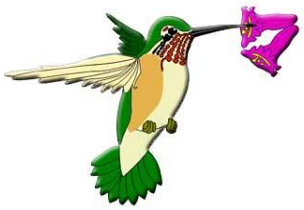

ScienceWatch - A Diet that Fits the Bill for any Menu

Sexual dimorphism, which refers to features differing between males and females, is common among animals. Males may be larger (or smaller) than females, they may be more (or less) colorful, or one sex may have structures (e.g., deer antlers) lacking in the other. Charles Darwin observed these differences, and in his 1871 book, *The Descent of Man and Selection in Relation to Sex*, he offered three mechanisms for their evolution. The first was sexual selection, which in its extreme yields the flashy feathers of male birds of paradise. The second was selection for fertility, which can result, for example, in more robust females (witness the fact that women live longer on average than men). The third mechanism was selection due to the environment. Numerous instances of the first two mechanisms have been found in nature; however, the only instance where ecology appears to be the cause for sexual dimorphism occurs in mosquitoes. Male mosquitoes have mouthparts adapted for drinking nectar, while female mouthparts are adapted for drinking blood. However, in his book Darwin suggested that hummingbirds may provide an example of ecological causation and 132 years later he seems to be right.

Three years ago I reported on a study by Ethan Temeles at Amherst College, Amherst, MA, that strongly suggested environmental causation of bill size in the purple-throated carib hummingbird (*Eulampis jugularis*) (see *ScienceWatch - A Diet That Fits the Bill*, Oct. 2000, the first paragraph of which is repeated above). The hummingbird lives on the island of St. Lucia in the West Indies, where the only food plants available during the breeding season are a red, short, straight flower (*Heliconia caribaea*) and a green long, curved flower (*H. bihai*). The dependence is mutual because the hummingbird is the sole pollinator of these flowers.

Although males on the island are larger than females, they have shorter and less curved bills (see figure). Temeles and his students showed that the differing flower shapes of the two *Heliconia* species match the bill differences between sexes and probably caused it. Males feed only on the more abundant red, short, straight, *H. caribaea* flowers, which they defend from other males as well as females. Females are therefore forced to feed on the green, long, curved *H. bihai* flowers. Temeles also noted that St. Lucia contains some areas lacking the straight-flowered species (*H. caribaea*). In those places a variant of the curved-flowered species (*H. bihai*) has arisen to replace *H. caribaea*. It is red-green, has shorter, straighter flowers than its parent species, and males defend it and feed on it. This floral dimorphism exhibited by *H. bihai* prompted Temeles *et al*. to speculate that plants and hummingbirds were adapting to each other.

Now Temeles and his colleague W. John Kress, National Museum of Natural History, Smithsonian Institute, Wash., DC have published a follow-up study in the April 25, 2003 issue of the journal *Science* providing even stronger evidence that plants and

hummingbirds are coadapting. They spent spring 2001 and 2002 on the West Indian island of Dominica and found it to be like the situation on St. Lucia. Males feed exclusively on short, straight *H. caribaea* and females on long, curved H. bihai. However, the pattern of floral dimorphism on Dominica is completely reversed. While the curved *H. bihai* has evolved a (red-green) variant to match the shape of the straight male bill, on St. Lucia, on Dominica the opposite has occurred. The otherwise straight *H. caribaea* has produced a (red) variant, and it matches the longer more curved female bill. This red variant is visited almost exclusively by females. The researchers observed 15 of 19 females, but only 2 of 13 males feeding on the red variant.

Ever since Darwin made his observations of species variation on the Galapagos Islands, biologists have believed that islands are good places to observe evolution in action because of their isolation. Temeles and Kress believe it is true for their island observations as well. Since male hummingbirds are larger they have greater energy requirements. On both islands males prefer *H. caribaea*, which provides more energy per flower by supplying more nectar. This feeding preference is probably the original cause for the bill dimorphism in the past. But now that it is well established, the *Heliconia* are responding to it by producing their own morphs. So on St. Lucia, the *H. bihai* variant that better matches the shape of the male bill also provides more nectar than its parent, whereas on Dominica the *H. caribaea* variant that matches the female bill provides less nectar than its parent. Interestingly, by offering flowers with differing amounts of energy, Heliconia may be responsible for the appearance of different hummingbird body sizes, and this would be another example of ecological dimorphism.

The two islands represent a situation where one or the other *Heliconis* has produced a variant in order to attract the sex that is its infrequent pollinator, thereby gaining an advantage. These *Heliconia* morphs are the latest signs of evolutionary pressure imposed by bird on plant due to hummingbird bill dimorphism that arose from flower and nectar differences in the first place. The coevolutionary dance between hummingbird and *Heliconia* continues.

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