 57(2):224-228

Investigations of the role of nutrient reserves in meeting the energy and nutrient requirements of ducks (Anatidae: Anatinae) during remigial molt (hereafter molt) have had conflicting results and interpretations. For example, Young and Boag (1982) found no declines in body mass or nutrient reserves of male mallards (*Anas platyrhynchos*) during molt, but several other investigators reported otherwise (Folk et al. 1966, Pehrsson 1987, Panek and Majewski 1990). Furthermore, declines in body mass or nutrient reserves in mallards were attributed variously to nutritional stress (Folk et al. 1966), an adaptive strategy that reduced wing-loading and shortened the flightless period (Pehrsson 1987), or to reduced foraging effort resulting from the potentially high risk of predation during molt (Panek and Majewski 1990).

Ducks are difficult to study during molt because of their secretive habits. Nonetheless, comprehensive management programs require knowledge of the activities and physiological requirements of ducks during this potentially vulnerable phase of the annual cycle. Herein, we present data on carcass mass and nutrient dynamics of mottled ducks during molt. We

hypothesized that carcass mass and nutrient reserves would decline during molt because mottled ducks would use their reserves to meet energy and other nutrient requirements.

Financial support was provided by the Louisiana Department of Wildlife and Fisheries. Special thanks to personnel of Rockefeller State Wildlife Refuge for their assistance and logistical support throughout the study. We thank the Miami Corporation for access to their land. We are grateful to A. M. Moorman for assistance with laboratory work. M. J. Mitchell, W. F. Porter, J. D. Thompson, L. W. VanDruff, and 2 anonymous reviewers provided helpful comments on earlier versions of the manuscript.

STUDY AREA AND METHODS

We collected mottled ducks in various stages of molt by night-lighting and netting from an airboat during July–August 1988; 2 additional molting females were collected in early October 1988. Specimens were collected from a tract of freshwater marsh located about 10 km northwest of Rockefeller State Wildlife Refuge, Cameron Parish, Louisiana. We collected birds from only 2 locations to minimize potential variability due to habitat differences. Paulus (1982) provides a detailed description of the study area.

After collection, we allowed plumage to dry, then determined mass of the birds to the nearest 0.1 g. We calculated a molt index by summing

¹ Present address: Ducks Unlimited, Inc., Southern Regional Office, 101 Business Park Drive, Suite D, Jackson, MS 39213.

the lengths (measured to ± 0.1 cm) of primary remiges 5, 9, and 10, and secondary remiges 5 and 10. We plucked and re-determined mass (± 0.1 g) of the birds to determine fresh plucked mass, removed and determined mass (± 0.1 g) of the ingesta, bill, tongue, and feet, and then subtracted the sum of their masses from fresh plucked mass. We defined the result as carcass mass.

We dissected the ducks and determined the mass (± 0.1 g) of the left breast muscles (pectoralis, supracoracoideus, and coracobrachialis) and left leg muscles (all muscles having either their origin or their insertion on the femur or tibiotarsus [Ankney 1979]). After carcasses were dissected and frozen, we allowed them to partially thaw and then passed them 3 times through a commercial meat grinder equipped with a 5-mm sieve plate to obtain a carcass homogenate. We removed a 90- to 100-g sample from each bird for determination of carcass components.

After samples were dried to constant mass at 90 C to determine water content (Kerr et al. 1982), they were homogenized further by passing them repeatedly through a coffee grinder and then mixing them by hand to maximize homogeneity. A 6- to 10-g subsample of this homogenate was used for proximate analysis of carcass composition. Lipid content (± 0.001 g) was determined by petroleum ether extraction in a modified Soxhlet apparatus (Dobush et al. 1985). Lipid-free subsamples were incinerated in a muffle furnace at 550 C for 6 hours to determine mineral ash content (± 0.001 g). We estimated carcass protein (± 0.001 g) by subtracting ash from lean dry mass. Methods of carcass analysis followed Alisauskas and Ankney (1985).

