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Reply to Klaassen's Commentary Concerning Water and Energy Limitations on Flight Range

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In our paper (Carmi et al. 1993) on the water and energy limitations to flight duration in small migrating birds, we presented a computer model that simulates the energy and water budgets of migrants and discussed the implications of the model predictions on migration strategies and routes. In response to our paper, Klaassen (1995) pointed out that the changes in body mass, due to the changes in the water content of the flying bird, were incompletely taken into account. Using our program as a basis, Klaassen incorporated changes to take into account the changes in water content; the enhanced version of the programs estimates flight ranges slightly greater than the original. The differences in flight ranges between the original and the corrected versions are slight and do not affect the general conclusion of our paper, which is that water may limit flight duration and, therefore, influence migration strategy.

In the light of Klaassen's commentary, a feedback loop was added to the original model that can, if the user so chooses, take into account the changes in body mass, flat-plate area, and frontal area that result from the changes in water content (clearly, change in water content affects body mass, but whether and to what extent it affects frontal and/or flat-plate areas is questionable). Results of Klaassen's and our calculations using the updated program are the same; any differences are due to the number of decimal places used for model input variables.

From our correspondence with Klaassen, we found that some discrepancies also resulted from differences in assumptions used. We calculated "resting" metabolic rate, as did Pennycuick (1989), using the fat-free mass of the bird in the allometric equation of Lasiewski and Dawson (1967). Thus, this contribution to total power input remains constant. Klaassen initially used the total body mass of the bird to estimate resting power input, and allowed it to decrease with mass loss. We also corrected his calculation of saturation vapor pressure below 0°C.

The scarcity of the information on the physiological processes that take place during flight limits the realism with which the energy and water budgets of a flying bird can be modelled. Thus, the quantitative predictive power of such models must not be overestimated. The qualitative value is for formulating testable hypotheses (e.g. it allowed us to predict that dehydration is not necessarily a minor factor limiting flight duration in migrants). Moreover, and no less important, it enabled us to identify and evaluate the sensitivity of physiological variables that affect the water budgets of flying birds.

Interested readers who have purchased Pennycuick's (1989) book may obtain the revised program by sending a high-density IBM diskette to the authors.

LITERATURE CITED

CARMI, N., B. PINSHOW, W. P. PORTER, AND J. JAEGER. 1992. Water and energy limitations on flight duration in small migrating birds. Auk 109:268–276.

KLAASSEN, M. 1995. Water and energy limitations on flight range. Auk 112:260–262.

LASIEWSKI, R. C., AND W. R. DAWSON. 1967. A reexamination of the relation between metabolic rate and body weights in birds. Condor 69:13–23.

PENNYCUICK, C. J. 1989. Bird flight performance. Oxford Science Publications, New York.

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