Species thrive when sexual dimorphism broadens their niches

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Some Caribbean lizards' strong sexual dimorphism allows them to colonize much larger niches and habitats than they might otherwise occupy, allowing males and females to avoid competing with each other for resources and setting the stage for the population as a whole to thrive. The finding, reported this week in the journal *Nature*, suggests sex differences may have fueled the evolutionary flourishing of the Earth's wildly diverse fauna in a way not previously appreciated by scientists.

Conducted at Harvard University, the University of Hawaii, and Washington University in St. Louis, the research is the first to investigate the role of sexual dimorphism -- which can yield differences between sexes as substantive as those seen between entirely separate species -- in adaptive radiation, the phenomenon by which species diverge from a single ancestor.

"Humans are keenly aware of the differences between the sexes, and such sexual dimorphism is widespread in the animal kingdom," says Jonathan B. Losos, professor of organismic and evolutionary biology in Harvard's Faculty of Arts and Sciences and curator in herpetology at the Harvard Museum of Comparative Zoology. "Evolutionary biologists have studied the much larger antlers of male deer, the showy plumage of male birds, and many other traits for decades. This extensive body of research has helped us understand why the sexes of particular species have evolved differences, but this sort of work has not previously been put into a broader context to understand how significant sexual

dimorphism is in the grander scheme of evolutionary diversification."

Found across the West Indies, the Anolis lizards studied by Losos, zoologist Marguerite A. Butler, and mathematician Stanley A. Sawyer represent a classic case of adaptive radiation, having evolved independently after arriving on Cuba, Hispaniola, Jamaica, and Puerto Rico. On each island, species have evolved traits suited to the local environment: For instance, anoles that occupy open habitats have evolved long legs that are advantageous in running, while arboreal species have shorter legs better suited to navigating narrow and irregular twigs.

West Indian anole species also vary greatly in their degree of sexual dimorphism, ranging from species where adult males and females are the same size to those where the mass of adult males is triple than of adult females. Sexual differences in microhabitat use, diet, and behavior are also common among West Indian anoles.

"Adaptive radiations are well-known for the fine-tuning of organismal traits to match their niches," says Butler, assistant professor of zoology at the University of Hawaii. "We noticed that every well-known adaptive radiation has sexual dimorphism -- such as Hawaiian honeycreepers, Galapagos finches, and African cichlids -- but these radiations are studied in terms of one sex only, usually males. So we asked a simple question: If animals are adapting to their environment, but the sexes are different, does the sexual variation add to diversity? In other words, is it important to consider both sexes? The answer is yes."

Butler, Sawyer, and Losos modeled the "morphospace" -- a gauge of ecological niche taking into account such factors as limb length, body length, and mass -- occupied by 15 different anole species. They found that only 14 percent of niches were occupied by both male and female members of the same anole species, compared to 45 percent that were

occupied by only females and 36 percent occupied by only males.

"Clearly, sexual dimorphism significantly increases the ecological niche occupied by a species," Butler says. "Among West Indian anoles, sexual dimorphism results in a 59 percent increase over the morphospace occupied by females alone, and an 88 percent increase over the morphospace occupied by males alone."

Evolutionary biologists attribute sexual dimorphism to three primary causes. Sexual selection, the competition among members of one sex to mate with individuals of the other sex, can occur when members of one sex, usually males, fight with each other for the ability to mate, or when one sex, often females, chooses among members of the other sex. Differing reproductive demands can also fuel sexual dimorphism: Females of some species, for example, must have larger pelvises to allow the birth of large offspring.

"Another explanation is that sexual differences arise so that the sexes can utilize different resources and not compete with each other," Losos says. "In some hummingbirds, for example, the sexes differ in the length of their beaks, allowing each to drink nectar from different flowers. By diverging in their resource use, the population as a whole can reach higher levels."

Source: Harvard University

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