We used simple linear regression with the molt index as the independent variable to determine if dependent variables (e.g., mass, carcass lipid) changed during molt. Mass and nutrient dynamics may be curvilinear in some species of molting waterfowl (Ankney 1984, Bailey 1985, Heitmeyer 1988a), but examination of residuals from our analyses did not indicate presence of such relationships for mottled ducks and use of polynomial regressions (Pfaffenberger and Patterson 1981, Zar 1984) did not improve the fit. Therefore, we treated relationships as linear. We performed the regressions separately for each sex because of differences in body size. We attempted to correct regression data

for within-sex variation due to structural size using log-transformed indices (e.g., division of dependent variables by carcass ash [Zar 1984]), but this technique did not decrease the variance or improve the fit. Thus, we present regression results uncorrected for body size.

RESULTS

We collected 31 flightless mottled ducks (15 males, 16 females) in all but the last stage of wing-molt (i.e., no birds were collected that had recently regained flight). Male carcass mass declined ($r^2 = 0.37$, $P = 0.02$), but female carcass mass did not change ($r^2 = 0.16$, $P = 0.13$) during molt (Fig. 1). Carcass lipid content declined in males ($r^2 = 0.25$, $P = 0.06$) and females ($r^2 = 0.45$, $P = 0.01$) during molt, but carcass protein levels did not change in either sex ($r^2 = 0.17$, $P = 0.12$ males; $r^2 = 0.02$, $P = 0.62$ females) (Fig. 1). Breast mass decreased ($Y = 186.7 - 0.42X$, $r^2 = 0.29$, $P = 0.04$) in males, but not ($r^2 = 0.03$, $P = 0.49$) in females during molt. Leg mass did not change in either sex during molt ($r^2 = 0.003$, $P = 0.83$ males; $r^2 = 0.006$, $P = 0.78$ females).

DISCUSSION

Both sexes of mottled ducks used lipid reserves for energy during molt. However, we estimated that these reserves provided only about 33% (9 days) of the energy necessary to meet the existence requirements of mottled ducks during molt. We based this estimate on the calculation of existence energy requirements for mottled ducks using the nesting/molting equation for nonpasserine birds (Kendeigh et al. 1977: 143), which yielded values of 409 kJ/day for males and 376 kJ/day for females. When extrapolated over the 27-day duration of molt (Stutzenbaker 1988), existence energy requirements were approximately 11,043 kJ for males and 10,152 kJ for females. The 94.5-g (Y-intercept) lipid reserve of males, if completely available (cf. Jenni-Eiermann and Schifferli 1989, Blem 1990), supplied 3,677 kJ (1 g lipid = 38.91 kJ; Whittow 1986:254), or enough energy to meet existence requirements for about 9 days. Similarly, lipid reserves of females (93.0 g, Y-intercept) yielded 3,619 kJ, also about a 9-day existence energy supply. This suggests that exogenous sources provided the bulk (approx 67%) of the energy and nutrients during molt. However, the importance of these reserves should not be underestimated because they probably allow mottled ducks to reduce their activities

