Observations on the feeding ecology and bioenergetics of the White-faced Whistling Duck in Venezuela

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Introduction

A severe increase in the population of Venezuela during the past few decades has put a noticeable strain on the country's agricultural resources, and has prompted thoughtful and systematic discussion regarding the production of additional sources of protein. One promising course of action is to raise in captivity native animals that are already adapted to the climate of tropical South America (Medina 1966). Among the species that have been suggested is the White-faced Whistling Duck *Dendrocygna viduata*.

Since a knowledge of the feeding ecology and bioenergetics is essential for the efficient raising of animals in captivity, the present study was undertaken to provide such basic information for the White-faced Whistling Duck, as well as to complement previous studies of this species in the wild (Casler *et al*. 1975; Bruzual 1976). Specifically, the present study was designed to (a) determine the relationship between stomach contents and the seasonal dynamics of the vegetation; (b) measure water, fat and ash content, and caloric values of the body tissues; and (c) estimate maintenance energy from dietary experiments.

Study area

The study area, in the State of Apure, is very flat, and contains the following principal habitats: (a) *bancos* (non-flooded low areas), originally riverbeds that became elevated through sedimentation (Ramia 1974), and which remain relatively dry during the rainy season; the highest areas have trees and bushes and the intermediate areas are grassy; (b) *bajios* (moderately flooded lowlands), which are flooded during the rainy months, and which slope gently down to the esteros; their vegetation is predominantly hydrophilic grasses; and (c) *esteros* (extensively flooded lowlands), the lowest areas, consisting of almost impermeable clay, and characterized by grasses and plants with small leaves. Both bajios and esteros are more fertile than the muddy-sandy soils of the bancos. The flora of the region has been studied by Ramia (1972, 1974).

The dry season, or summer (December–March), reaches its peak in March and the wet season, or winter (April–November), has its peak in July. The mean annual temperature is 26–29°C.; the highest temperatures are in March and April, and the lowest, in December.

Materials and methods

A total of 116 birds were shot, wrapped in plastic and immediately transported on ice to the laboratory, where they were weighed (to 0·1 g) and frozen. Juveniles were obtained from eggs that were incubated under hens or in an incubator.

Adults were sexed by the presence or absence of a penis, and sexually immature specimens by examining the gonads.

Crop contents were sorted into (a) fruits and seeds; (b) vegetal material, primarily leaf parts, decomposing organic matter, and algae; (c) insect larvae and adults; and (d) other invertebrates, e.g. snails and spiders. To determine water and fat content, as well as caloric values, the fleshy parts were opened, the specimens wrapped in aluminum foil and dried 72–96 hours to obtain a constant weight (Golley 1961; Morales 1977).

The dried specimens were weighed (to 0·01 g) to calculate water content, ground twice in a commercial meat grinder (Hobard), and homogenized in a commercial blender (Waring). The portion to be analysed for fat content and caloric value was further processed in a microhomogenizer to the consistency of flour.

For the ash content analysis 2–3 g aliquots of the homogenate were calcined 4–5 hours in a thermolyne oven at 500°C. For the ash calorimetric analysis, fat was extracted from 2–3 g of microhomogenate by means of the Soxhlet method, using petroleum ether as a solvent at 40–60°C. The process took 12 hours, and two aliquots were taken from each individual. Percent fat, based on dry weight (dw) was calculated before and after extraction. Percent

fat, based on fresh weight (fw), was calculated as follows: % fat (fw) = % fat (dw) × (1 − %$H_2$0/100). Caloric content of dry body mass was estimated with a Parr 1241 automatic adiabatic bomb calorimeter.

Maintenance energy, calculated by substracting the energy content of the faeces from that of the food consumed while the specimen maintains a constant weight, was determined for four birds maintained in cages for a 15-day adjustment period followed by a 15-day experimental period. The temperature varied from 22·8°C to 26·9°C, and the relative humidity was kept at 72%. The photoperiod remained constant. Each bird received 100 g of commercial poultry feed (La Lucha) daily, and seeds dried at 70°C to a constant weight and sifted through no. 10 mesh to prevent the ducks from selecting seeds of a particular size. The caloric value of the feed was 4·14 KCal/g, approximately the same value (4·3–4·4 KCal/g) as in comparable experiments by Grodzinski *et al.* (1975).

