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Research Article

Turk J Zool
2011; 35(1): 103-108
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doi:10.3906/zoo-0904-21

Gender-based differences in stride and limb dimensions between healthy red-wing tinamou (*Rhynchotus rufescens*) Temminck, 1815

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Received: 28.04.2009

Abstract: The red-wing tinamou (*Rhynchotus rufescens*) is economically important as food. The current study investigated the limb and trunk characteristics in age-matched [year-of-hatch (yoh) 2004 and 2005], gender segregated birds, and determined differences in stride between cocks and hens. The locomotion trial was completed in a corridor of 0.6 × 2.36 m dimension. The girth was significantly higher in cocks than in hens, while body weight was slightly higher in hens. Cocks had a greater height than hens. The time to walk 2.36 m was longer for cocks than for hens. This was related to an attenuated speed and stride length in cocks by comparison with hens. The increased number of strides and reduced stride lengths in cocks suggested their defensive posture by lagging behind the fleeing hens or juveniles. Subtle differences in yoh may have been related to small variances in nutrition, weather, management, age, and reproductive traits. Although the birds born in distinct years were submitted, the net sum of these effects could have potentiated the different performances observed.

Key words: Limb dimension, tinamou, stride, gender

Introduction

The red-wing tinamou (*Rhynchotus rufescens*, Temminck, 1815; Tinamiformes, Tinamidae; Figure 1) is a bird of ca. 40 cm in length and ca. 770 g of body mass, which inhabits American marshy grasslands and savannah. Its diet is based on insects and other small animals in the summer and vegetable matter (fruits, shoots, tubers, and bulbs) in the winter. It can, potentially, be an agricultural pest, feeding on cereals, rice, and peanuts. Like all tinamous, the red-wing tinamou is a popular target for hunters and in areas of high human population density its numbers have unfortunately declined. However, this species has also increased in some areas where forest clearance has created a favourable habitat. Overall, it is not considered threatened and is therefore listed in the category of Least Concern by BirdLife International (Cooper, 2009). Despite being one of the most ancient species living in South America, most of the biological aspects of this bird remain unknown.

Due to its broad geographical dispersion, omnivorous feeding habits, and the taste of its meat,

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Figure 1. Tinamou housed in pens with a glimpse of the sand run on the right.

the domestication of the tinamou has become economically important. Raising tinamous in an environment similar to the chicken results in good performance of growth rate, excellent carcass and breast yields, and perfect adaptation to meal and pelleted feeds (Cooper, 2009). The breeding of this bird in captivity, though, is problematic. Cocks and hens only take together during the mating season. Under natural conditions the breeding season commences in September and comes to an end in March. The hens are polyandrous, mating with 2-4 cocks. The hen lays ca. 25 eggs/season and the cock incubates them and takes care of the young. The cock's sexual potential could be improved in the presence of a dominant hen as they could exhibit a more pronounced domination. However, the cock is not always able to exhibit its reproductive potential in order to attract and stimulate hen oviposition. Thus, housing harems of one cock and several hens does not seem to improve reproduction (Cromberg et al., 2007).

There are no studies to date on the locomotion characteristics and stride measurements in the tinamou. The knowledge of these traits could help researchers to determine their activities by inspection of their footprints in natural environment and/or to assist identifying birds with bone problem. It is also important to study the novel comparisons of locomotion parameters between species of ratites. Poor locomotion would incapacitate the bird from feeding efficiently and leave it susceptible to predation. We based the principles and methodology herein from those elucidated in living ostriches (Cooper, 2007a, 2007b, 2008, 2009; Cooper et al., 2008a, 2008b), and between the ostrich and the extinct terror bird (Cooper and Tennett, 2008, 2009). The aim of the current study was therefore to compare the limb and trunk characteristics in age-matched [year-of-hatch (yoh) 2004 and 2005], gender segregated birds, and to determine differences in stride between cocks and hens.

