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Hitchhiking Snails Fly From Ocean to Ocean

A UC Santa Barbara scientist and his colleagues report that snails successfully crossed Central America, long considered an impenetrable barrier to marine organisms, twice in the past million years –– both times probably by flying across Mexico, stuck to the legs or riding on the bellies of shorebirds, and introducing new genes that contributed to the marine biodiversity on each coast.

The discovery of the hitchhiking snails, published in Proceedings of the Royal Society: B, has broad implications. "Not only snails, but many intertidal organisms may be able to ‘fly' with birds," said Osama Miura, first author of the study and assistant professor at Japan's Kochi University.

"There is a chance that the hitchhiking snails benefited native populations by bringing in new genes that helped them resist common parasites that castrate the snails and keep them from reproducing," said co-author Ryan Hechinger, a research biologist with the Marine Science Institute. "Now we are looking at the parasite genes to see if they jumped Central America, too."

Chance events that occur only once in a great while may be extremely important in the history of life. In 1940, George Gaylord Simpson, who studied natural history as recorded in fossils, coined the term "sweepstakes dispersal" to describe the unlikely events in which animals cross over a barrier resulting in major consequences for the diversity of life on Earth. Simpson was thinking about land-based animals that might

"get lucky" and cross between continents or islands by floating on rafts of debris. Sometimes such events result in devastating biological invasions––introducing new diseases, wiping out resident species, or causing economic damage to food crops.

The idea of land snails hitching rides on birds goes back to Charles Darwin, who speculated that migratory birds could transport snails to distant places. In fact, birds are thought to have carried land snails 5,500 miles from Europe to Tristan de Cunha Island in the South Atlantic Ocean and back. But this is the first report of a marine snail "flying" from one ocean to another.

"Just as people use airplanes to fly overseas, marine snails may use birds to fly over land," said Mark Torchin, staff scientist at the Smithsonian and a co-author. "It just happens much less frequently."

Scientists have long been interested in how the rise of the Central American land bridge more than 3 million years ago drove speciation and increased biodiversity. It formed a barrier between marine species, some of which evolved in their new surroundings, becoming new "sister" species that could no longer mate with their former relatives.

By studying the genetics of two sister species of Horn Snails –– Cerithideopsis californica and C. pliculosa –– collected at 29 different locations in mudflats and mangrove habitats from California to Panama on the Pacific, and from Texas to Panama on the Atlantic, the researchers discovered that, about 750,000 years ago, these snails invaded the Atlantic from the Pacific. Then, about 72,000 years ago, Atlantic populations returned to invade Pacific shores.

"Shorebirds cross Central America via two main flyways," said Hechinger. "It looks like the snails crossed with birds at the flyway in southern Mexico. And they used this flyway both times, going both directions –– separated by hundreds of thousands of years.

Understanding that such hitchhiking occurs can help reveal where new species might have become established or where they might establish in the future, Hechinger added.

"I am here in Panama, watching as snails fly over my head," said co-author Eldredge Bermingham, Smithsonian Tropical Research Institute director and staff scientist. "Tongue in cheek, I fail to understand why others did not notice this before! I

suspect our interpretation of this phylogeographic pattern would make George Gaylord Simpson smile."

David Jacobs, a professor of biology at UCLA, is also a co-author of the study.

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