Each evening between 19.00 and 20.00 the birds were fed, the faeces were removed, and the cage was carefully washed to obtain faeces and uneaten seeds. These were separated and dried to a constant weight at 80°C. The dried faeces were homogenized, pressed into tablets and analysed in a bomb calorimeter. The birds were weighed once before and once after the 15-day experiment.

Results and discussion

The mean weight of the crop contents, based on 23 specimens, was 8·63 g (0·8–18·4, sd = 4·67), and of the contents from 56 gizzards, 4·22 g (1·5–7·0, sd = 1·37). Neither quantity nor composition were correlated with age or sex.

The principal component of the diet was vegetable matter, as has been shown to be the case for *D. autumnalis* (Bolen 1967), *D. bicolor* (Landers & Johnson 1976) and African specimens of *D. viduata* (Douthwaite 1977). Seed consumption was lowest during the dry season and early rainy season and highest during the middle rainy season, when the majority of plants in the bajios and esteros were flowering (Figure 1). Tubercle consumption, which remains relatively high during the early and middle

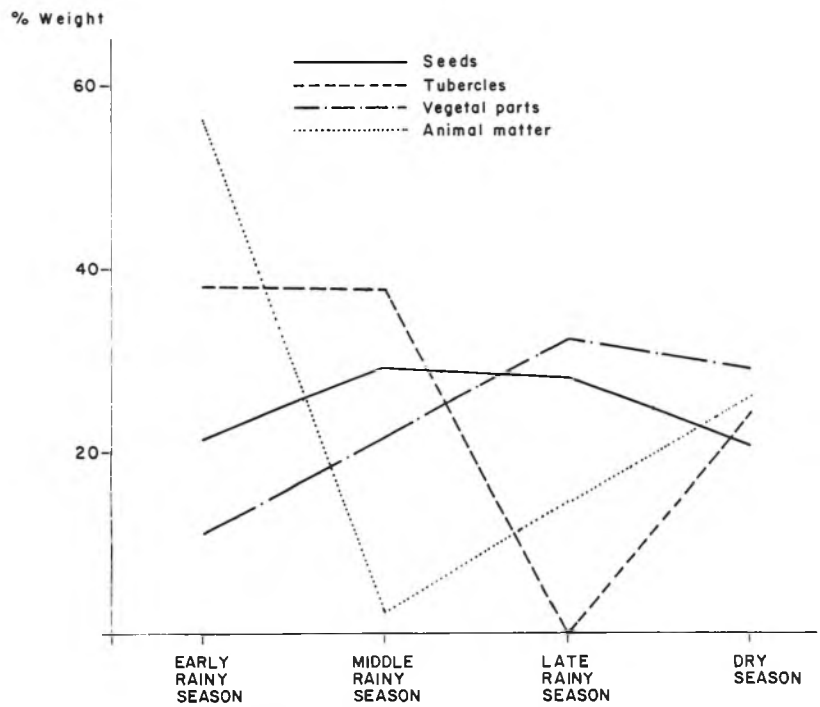

Figure 1. Seasonal changes in the diet of White-faced Whistling Ducks.

rainy season, diminishes to zero when the rains begin to decrease, and increases again during the dry season.

Consumption of plant parts increases when the rainy season begins, reaches a peak at its end, and decreases during the dry season. At the beginning of the rainy season the animal matter consumed is mostly insect larvae (21% of the diet). The percentage decreases to its lowest value during the height of the rainy season, and begins to increase again at its end and the beginning of the dry season. The amount of grit consumed is greatest at the peaks of the rainy season and the dry season and is considerably reduced at other times. In general, the consumption of vegetable matter (principally seeds and plant parts) is inversely proportional to the consumption of tubercles and animal matter.

Larvae and aquatic beetles, the principal kinds of animal matter consumed, form the major part of the diet during the early rainy season when they are most abundant and when diversity and quantity of vegetable matter is lowest. The diet of the juveniles consists principally of insects. Thus, food availability may be a major factor determining the type of food ingested, a conclusion reached for this species by Bruzual (1976) and Casler *et al.* (1978). On the other hand, it is likely that during the breeding season animal matter is selected because of the increased protein requirements, as has been shown for other waterfowl, e.g., the Pintail *Anas acuta* (Krapu 1974), Wood Duck *Aix sponsa* (Drobney & Fredrickson 1979) and Blue-winged Teal *Anas discors* (Swanson *et al.* 1974).

Finally, fat content appears to be strictly related to the type of food consumed, regardless of sex, e.g., more fat is stored when seeds having high caloric content are consumed, at the time of year that seed diversity and quantity were the greatest, that is, just before the reproductive period.

