ScienceWatch – House Finch Adaptability: Mother Knows Best!

As its Latin name implies, the house finch (*Carpodacus mexicanus*) is a bird that shouldn't be seen at New York feeders. Indigenous to the deserts of California and the U.S. Southwest, house finches are now one of the most prevalent urban birds in the Eastern U.S. Their total number in North America was recently estimated at one billion, with a significant portion east of the Mississippi. The spread of house finches east of the Rockies began in 1939 when pet store owners on Long Island released their stocks of "Hollywood" finches after raids by the U.S Fish & Wildlife Service. The raids occurred because the owners had ignored the Migratory Bird Treaty Act of 1918, which made it illegal to keep the finches as pets. From New York, the birds quickly headed south, reaching Alabama about 25 years ago. At about the same time, birds from California headed east, colonizing Montana, where they have been equally successful.

Alexander Badyaev, an evolutionary ecologist at Auburn University in Alabama and his colleague Geoffrey Hill have studied house finches for eight and 15 years, respectively. These researchers have shown that finches in different regions quickly begin to look differently from each other. They examined seven different populations of finches, including those from Montana and Alabama. Badyaev and Hill tagged hundreds of birds at each site and followed their growth and survivorship. They found that males and females display a particular size and shape that is beneficial for survival in each local environment. In some populations males were larger than females, but in others, males were smaller. The same thing held true for bill size and tarsus (leg) length. In particular, Alabama males grow faster than females, are larger, have wider bills and longer tails. In Montana it was quite the reverse; females grow faster than males and are bigger. Moreover, in Montana higher fecundity was most affected by increased body size, while in Alabama it was survival that was most impacted by body size. Badyaev and Hill speculated that fecundity was important for the expanding Montana population, but resistance to disease* and parasites was paramount in the moist Alabama climate. Whatever the reason, these adaptive changes evidently promote the spread of the finches to disparate habitats. But how do they occur so rapidly?

To try to answer that question Badyaev and his team conducted a massive six-year study, which is described in the January 11, 2002 issue of *Science* and reveals a mechanism for the rapid adaptability of house finch populations. House finch females typically lay one egg per day for five days until a clutch is complete. Eggs do not begin development until the female starts her 12-day incubation, which she typically begins 2-3 days before the last egg is laid. Thus chicks from first-laid eggs hatch earlier and get several days more brood care than those from last-laid eggs. Therefore the team was not surprised to find that chicks from first eggs are considerably larger than those from last-laid eggs. However, hatch order is linked to other biases as well.

First the team determined that finches in Montana and Alabama exhibit different sex ratios in relation to hatch order; apparently breeding females place sons and daughters in the most advantageous positions for survival in each environment. In Montana first-laid eggs produced mostly females, while last-laid eggs yielded mostly males. In Alabama the sex ratio with respect to hatching was completely reversed; first-laid eggs yielded mostly males, last-laid eggs females.

Next the team followed survivorship of hundreds of tagged chicks and found that birds hatched in the most sex-biased position had the most sex-biased survival. For example, males hatched in male-biased positions had a 43% chance of survival, while males hatched in female-biased positions had only a 14% chance. They estimated that the sex-bias in hatch order reduces chick mortality by 10-20% at each location. Certainly size affects survival and it appears that females take advantage of the relationship between hatch order and chick size to place each sex in the order that ensures greatest survival. In Montana where small males and large females do best, breeding females tend to produce daughters in first-laid eggs and sons in last-laid eggs. Conversely, in Alabama, where large males are favored, the hatch order is reversed.

Finally, the team sought to determine how laying order determines growth and body size. Does laying order make eggs intrinsically different from each other or do chicks from first-laid eggs get bigger simply because they spend more time in the nest? Newly hatched nestlings were placed in nearby foster nests in exchange for a nestling from a different hatch order and measured for growth every other day. For example, a first-hatched nestling was moved into the fourth-hatched position in the foster nest. Other hatchlings were placed in foster nests in the same order as they hatched to serve as controls.

Amazingly, Badyaev *et al.*, found that the original laying order influenced growth rate and final size much more than hatch order in the foster nest. Hatchlings from a first-laid egg grew up to look like a first nestling even when placed in the fifth position in the foster nest. This means that early and late-laid eggs are already different when they are laid. It is likely that each egg receives different levels of testosterone and/or estrogen as has been shown for a related finch species. Whatever the exact mechanism, apparently mother finches can determine which offspring are best adapted to the local environment and they act accordingly by laying eggs that yield the right combination of sex and growth rate best suited for survival.

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*Since its discovery in 1994 an epidemic of conjunctivitis, caused by the poultry pathogen *Mycoplasma galliseptum* has devastated house finch populations. Estimates are that over 100 million birds-half the house finches in eastern N.A.-have died. Lately, eastern populations show signs of developing resistance. It will be interesting to see how this adaptable species continues to respond to the disease. To learn more

about the disease and to take part in a survey sponsored by the Cornell Laboratory of Ornithology, go to: www.birds.cornell.edu/hofi/.