Materials and methods

The trial was carried out at the Sector of Wild Animals of the College of Agricultural and Veterinarian Sciences, UNESP, "Campus" of Jaboticabal, São Paulo, Brazil, in December 2008. Twenty adult birds were used in this study, 10 cocks and 10 hens. For both genders, 6 birds hatched in 2004 and 4 birds in 2005, respectively. The number of birds available was, however, limited in this investigation due to concerns for their welfare during the procedures. The birds were lodged in an avian barn, divided by boxes of 2.50 × 1.45 × 2.00 m, and separated by a wire screen (Figure 1). They received water and pelletized food ad libitum. The food contained 15% crude protein and 2800 kcal/kg of metabolisable energy. The floor was laid with a coast cross (*Cynodon dactilum*) hay bed. The traits measured included body weight (on a pre-set balance), height, girth, and the length of neck, humerus, ulna, manus, wing (from one wing to the other), femur, tibia, metatarsal, toe, and claw (using a material tape measure). Body weight was recorded in grams and all other measurements in centimetres.

The locomotion trial was completed in a corridor of 0.6 × 2.36 m dimension (Figures 2 and 3). Trial runs using 5 cocks and hens were performed prior to commencement of the experiments. The birds walked on a fine, previously raked sandy surface and the following measures were collected: the total time expended in walking 2.36 m; the left and right footprint lengths (cm), the stride length (cm), and the number of strides over the 2.36 m surface. The overall speed was estimated by dividing 2.36 m by the time (s) spent to complete the walk.

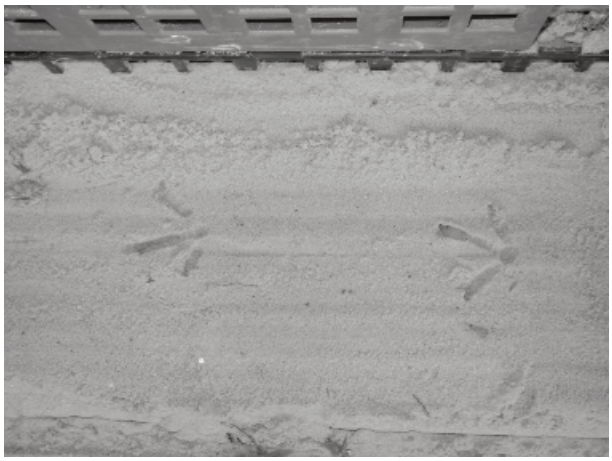

Figure 2. Experimental protocol of locomotion and stride determination in the red-wing tinamou indicating footprints in a freshly raked sand run of 0.6 × 2.36 m dimensions.

Figure 3. Adult tinamou on sand run.

Data were analysed statistically using the General Linear Models (GLM) procedure of Statistical Analysis System (SAS®) software (SAS 9.1, SAS Institute, Cary, North Carolina, USA). The linear model used for the body measures analyses (body weight, height, girth, and the length of neck, humerus, ulna, manus, wing, femur, tibia, metatarsal, toe, and claw) included the effect of yoh, sex, and the interaction (yoh × sex). The locomotion traits (the left and right footprint lengths, the stride length, and the number of strides over the 2.36 m surface) were analysed using as independent variables yoh (2004, 2005), sex (cock = 1, hen = 2), body weight, and time taken to walk across the 2.36 m surface.

The model used to analyse speed included the same effects as the last one, but the time taken to walk the 2.36 m distance effect was removed because it was used to estimate speed. The regression coefficients (b) were tested using Student's t-test. Comparisons between different traits of the same animals were performed using a paired Student's t-test, tabulated as mean ± sd, and $P < 0.05$ was taken as significant.

The study was in agreement and accordance with the Ethical Principles in Animal Experimentation adopted by the Brazilian College of Animal Experimentation and was approved by the University's Institutional Animal Care and Use Committee, Universidade Estadual Paulista, Jaboticabal, São Paulo, Brazil.

Results

The girth was significantly higher in cocks than in hens (Table 1), although any other trait differences were associated with gender. Body weight was higher for hens than males but this difference was not statistically significant (Table 1). Although there were no significant differences in height between hens and cocks, cocks had a greater height than hens (Table 1). Overall, though, we determined that yoh did not totally influence all dimensional measurements (Table 1).

No significant differences were found between the means of different traits in the same bird, like right footprint vs. left footprint.

Table 2 summarized the ANOVA results obtained for the locomotion trial. Sex did not affect any trait. The year of hatch affected the number of steps and the time to walk a distance of 2.36 m influenced both the stride length and the number of steps ($P < 0.05$, Table 2).

Table 1. Mean and sd of red-wing Tinamou body dimensions according to gender and yoh.