Dry body weights (g) for adult males are as follows (number of individuals in parentheses): February (8), 328·1 (sd = 47·1); June (9), 264·4 (sd = 47·2); August (9), 247·6 (sd = 19·9); September (3), 252·0 (sd = 16·1); December (5), 264·9 (sd = 17·1). The following weights are for adult females: February (4), 355·7 (sd = 6·9); June (7), 256·4 (sd = 23·6); August (9), 280·7 (sd = 21·6). Thus, dry body weight is greatest for both sexes during the pre-reproductive period (February), and least during the reproductive period (summer).

Ash content (% dry weight) for adults ranged from 8·94% to 14·91% and did not vary significantly during the year, nor did fat content (% dry weight) among adult males. In adult females it was higher during the pre-reproductive period when seeds having high caloric content were consumed (January–March): January, 32·5 (sd = 1·0); February, 33·4 (sd = 2·9); March, 36·6 (sd = 0·3); June, 11·7

Table 1. Maintenance energy (Kcal/bird), based on mean monthly fresh weight, of White-faced Whistling Ducks (1976, 1977).

Month	Adults (1976) X	SD	Monthly mean temperature (C) 1976	Adults (1977) X	SD	Monthly mean temperature (C) 1977
Jan	106·6	4·2	26·1	104·3	4·2	27·6
Feb	108·5	0·6	27·3	106·5	0·6	28·4
Mar	107·7	—	28·3	106·1	—	29·2
Apr			27·6			29·4
May			26·5			26·9
Jun	104·9	2·3	25·5	103·9	2·3	26·0
Jul			25·4			26·0
Aug	104·7	2·5	26·3	104·5	2·5	26·4
Sep	102·0	1·5	27·1	102·6	1·6	27·7
Oct	87·6	—	27·4	87·6	—	27·3
Nov	99·2	11·6	27·4	96·2	7·4	27·4
Dec	98·7	4·5	27·1			

Total for adults 1976–1977 102·5 6·1

$EM = 4{,}142\ W^{0.5444} - 0{,}2761\ W^{0.2818}\ T$

EM = Metabolism of existence

W = Maintenance energy

T = Monthly mean temperature

Table 2. Monthly energy of assimilation (Kcal/bird/month), daily food consumption (Kcal/bird/day) and monthly food consumption (Kcal/bird/month) for adult White-faced Whistling Ducks.

Month	Monthly energy of assimilation 1976	1977	Daily consumption of food 1976	1977	Monthly consumption of food 1976	1977
Jan	3,623·0	3,513·9	141·4	137·2	4,383·7	4,251·2
Feb	3,410·4	3,208·2	142·3	138·6	4,126·7	4,020·6
Mar	3,591·4	3,515·1	140·2	137·2	4,345·6	4,253·2
Apr	—	—	—	—	—	—
May	—	—	—	—	—	—
Jun	3,470·1	3,425·7	134·0	138·2	4,198·9	4,145·1
Jul	—	—	—	—	—	—
Aug	3,585·2	3,545·8	138·7	138·3	4,300·5	3,545·8
Sep	3,337·8	3,336·9	134·6	135·8	4,038·6	4,074·0
Oct	2,993·1	2,998·3	116·8	117·0	3,621·6	3,627·9
Nov	3,245·7	3,156·6	130·9	127·3	3,927·3	3,819·5
Dec	3,346·8	—	130·6	—	4,049·6	—

Assimilated energy based on 9 months in 1976 = 30,603·3 KCal/bird
Energy of assimilation based on 8 months in 1977 = 26,700·5 KCal/bird
Consumption of food based on 9 months in 1976 = 36,992·4 KCal/bird
Consumption of food based on 8 months in 1977 = 31,737·7 KCal/bird

$$C \text{ (consumption)} = \frac{EA \text{ (energy of assimilation)} \times 100 + (100 - \%\text{digestibility})}{100}$$

% digestibility = 79, calculated from laboratory experiments

(sd = 0·4); June, 17·8 (sd = 1·9); June, 19·7 (sd = 3·4); September, 10·1 (sd = 0·1); September, 15·5 (sd = 0·7); December 13·5 (sd = 1·1). Each value is for a single bird for which several determinations were made. The combined caloric values for males was 5,909·0 (sd = 740·9) and for females, 5,879·3 (sd = 768·1), with no significant differences between the two groups.

