



## ScienceWatch – Living on the Edge

**“Over the short span of 60 years, house sparrows have spread across Kenya, changing dramatically as they’ve moved into new areas.” - L.B. Martin**

The house sparrow (*Passer domesticus*) is the most successful wild bird invasive species. Originally from Europe and Asia its range has expanded to all the continents except Antarctica. Many introductions have been deliberate. For example, in the 1850’s house sparrows were released in Central Park, supposedly to bring birds mentioned by Shakespeare to the New World. While other released birds like java sparrows (*Padda oryzivora*) and chaffinches (*Fringilla coelebs*) failed to take hold, house sparrows quickly spread across North America. So what makes them so successful?

Lynn B. Martin, an ecological physiologist at the University of South Florida, Tampa, has pursued this question for over ten years. We may rightly expect a successful invasive species to be a generalist in diet and something of an “adventurist” behaviorally. But Martin and his colleagues have gone a step further. They look at the individuals on the front line of the invasion, asking if these “edge” birds have any special attributes. They find that edge birds are indeed different behaviorally and physiologically from already established birds.

For example, in a 2005 study Martin compared the behavior of two house sparrow populations: a 150-year-old already established one in New Jersey, and a 28-year-old actively invading one in Panama. The Panamanian active invaders approached and ate novel foods like peanut butter and a dog food mix much faster than the established New Jersey birds. Clearly active invaders are more adventurous than established birds.

In the 1950’s house sparrows began arriving in Mombasa on the east coast of Kenya as stowaways aboard freighters. Spreading westward, within 60 years they made it to the Ugandan border, a distance of 850 km (450 mi). Martin realized the Kenyan birds would be a model system for comparing frontline invaders with established birds by using distance from Mombasa as a measure of range expansion.

In 2012 Martin and his graduate student Andrea Liebl studied the behavior of the Kenyan sparrows. Birds captured at Mombasa and seven other locations across Kenya were tested for their exploratory behavior by placing them in a small tent with novel items and measuring the area explored in five minutes. Exploration increased with increasing distance from Mombasa. Mombasa birds were the least exploratory, edge birds the most.

Martin and Liebl showed that edge birds also differ physiologically; they release more cortisol when stressed and their brains have more cortisol receptors. Cortisol, the “stress” hormone, revs up the body to deal with threats and enhances memory—responses to be

expected from birds on the edge—and more receptors allow for a more rapid response to the challenges they encounter.

In a more recent study of Kenyan birds published in the January 7, 2013 issue of *Proceeding of the Royal Society B, Biological Sciences*, Liebl and Martin along with Courtney Coon and Aaron Schrey found that active invaders have a more alert immune system. Certain molecules of the immune system, Toll-like receptors (TLR), perform immune surveillance. They detect bacteria or parasites invading the host and trigger an inflammatory response to kill the pathogens.

First Martin *et al.* measured TLR baseline levels in the blood of captured birds. After injecting a bacterial antigen, they checked to see if the levels increased. They thought that edge birds would produce a greater response to the antigen. Instead they found that edge birds maintained greater baseline levels than established birds. Although maintaining a high baseline level is energetically costly, a sharper immune system may be worthwhile for birds encountering new pathogens. “Perhaps their immune systems are more attuned to finding particularly harmful parasites in new regions where parasites are more likely novel,” said Martin.

Currently Martin and his team are looking at how edge birds differ genetically. They are finding that while invading birds have less genetic diversity, they exhibit greater genetic plasticity, yet another adaptation that makes them the most cosmopolitan bird on the planet.

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