Trait	Gender				Yoh			
	Hen (n = 10)		Cock (n = 10)		2004 (n = 12)		2005 (n = 8)	
	mean	sd	mean	sd	mean	sd	mean	sd
Body weight (g)	786.60	79.91	747.20	59.35	764.67	51.49	770.25	98.29
Height (cm)	24.40	2.47	26.84	3.39	25.39	3.85	25.96	1.84
Neck (cm)	9.04	0.86	8.22	1.43	8.72	1.41	8.49	0.95
Girth (cm)	33.80	1.55	35.80*	1.62	35.17	1.95	34.25	1.67
Humerus (cm)	4.46	0.60	4.33	0.33	4.34	0.39	4.47	0.61
Ulna (cm)	6.57	0.29	6.60	0.67	6.57	0.60	6.61	0.35
Manus (cm)	5.23	0.3	5.60	0.52	5.42	0.55	5.40	0.37
Wing length (cm)	32.00	1.94	33.30	1.70	33.00	2.21	32.12	1.25
Femur (cm)	7.53	0.54	8.13	1.05	7.80	0.77	7.87	1.01
Tibia (cm)	5.36	0.52	5.43	0.38	5.42	0.48	5.36	0.42
Metatarsal (cm)	1.52	0.17	1.44	0.26	1.51	0.25	1.44	0.15
Toe (cm)	3.22	0.13	3.13	0.43	3.20	0.39	3.14	0.16
Claw (cm)	1.02	0.17	0.95	0.16	0.97	0.12	1.01	0.22

*P < 0.05

Table 2. Summaries of variance analyses for the locomotion traits of healthy red-wing tinamou (*Rhynchotus rufescens*).

	Mean square					Mean square	
Source of variation	D.F.	RF	LF	SL	NS	D.F.	Speed
Sex	1	0.04560	0.00445	4.11122	0.12369	1	0.04734
Year of hatch	1	0.11280	0.57231	0.82570	2.14934*	1	0.01335
Body weight (L)	1	0.46265*	0.37719	10.49358	0.01779	1	0.07874
Time to walk 2.36 m (L)	1	0.31533	0.08485	45.88761*	38.82511*		
Residue	15	0.10072	0.13151	6.00018	0.46220	16	
CV %		5.85	6.75	15.53	8.55		43.21
R^2		0.29	0.33	0.51	0.89		0.22

*P < 0.05; D.F. = degrees of freedom; RF = right footprint; LF = left footprint; SL = stride length; NS = number of strides in 2.36 m; (L) = linear; CV = coefficient of variation; R^2 = coefficient of determination

In cocks, the time to walk 2.36 m was longer than in hens (Table 3), although differences were not significant. This was related to an attenuated speed in cocks. Additionally, there was an associated stride length in cocks, which were attenuated by comparison with hens (Table 3). Indeed, the stride length decreased as the time to walk the distance increased [$b = -0.59 \pm 0.21$, $P < 0.05$].

Heavier birds exhibited slightly longer right footprint lengths (Table 2, $b = 0.0024 \pm 0.0011$, $P < 0.05$). These measurements were, however, not significantly different between genders and the right

Table 3. Means and sd of red-wing tinamou locomotion recordings according to gender and yoh.

	Gender				Yoh			
	Hen (n = 10)		Cock (n = 10)		2004 (n = 12)		2005 (n = 8)	
Trait	mean	sd	Mean	sd	mean	sd	mean	sd
Time to walk 2.36 m	6.40	2.80	7.60	3.10	7.50	3.26	6.25	2.37
Speed (m/s)	0.45	0.22	0.35	0.12	0.38	0.18	0.43	0.18
Right footprint (cm)	5.45	0.28	5.40	0.39	5.46	0.33	5.37	0.35
Left footprint (cm)	5.45	0.37	5.30	0.42	5.50	0.43	5.19	0.26
Stride length (cm)	16.40	3.64	15.15	2.55	15.33	2.83	16.44	3.62
Number of strides in 2.36 m	7.70	1.64	8.20	1.99	8.50†	1.98	7.12†	1.12

footprint dimensions means were virtually unchanged (Table 2).