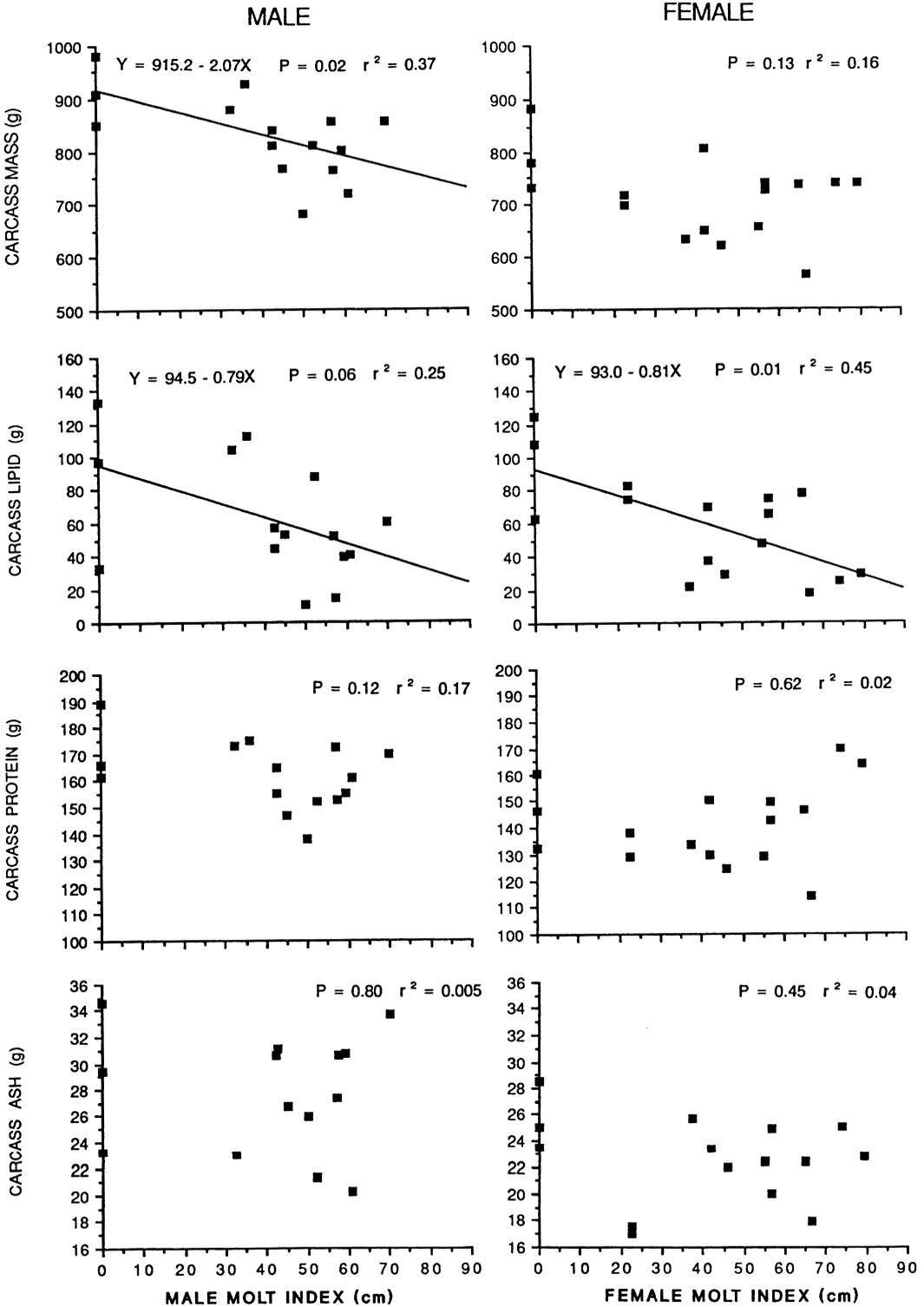


Fig. 1. Relationship between carcass or nutrient reserve mass and the progression of remigial molt of male (n = 15) and female (n = 16) mottled ducks in Louisiana in 1988. The molt index is the sum of the lengths of growing primary remiges 5, 9, and 10, and secondary remiges 5 and 10.

and exposure to predation during molt, as has been suggested for mallards (Pehrsson 1987, Panek and Majewski 1990).

Interestingly, the nearly equal *Y*-intercepts of males and females suggest that lipid reserves were similar between the sexes at initiation of molt. This implies that females were able to recover from their greater commitment of reserves to reproduction (Moorman 1991). However, we were not able to determine reproductive success of the molting females in our sample. Hence, this conclusion should be considered tentative pending studies that use marked birds to assess the potential effects of reserve use during reproduction on nutrient dynamics during molt.

