ScienceWatch – Cheap Fares for Migrating Birds

Savvy travelers always seem to find the cheap airfares and they usually fly for less than the rest of us. Migrating birds are the ultimate air travelers. So it's not surprising that they too have figured out ways to fly cheaply. Flight is a huge expenditure of energy for birds. To save energy they use strategies such as gliding in thermals or flying with the prevailing winds. But many bird migrations, especially those of shore birds, are quite long, covering non-stop distances of several thousand miles. Two investigations, published in the October 18th issue of *Nature*, shed some light on the way birds accomplish these marvelous physical feats.

The first report by Henri Weimerskirch and his team at the Centre d'Etudes Biolgiques de Chize, Villeirs en Bois, France, measured heart rate as an estimate of energy expenditure in great white pelicans (*Pelecanus onocrotalus*) flying alone and in formation. The study showed that birds flying in a "V" formation save significant amounts of energy. Eight pelicans were imprinted to follow either a motorboat or an ultralight airplane. Each was fitted with an electronic heart monitor and all flights were filmed to record wing-beat frequency.

The researchers found that pelicans flying in formation beat their wings less frequently, spent more time gliding and had a heart rate that was over 10% lower than when flying alone. While these results may seem obvious to many of us, not all ornithologists had accepted the theoretical, but unproven, notion that flying in formation allowed birds to save energy by staying in the updraft generated by the bird in front. Some contended that the "V" formation was behavioral and had evolved for communication. This study provides proof that birds fly in formation to save energy. It explains why large birds like pelicans not only fly in formation when migrating, but also during group trips between colonies and foraging areas.

The second report, by ecologist Anders Kvist at Lund University, Sweden and his team from the Netherlands, shows that when birds fill up with food in preparation for long flights and are at their heaviest, they burn less energy in flight than expected. Kvist *et al*. measured the energy expended by red knots (*Calidris canutus*) flying 6-10 hours in a wind tunnel by using the doubly labeled water technique.

This technique (described in *Rivertown Naturalist*, Sept. 2001) measures metabolism by following the dilution rate of isotopically labeled water. Red knots barely weigh as much as a quarter-pounder (100 grams), yet they routinely make non-stop flights from Britain to the Russian Arctic of 5,000 km (3,500 miles). Like many other migrants they pull off this remarkable achievement by gorging themselves, often doubling their body weight, before taking off. The body fat they gain during these feast is used to fuel their flight.

The team tested four red knots flying at different weights under controlled conditions in the wind tunnel. Each bird flew an average of seventeen 10-hour flights. Prior to each flight the bird was freely fed and then injected with labeled water. Blood samples were taken before and after each flight, and energy expenditure was calculated by measuring the proportion of labeled hydrogen and oxygen as well as the production of carbon dioxide. The results show that when they are heavy, birds metabolize less fuel, on a weight basis, than when they are light. Kvist *et al*. suggest that flight muscles are able to become more efficient as the load increases. This means that birds, unlike fully loaded 767's, can carry full loads relatively cheaply. How this might occur is a physiological mystery that the airlines would probably love to know.

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