The number of strides between cocks and hens did not differ significantly over 2.36 m but the yoh effect was statistically significant for this trait (Table 2). Indeed the time spent to walk 2.36 m was greater for birds hatched in 2004 compared to animals hatched in 2005 (Table 3). There was a significant increased association of the number of strides with time taken (Table 2, $b = 0.545 \pm 0.06$, $P < 0.05$). Birds hatched in 2004 presented a higher computed stride collective mean than those hatched in 2005 (Table 3). Although non-significant, the same pattern could be seen for gender. Hens took less time and number of strides to walk the 2.36 m (Table 2).

Discussion

Sick (1985) reported that red-wing tinamou hens are slightly heavier than cocks. We attributed this to a greater egg-carrying capacity in the older hen. Generally, the body weight results reported in the current investigation agreed with the findings of Tholon and Queiroz (2007), who studied the growth curve of red-wing tinamou from birth to attainment of adult weight and reported 686 g and 647 g for mature weight of females and males, respectively, using the Gompertz model. Wild tinamou reach an average height of 38 cm (Sick, 1985), a value higher than those estimated in the current study.

We could not explain the greater height in the cocks precisely, although it could be as a result of the increasing need of cocks to scan for danger by assisting hens or chicks to peer over clumps of grass and vegetation.

The yoh did not influence dimensions, suggesting that age is not an important governing factor for these traits in the adult bird, although it must be noted the low sample size and number of yoh for comparisons.

We postulated that cocks, being territorial, would, in the wild, reduce their speed to allow hens or chicks to accelerate ahead as part of an evolutionary defensive stance.

Subtle differences in yoh may have been related to small variances in nutrition, weather, management, age, and reproductive traits. Although the birds born in distinct years were submitted, the net sum of these effects could have potentiated the different performances observed. Further studies on this remarkable species are warranted.

Acknowledgements

The authors are thankful to the technicians Regiane Cristina da Silva and Laura de Almeida Prado Castro, who cared for the birds, and to the Conselho Nacional de Pesquisa (CNPq), the Brazilian Agency that supported this research.

References

Cooper, R.G. 2007a. Differences in stride between healthy ostriches (Struthio camelus) and those affected by tibiotarsal rotation. J. South Afr. Vet. Assoc. 78: 52-53.

Cooper, R.G. 2007b. Spread bow leg syndrome and associated pathology in ostrich (Struthio camelus) chicks aged 2-12 weeks. Proceed. XIVth World Ratite Congress, Oct. 19-20, Riga, Latvia: 34-39.

Cooper, R.G. 2008. Walking and behaviours of birds kept in captivity. World Poult. 24: 24-25.

Cooper, R.G. 2009. Red-winged Tinamou (Rhynchotus rufescens) Temminck, 1815. World Poultry – in press.

Cooper, R.G., Mahrose, Kh.M.A. and El-Shafei, M. 2008a. Spread bow leg syndrome in ostrich (Struthio camelus) chicks aged 2 to 12 weeks. Brit. Poult. Sci. 49: 1-6.

Cooper, R.G., Naranowicz, H., Maliszewska, E., Tennett, A. and Horbańczuk, J.O. 2008b. Sex-based comparison of limb segmentation in healthy and tibiotarsal rotation ostriches aged 14 months. J. South Afr. Vet. Assoc. 79: 142-144.

Cooper, R.G. and Tennett, A. 2008. Geometric limb similarity between two flightless birds: an extinct terror bird (Phorusrhacinae gen.) vs. ostrich (Struthio camelus). Proceed. XXIII World's Poultry Congress and the 4th Int. Ratite Science Symp., June 30-July 4, 2008, Brisbane, Australia: 659.

Cooper, R.G. and Tennett, A. 2009. Geometric limb similarity between two flightless birds: an extinct terror bird (Phorusrhacinae gen.) vs. the ostrich (Struthio camelus). Vet. Hist. 14: 371-375.

Cromberg, V.U., Stein, M.S., Boleli, I.C., Tonhati, H. and Queiroz, S.A. 2007. Reproductive and behavioural aspects of red-winged tinamous (Rhynchotus rufescens) in groups with different sex ratios. Brazil. J. Poult. Sci. 9: 161-166.

Sick, H. 1985. Ornitologia Brasileira, uma Introdução. Vol.1. Universidade de Brasília, Brasília: 482 p.

Tholon, P. and Queiroz, S.A. 2007. Models for the analysis of growth curves for rearing tinamous (Rhynchotus rufescens) in captivity. Brazil. J. Poult. Sci. 9: 23-31.