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TEMPERATURE-DEPENDENT LOSS OF MASS BY SHOREBIRDS FOLLOWING CAPTURE

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Abstract.—It is well established that birds lose mass following capture. In this paper the effects of bird species and temperature on mass loss are examined, and it is shown that mass loss after capture is independent of bird species, but strongly influenced by temperature, especially above a threshold of about 30 C. Data on body mass must be collected immediately after capture to minimize this potential bias, especially on hot days.

LA PÉRDIDA DE MASA POSTERIOR A LA CAPTURA EN AVES PLAYERAS ES DEPENDIENTE DE LA TEMPERATURA

Sinopsis.—El fenómeno de la pérdida de masa en aves luego de su captura está bien establecido. En este estudio examinamos algunos factores que pueden alterar esta pérdida de masa. La pérdida de masa es independiente de la especie en estudio, pero puede ser influenciado marcadamente por la temperatura, especialmente sobre el umbral de 30 C. Los datos sobre masa corporal en aves deben ser tomados inmediatamente despueés de la captura para minimizar este sesgo, particularmente en días calurosos.

Shorebirds held in captivity after capture lose mass (Table 1). This loss of mass occurs in two phases. During phase 1 (up to 8 h after capture), most mass decrease is due to water loss. Thereafter (phase 2), fat and tissue metabolism also contribute importantly to mass loss (Davidson 1984, Piersma and van Brederode 1990). To date, no studies have been conducted to identify factors affecting these phenomena, although Wilson and Davidson (1982) suggested that they may be temperature dependent. The practical importance of this occurrence for field studies is tremendous because significant amounts of mass can be lost within several minutes to a few hours after capture. Therefore, body mass data obtained in banding operations that do not weigh birds immediately can be seriously biased (Wilson and Davidson 1982).

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TABLE 1. Loss of mass in shorebirds after capture.

Species	References
Haematopus ostralegus	Zwarts et al. 1990
Charadrius alexandrinus	Zwarts et al. 1990
Charadrius hiaticula	Piersma and van Brederode 1990, Zwarts et al. 1990
Arenaria interpres	Zwarts et al. 1990
Calidris alpina	Davidson 1984, Goede and Nieboer 1983, Lloyd et al. 1979, OAG Münster 1976, Pienkowski et al. 1979, Piersma and van Brederode 1990, Ruiz et al. 1989, Zwarts et al. 1990
Calidris minuta	Piersma and van Brederode 1990, Zwarts et al. 1990
Calidris alba	Schick 1983, Zwarts et al. 1990
Calidris canutus	Davidson 1984, Piersma and van Brederode 1990, Wilson and Davidson 1982, Zwarts et al. 1990
Calidris ferruginea	Zwarts et al. 1990
Numenius phaeopus	Zwarts et al. 1990
Limosa lapponica	Zwarts et al. 1990
Tringa totanus	Zwarts et al. 1990
Gallinago gallinago	OAG Münster 1975

Here we present data on mass loss in shorebirds obtained incidental to a study of shorebird migration at Cheyenne Bottoms Wildlife Management Area (38°20′N, 98°40′W), Barton County, Kansas, central U.S. We study the effects of bird species and temperature on mass loss, and show that mass loss after capture is independent of bird species, but strongly influenced by temperature.

METHODS

One hundred and twenty birds were captured around noon, 19–25 August 1989 at Cheyenne Bottoms using mist nets (Table 2). They were weighed within 5 min of capture to the nearest 0.1 g with a portable electronic Ohaus C300-M balance, banded with U.S. Fish and Wildlife Service bands, and placed in cardboard boxes, measuring approximately 0.4 × 0.5 × 0.3 m, with a cloth top. No more than five birds were placed in one box at any given time. The boxes were placed in the shade, to

TABLE 2. Species used in this study.

Species	Number
Calidris minutilla	72
Calidris pusilla	11
Charadrius vociferus	10
Gallinago gallinago	9
Tringa solitaria	7
Calidris melanotos	6
Calidris mauri	3
Tringa flavipes[1]	1
Actitis macularia[1]	1

[1] Included in Figures 1 and 2, but not in the ANCOVA.