The decline in breast mass of male mottled ducks might have resulted partially from catabolism of intracellular lipids (Raveling 1979, Gaunt et al. 1990), but atrophy from lack of use seems a more likely explanation (Ankney 1979). The breast muscle of males might supplement their energy or protein requirements during molt. However, although the protein requirements of feather synthesis in waterfowl may be high relative to other annual events (Heitmeyer 1988*b*), studies of mallards and several species of geese indicated that requirements of molt were met from exogenous nutrients (Ankney 1979, 1984; Raveling 1979; Mainguy and Thomas 1985; Heitmeyer 1985, 1988*a*). Given the relatively small reserve (approx 30 g) that the breast muscle could provide, we suspect the benefits accrued by males are slight. Furthermore, the lack of change in carcass protein in either sex suggests that protein requirements were met with exogenous nutrients, requirements were too small to cause detectable changes in protein reserves, or the power of our tests was too low to detect trends in carcass protein.

Panek and Majewski (1990) suggested that flightless mallards declined in mass because of reliance on endogenous reserves and that this strategy allowed for reduced activity levels and lowered the risk of predation. Pehrsson (1987) suggested that the decline in mass of flightless mallards was an adaptive strategy to reduce maintenance energy requirements and simultaneously shorten the flightless period by reducing wing-loading. Pehrsson (1987) also indicated that use of reserves may have allowed mallards to occupy habitat offering cover from predators even if food was scarce in that habitat. We agree that use of lipid reserves probably allows mottled ducks to reduce activities and

the associated risk of predation, but we believe reduced wing-loading probably is a benefit of nutrient reserve use and not the cause of the strategy. Additionally, our data indicate that molting mottled ducks obtain a significant portion (approx 67%) of their energy requirements from exogenous sources.

Finally, if it is adaptive to store and use lipid reserves during molt to lower the risk of predation, then mottled ducks should store reserves (assuming food abundance permits) to the extent that little or no feeding is required during molt. However, mottled ducks had reserves that would meet existence requirements for only about 33% of the flightless period, which suggests that their lipid reserves reflect a balance between the benefits of reduced activity and the cost of increased wing-loading. For example, if lipid reserves were too large and not fully utilized in late molt, escape flights probably would be impaired by the additional mass, and the length of the flightless period and associated risk of predation probably would be increased (Pehrsson 1987). Alternatively, if reserves were too small, foraging time might be increased, resulting in increased exposure to predators (Panek and Majewski 1990).

RESEARCH AND MANAGEMENT IMPLICATIONS

Hypotheses regarding regulation of nutrient reserves should be tested by manipulating the mass of ducks during remigial molt. Also, studies should be performed on female ducks equipped with radio transmitters to examine how reserve use during reproduction affects nutrient reserve dynamics during remigial molt.

Our findings also suggest a need for habitat that offers both dense cover and abundant food resources. Ideally, areas of permanent, deep-water marsh should be managed to ensure production of aquatic vegetation that provide food for molting mottled ducks (Stutzenbaker 1988). This may require periodic draw downs of impounded areas. Therefore, draw downs should either occur prior to initiation of remigial molt by large numbers of mottled ducks, or where impounded areas are adjacent to each other, draw downs should be rotated to ensure habitat availability for molting mottled ducks.

LITERATURE CITED

- ALISAUSKAS, R. T., AND C. D. ANKNEY. 1985. Nutrient reserves and the energetics of reproduction in American coots. *Auk* 102:133-144.

