How a small stretch of DNA can keep species separate — even when they interbreed

The most widely used definition of a species, whether we're talking about coyotes and wolves or modern humans and Neanderthals, comes down to intebreeding. Can the two species interbreed and produce viable offspring? The answer, for separate species, should be no. But nature is messy, and genetic evidence says both wolf-coyote and human-Neanderthal hybrids were common enough to leave a mark on the genetics of their 'parent' populations.

Yet in neither case did we end up with a new, hybrid species. The boundaries were preserved, the groups remained distinct. They are, to any commonsense observer, still species. So what is it that kept them from merging?

Emily Singer probes this question in Quanta using closely related carrion crows and hooded crows in eastern Europe:

> The two groups can mate with each other, but they look very different — carrion crows are black, and hooded crows have black-and-gray bodies — and the birds strongly prefer mates of their own kind. For a long as anyone can remember, the two groups have remained distinct, save for a narrow band of habitat stretching from Denmark through eastern Germany to northern Italy where they sometimes intermingle.
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> The crows present a puzzling question to biologists, which gets to the heart of what it means to be a species: Given that hooded and carrion crows can mate and swap genes, how do the two groups maintain their individual identities? It's as if you mixed red and yellow paint in a bucket but the two colors stubbornly refused to make orange.

A team led by Jochen Wolf, evolutionary biologist at Uppsala University, has found that a surprisingly small chunk of DNA may hold the answer:

> A comparison of the carrion and hooded-crow genomes showed that the sequences are almost identical. Differences in just 82 DNA letters, out of a total of about 1.2 billion, appear to separate the two groups. Almost all of them are clustered in a small part of one chromosome. "Maybe just a few genes make a species what they are," said Chris Jiggins, a biologist at the University of Cambridge in England, who was not involved in the study. "Maybe the rest of genome can flow, so species are much more fluid than we imagined before."
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> The findings are striking because they suggest that just a few genes can keep two populations apart. Something within that segment of DNA stops black crows from mating with gray ones and vice versa, creating a tenuous mating barrier that could represent one of the earliest steps in the formation of new species. "They look very different and prefer to mate with their own

kind, and all of that must be controlled by these narrow regions," Jiggins said.

Crows aren't alone in their behavior. A deluge of genetic data in recent years suggests that interbreeding between species is more widespread than scientists ever imagined. "I think people will be surprised and the view of species will be challenged as more data comes along," Jiggins said. "I think it will lead to a fundamental shift in how they view what a species is."

Read the full, original article: As Animals Mingle, a Baffling Genetic Barrier

Additional Resources:

- Shaking up science with transgenerational epigenetics and blurred species boundaries, Genetic Literacy Project
- This Ant Species May Support a Controversial Theory on Evolution, Smithsonian
- Interbreeding Among Early Hominins, I Fucking Love Science