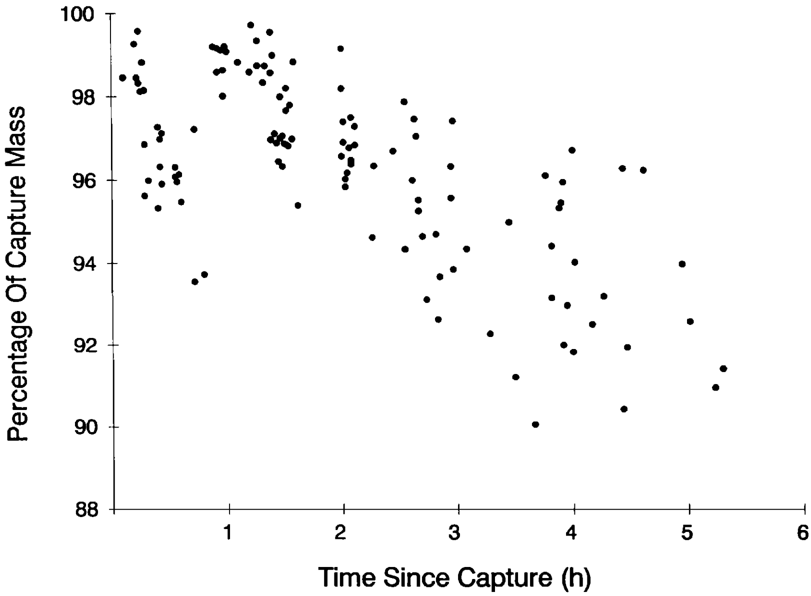

FIGURE 1. Loss of mass in shorebirds after capture. Data for 120 birds of nine species are shown (see Table 2).

simulate conditions during banding operations. Birds were re-weighed within 15 min to 6 h after capture. Each bird was re-weighed only once.

The maximum air temperature of the day of each experiment was recorded. On 25 August, birds were held inside an air-conditioned car, to extend the range of experimental temperatures to include low values. After the second weighing, they were measured and released.

The log of the rate of mass loss (g/h) was regressed against the log of the capture mass to explore the scaling of mass loss vs. body mass (Schmidt-Nielsen 1984). The slope of the regression ($\beta = 0.9$) was not significantly different from unity ($P = 0.488$; $n = 118$). Therefore, loss of mass is expressed as a percentage of capture mass. This independence of relative mass loss vs. body mass has also been found by Zwarts et al. (1990).

RESULTS AND DISCUSSION

Total loss of mass of up to 10% occurred within the first 6 h after capture (Fig. 1). The variation observed was great, however. The effects of bird species and temperature on the rate of mass loss were compared using an analysis of covariance, with rate of loss as the dependent variable (percentage of the initial mass/min, arcsine transformed), bird species as the main effect, and ambient temperature as the covariate ($n = 118$). No significant interaction was found ($P = 0.219$). Rate of loss was independent of bird species ($P = 0.175$), but dependent on ambient temperature ($P < 0.0001$).

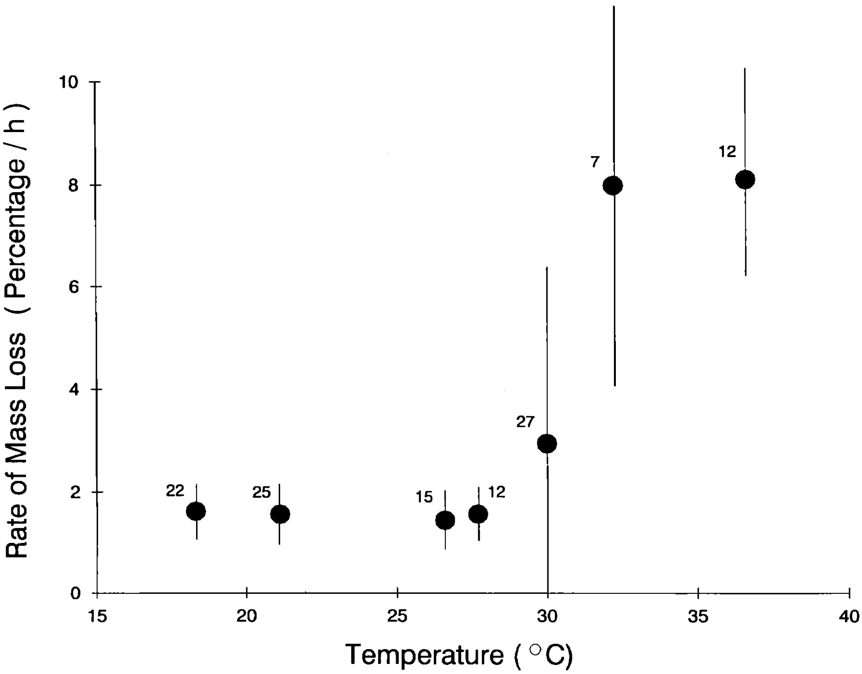

FIGURE 2. Rate of mass loss as a function of ambient temperature. Mean ± SD are shown. Sample sizes next to mean.

The rate of mass loss was about 1.5% of capture mass/h between ca. 18 C and 29 C. A sudden increase occurred above 30 C, and approached 8% of capture mass/h between 33 C and 38 C (Fig. 2).

As the period between capture and second weighing was less than 6 h (phase 1), most loss of mass was probably due to water loss (see above). Therefore it is not surprising that this loss of mass is temperature dependent; this increase at high temperatures probably reflects increased evaporative water loss due to over-heating (Cossins and Bowler 1987).

CONCLUSIONS

Loss of mass in shorebirds after capture is independent of bird species when expressed as a percentage of capture mass, and increases with increasing temperature, especially above a threshold of about 30 C. Data on body mass must be collected immediately after capture to minimize this potential bias, especially on hot days.

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