Prehistoric aesthetics explains snail biogeography puzzle

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The answer to a mystery that long has puzzled biologists may lie in prehistoric Polynesians' penchant for pretty white shells, a research team headed by University of Michigan mollusk expert Diarmaid Ó Foighil has found.

The team's findings, published online Sept. 12 in the British biological research journal *Proceedings of the Royal Society B*, have implications for conservation efforts aimed at rescuing nearly-extinct Tahitian tree snails.

The study focused on a tree snail species, Partula hyalina, found on the island of Tahiti—where it has been nearly wiped out by a predatory snail introduced in the 1970s—and also on the Austral and Southern Cook Islands. The snail's multiarchipelago distribution is unique in the partulid tree snail family; most are restricted to single islands.

But even more intriguing is the observation that while this snail exhibits a range of shell colors on Tahiti, including white, only white-shelled variants are found in the Austral and Southern Cook Islands. What's more, P. hyalina—white-shelled or otherwise—isn't found at all on Tahiti's nearest neighbors, Moorea and the other islands in the Society archipelago.

The odd distribution pattern has had biologists scratching their heads since at least the 1880s. Over the years they've come up with a variety of possible explanations, suggesting for example that the white-shelled

forms are actually all distinct species that independently evolved on different islands.

But Ó Foighil and coworkers, who knew from previous genetic research that P. hyalina originated on Tahiti, thought a more likely explanation was that the snails were introduced to the other islands. The question was, how?

"Land snails are known to have been introduced to many Pacific islands by Polynesians but all the other cases were inadvertent introductions involving tiny snails of continental origin associated with food crops; the introduced snails were not endemic to the islands," said Ó Foighil, who is an associate professor of ecology and evolutionary biology and a curator at the U-M Museum of Zoology.

If the white snails were similarly transported by accident, their distribution pattern should be random, with nearby islands being much more likely than more distant ones to have received them. "The fact that they're not present on nearby islands suggests deliberate introduction to the more distant archipelagos," Ó Foighil said.

To investigate that possibility, the researchers conducted genetic analyses of snails from Tahiti and the Austral and Southern Cook Islands. The task was complicated by the dearth of wild snails on Tahiti, the result of a disastrous biological control experiment in which the predatory rosy wolf snail was brought to the island in 1975 to squelch an agricultural pest but feasted instead on native tree snails. Fortuitously, U-M professor emeritus John B. (Jack) Burch had collected Partula specimens in Tahiti in 1970, and those freeze-dried specimens still reside in the Museum of Zoology, where Ó Foighil and assistant research scientist Taehwan Lee recently have been extracting, amplifying and analyzing their DNA and using the information to construct evolutionary trees. The researchers also had access to captive populations maintained

in London Zoo.

The genetic analyses confirmed the Tahitian origins of the Austral and Southern Cook snails and suggested multiple prehistoric introductions from Tahiti. To understand what motivated early islanders to deliberately transport live snails, the researchers turned their attention from genetics to aesthetics.

"We know that Polynesians used these shells ornamentally. We think the fact that the white shells were aesthetically valuable within this regional trading network explains their unusual distribution," Ó Foighil said. On Tahiti, where the shells were relatively common, they would not have been highly prized; on nearby Moorea, the shells would have had slightly more value, but could easily have been obtained through trade with Tahiti. To residents of more distant islands, however, white shells from Tahiti would have been a rare treasure, desirable enough to make it worthwhile to travel to Tahiti, bring back live snails and raise them.

"The combination of aesthetic preference and fashionability made the unlikely introduction possible," said Ó Foighil, who also read up on marketing theory while preparing the paper and found parallels with today's marketing of trendy fashion items whose value is enhanced by their scarcity.

In addition to providing insights into early Polynesians' taste in jewelry, and into prehistoric trading links among these archipelagoes, the research suggests solutions to conservation quandaries.

Since the 1980s, researchers and conservationists have been setting up captive populations of Tahitian tree snails in European and North American zoos, including the Detroit Zoo. "The big problem for captive breeding programs is how best to reintroduce these snails to the wild. Should you reintroduce the snails to Tahiti, where the predator is, or

should you spread them out to other—predator-free—islands, where the white-shelled snails that were introduced long ago are still thriving? Our research would suggest that establishing multiple populations on other islands may be one possible way forward."

Source: University of Michigan