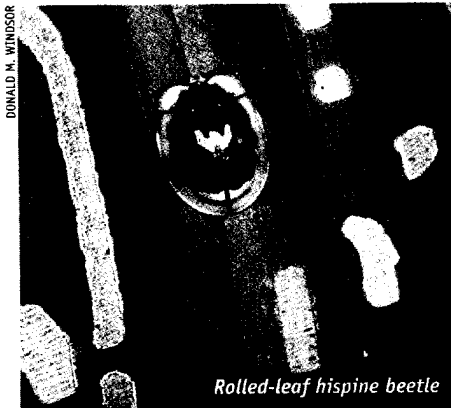


## IN SUM

### BEETLE BITES

Beetles are the world's most abundant insects, but the fossil record reveals little about when they diversified. Although there is an excellent fossil record of flowering plants during the Cretaceous, remains of leaf beetles from this period are almost nonexistent, and their fossilized bodies begin to appear in the rocks only 20 million years later.



Rolled-leaf hispine beetle

Since most of the 40,000 known leaf beetle species specialize in feeding on flowering plants, Peter Wilf, of the University of Michigan's Museum of Paleontology, and colleagues examined fossils of ginger leaves from the Late Cretaceous (66 million years ago) for signs that the beetles had been present. Many fossil leaves, they found, displayed patterns of bite marks characteristic of rolled-leaf hispine beetles, a group that today specializes in eating ginger leaves.

Larvae of these beetles live within the rolled-up leaves of the plant, and their feeding produces a unique pattern of linear strips between the leaves' veins. (Adult beetles produce a different feeding pattern on the unfurled leaves.) The trace fossils from North Dakota and Wyoming, dating from the Late Cretaceous and early Eocene (52–53 million years ago), push the evolution of hispine beetles back nearly to the time of origin of their flowering host plants. ("Timing the Radiations of Leaf Beetles: Hispines on Gingers From Latest Cretaceous to Recent," *Science* 289, 2000)

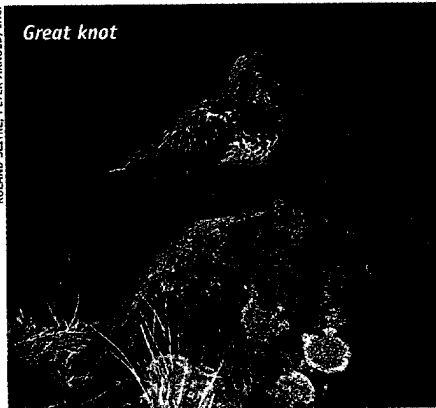
### DIMINISHED RETURNS

Although perching birds stop to rest during migration, many shorebirds make long, continu-

ous transoceanic flights, during which they do not eat. Until recently, scientists believed the birds relied only on stored fat as fuel.

Phil F. Battley, of the Australian School of Environmental Studies, working with a team of ecologists from the Netherlands and China, recently tested that assumption in a study of the great knot (*Calidris tenuirostris*), a medium-sized shorebird. The great knot flies 3,000 miles from northwest Australia to its breeding ground in eastern China. Samples of the migrants were tagged in Australia and recaptured in China. When Battley and his team weighed and measured the knots' organs, they found that all the birds showed significant weight loss in their kidneys, liver, skin, and pectoral muscles and that these organs were reduced in size—evidence that large amounts of protein, as well as fat, are utilized during flight. (Once the knots reach their breeding ground, the liver can triple in size in two weeks, while the stomach and kidneys can increase by almost 50 percent.)

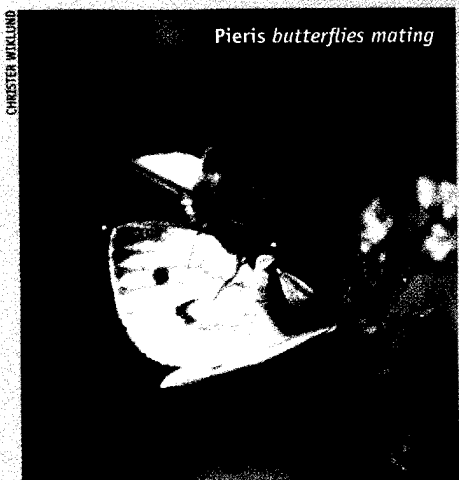
Researchers believe that although fat provides the fuel for sustained effort, protein is an essential component of the chemical reactions that convert large quantities of fat into energy during prolonged and extraordinary efforts. From the breakdown process of fat, birds lose important compounds that need to be replenished by amino acids (protein). In addition, their brains require glycogen, which cannot be manufactured without protein breakdown. ("Empirical Evidence for Differential Organ Reductions During Trans-Oceanic Bird Flight," *Proceedings of the Royal Society of London B* 267: 191, 2000)



Great knot

### BUTTERFLY ANTIAPHRODISIAC

In the green-veined white butterfly *Pieris napi*, when a male mates with a female, it transfers, along with its sperm, a chemical chastity belt that wards off other males for a period of time. The chemical, methyl-salicylate, a volatile repellent, is then emitted by the mated female, allowing her to lay her eggs without being harassed by other males. (Persistent suitors can drive a female down among the vegetation, where predatory small mammals, lizards, or insects may lurk.) Males also benefit from a mating system in which females retain sperm before fertilization, and in which the last male to deposit sperm fertilizes the eggs.



Johan Andersson, of the Ecological Chemistry Group at Stockholm's Royal Institute of Technology, and colleagues have demonstrated that only male butterflies can produce the antiaphrodisiac. Its effects are so strong that most males will refrain from mating even with virgin females (ordinarily more sought after than nonvirgins) to which it has been artificially applied. When *P. napi* males mate, they also transfer nutrients to the females, increasing the females' fecundity and longevity. The researchers are still trying to discover which sex controls the gradual decrease in the methyl-salicylate shield that allows females to eventually regain their attractiveness and remate. ("Sexual Cooperation and Conflict in Butterflies: A Male-Transferred Antiaphrodisiac Reduces Harassment of Recently Mated Females." *Proceedings of the Royal Society of London B* 267: 1271, 2000)—Richard Milner