- ANKNEY, C. D. 1979. Does wing molt cause nutritional stress in lesser snow geese? *Auk* 96:68-72.
- . 1984. Nutrient reserve dynamics of breeding and molting brant. *Auk* 101:361-370.
- BAILEY, R. O. 1985. Protein reserve dynamics in postbreeding adult male redheads. *Condor* 87:23-32.
- BLEM, C. R. 1990. Avian energy storage. Pages 59-113 in D. M. Power, ed. *Current ornithology*. Vol. 7. Plenum Press, New York, N.Y.
- DOBUSH, G. R., C. D. ANKNEY, AND D. G. KREMENTZ. 1985. The effect of apparatus, extraction time, and solvent type on lipid extractions of snow geese. *Can. J. Zool.* 63:1917-1920.
- FOLK, C., K. HUDEC, AND J. TOUFAR. 1966. The weight of the mallard, *Anas platyrhynchos*, and its changes in the course of the year. *Zool. Listy* 15:249-260.
- GAUNT, A. S., R. S. HIKIDA, J. R. JEHL, JR., AND L. FENBERT. 1990. Rapid atrophy and hypertrophy of an avian flight muscle. *Auk* 107:649-659.
- 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. of Missouri, Columbia. 378pp.
- . 1988a. Body composition of female mallards in winter in relation to annual cycle events. *Condor* 90:669-680.
- . 1988b. Protein costs of the prebasic molt of female mallards. *Condor* 90:263-266.
- JENNI-EIERMANN, S., AND L. SCHIFFERLI. 1989. Body composition of starved tufted ducks *Aythya fuligula*, pochards *A. ferina*, and little grebes *Tachybaptus ruficollis*. *Wildfowl* 40:99-105.
- KENDEIGH, S. C., V. R. DOL'NIK, AND V. GAVRILOV. 1977. Avian energetics. Pages 127-204 in J. Pinoski and S. C. Kendeigh, eds. *Granivorous birds in ecosystems*. Cambridge Univ. Press, London.
- KERR, D. C., C. D. ANKNEY, AND J. S. MILLAR. 1982. The effect of drying temperature on extraction of petroleum ether soluble fats of small birds and mammals. *Can. J. Zool.* 60:470-472.
- MAINGUY, S. K., AND V. G. THOMAS. 1985. Comparisons of body reserve buildup and use in several groups of Canada geese. *Can. J. Zool.* 63:1765-1772.
- MOORMAN, T. E. 1991. Carcass mass, composition, and gut morphology dynamics of mottled ducks in Louisiana in relation to annual cycle events. Ph.D. Thesis, State Univ. of New York, Syracuse. 113pp.
- PANEK, M., AND P. MAJEWSKI. 1990. Remex growth and body mass of mallards during wing molt. *Auk* 107:255-259.
- PAULUS, S. L. 1982. Feeding ecology of gadwalls in Louisiana in winter. *J. Wildl. Manage.* 46:71-79.
- PEHRSSON, O. 1987. Effects of body condition on molting in mallards. *Condor* 89:329-339.
- PFaffenBERGER, R. C., AND J. H. PATTERSON. 1981. *Statistical methods for business and economics*. R. D. Irwin Publ., Inc., Homewood, Ill. 828pp.
- RAVELING, D. G. 1979. The annual cycle of body composition of Canada geese with special reference to control of reproduction. *Auk* 96:234-252.
- STUTZENBAKER, C. D. 1988. *The mottled duck, its life history, ecology and management*. Tex. Parks and Wildl., Austin. 209pp.
- WHITTOW, G. C. 1986. Energy metabolism. Pages 253-268 in P. D. Sturkie, ed. *Avian physiology*. Fourth ed. Springer-Verlag Inc., New York, N.Y.
- YOUNG, D. A., AND D. A. BOAG. 1982. Changes in physical condition of male mallards (*Anas platyrhynchos*) during moult. *Can. J. Zool.* 60:3220-3226.
- ZAR, J. H. 1984. *Biostatistical analysis*. Second ed. Prentice-Hall, Inc., Englewood Cliffs, N.J. 718pp.

Received 15 July 1991.

Accepted 1 September 1992.

Associate Editor: Sedinger.