The initial weights of the four birds used in the feeding experiment were 641·5 g and 646·0 g for the first pair, and 694·0 g and 678·0 g for the second pair. The first three specimens lost weight during the experiment by 1·17%, 13·16% and 3·75% respectively. The weight of the fourth specimen increased by 2·95%.

The maintenance energy for the first pair of birds was 62·78 KCal/g per bird, and for the second pair, 82·57 KCal/g per bird. The maintenance energy was calculated on the basis of dry weight (Table 1) and these values were used to calculate the energy of assimilation (Table 2). The monthly values of assimilated energy vary according to the number of days in each month.

The daily food intake and the monthly food intake were calculated for adults from the calculated values of assimilated energy and percent digestibility (Table 2), this last value (79%) being determined experimentally from the means of the four birds. The caloric value of the food consumed daily under natural conditions was 4·36 KCal/g, based on fresh weight, taking as 10% the water content of the food. The caloric intake per bird for 9 months in 1976 and 8 months in 1977 was 4,110 KCal/month and 3,965 KCal/month, respectively. The total amount of food consumed annually, calculated from these values and from the caloric value of the food consumed, was 9,412·82 g in 1976 and 8,075·75 g in 1977.

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Summary

White-faced Whistling Ducks *Dendrocygna viduata* are a possible source of protein, suitable for raising in captivity. The nature of the food taken in the wild, and in relation to availability, was determined. Fat content, ash content and combined calorific values of the birds were measured. The maintenance energy for birds held in captivity was investigated, along with their food consumption.

References

Bolen, E. 1967. The ecology of the black-bellied tree duck in Southern Texas. Ph.D. dissertation, Utah State University.

Bruzual, J. J. 1976. Habitos alimenticios de los patos silvestres del género *Dendrocygna* en los cultivos de arroz en Calabozo. Edo. Guarico. *Acta Cientifica Venezolana*, vol. 27, suplemento no. 1, 70 pp.

Casler, C., Pacheco, J. & Gomez. F. 1975. Contribución de estudio de la ornitofauna de los modulos de Apure en Mantecal. *Acta Cientifica Venezolana*, vol. 26, suplemento no. 1, 26 pp.

Casler, C. L., Rivero, A. R. & Lira, J. R. 1978. Los patos (*Dendrocygna*) como causantes de daños en los cultivos de arroz en el Edo. Portuguesa. *Acta Cientifica Venezolana*, vol. 29, suplemento no. 1, 39 pp.

Douthwaite, R. J. 1977. Filter-feeding ducks of the Kafue Flats, Zambia, 1971–1973. *Ibis* 119: 44–66.

Drobney, R. D. & Fredrickson, L. H. 1979. Food selection by wood ducks in relation to breeding status. *J. Wildl. Manage.* 43: 109–20.

Golley, F. B. 1961. Energy values of ecological materials. *Ecology* 42: 581–4.

Grodzinski, W., Klekowski, R. Z. & Duncan, A. (eds.) 1975. *Methods for ecological bioenergetids.* I.B.P. Handbook No. 24. Oxford: Blackwell.

Krapu, G. L. 1974. Foods of breeding pintails in North Dakota. *J. Wildl. Manage.* 38: 408–17.

Landers, L. & Johnson, S. 1976. Foods of six fulvous whistling ducks in coastal South Carolina. *Wilson Bull.* 88: 659–60.

Medina, G. 1966. Consideraciones sobre la periodicidad de la reprodución de los animales de caza de Venezuela y sus implicaciones para la actividad cinegética. *MAC. Dir. Rec. Nat. Ren. Div. de Fauna.*, Caracas, 16 pp.

Morales, G. 1977. Contribución al estudio ecológico de la perdiz sabanera (*Colinus cristatus barnesi* Gilliard). *Tra. Esp. de Gr. U.C.V. Caracas*, 180 pp.

Ramia, M. 1972. Cambios en la vegetación de las sabanas del Hato El Frio (Alto Apure) causados por diques. *Boletin de la S.V.C.N.*, 30 (124–125): 57–90.

Ramia, M. 1974. Estudio ecológico del módulo experimental de Mantecal (Alto Apure). *Bol. S.V.C.N.* 31 (128–129): 117–42.

Swanson, G. A., Meyer, M. I. & Serie, J. R. 1974. Feeding ecology of breeding blue-winged teals. *J. Wildl. Manage.* 38: 396–407.

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