Speciation and Hybridization Summary

Maggie Schedl

Words: 837

﻿ The concepts of what constitutes a species, how speciation occurs, and what role hybridization and geographic isolation play a role in speciation are some the main and most hotly debated questions in the field of evolutionary biology. Sometimes opposing theories seem to have just as much support depending on the study system, questions asked, and methodologies. Arguably, this is what makes evolutionary biology equally enticing and infuriating, and there seems to be no overarching speciation pattern for all life on earth that we have found as of yet. Two papers, ﻿Lamichhaney et al. (2018) and Kautt et al. (2016), address the concept of hybridization in different ways: speciation as the result of hybridization, and speciation that has occurred despite hybridization, respectively. Importantly, Kautt et al. (2016) painstakingly demonstrate evidence for sympatric speciation in crater lake species of cichlid fish.

One of the main contrasts between these two papers were their respective definitions of species. Lamichhaney et al. (2018) adheared to a relatively strict biological species concept, which is based on reproductive isolation, facilitated by the easy-to-observe mating behaviors and song preferences of Galapagos Finches. A migrant ﻿*G. conirostris* arrived on ﻿Daphne Major and mated with a native *﻿G. fortis*. The offspring were morphologically distinct from the native finch species, and differed noticably in song. Importantly, they differed enough in song for mate choice to be almost exclusively endogamous. These “Big Bird” finches, as the authors coined them, also occupied an intermediate ecological niche between native populations which allowed for their persistence. This paper represents a clear and easy to understand example of speciation: entirely new genotypes are reproductively isolated and ecologically viable. This is also one example of rapid speciation, which is most often described with ploidy mismatches in plants (Ungerer et al. 1998), and in this case remarkably in about three generations.

In contrast, Kautt et al. (2016) adopted a genetic cluster species concept. In a complex analysis, they describe the evolutionary relationships and potential models of speciation for cichlid fish in two isolated crater lakes in Nicaragua. Each lake contains multiple species of fish, and genetic clusters identified by their data did not exactly match the species described morphologically. Using a variety of methods, models, and statistics, the authors attempted to characterize species relationships within each lake, and determine how the species arose in these lakes where there are no allopatric barriers. They found support in both lakes for sympatric speciation: the species within the crater lakes diverged from each other after the ancestral population migrated into the lake, and they found evidence that there was likely a secondary admixture event from the ancestral population to the crater lake, but occuring before the within-lake radiation. The authors affirmed that this is an example of sympatric speciation.

The type of data used to inform evolutionary analyses is also context dependent. Kautt et al. (2016) used only genetic data to investigate population history. Complex algorithms and models that take into account molecular clock estimates and nucleotide substitution rates are used to turn back time and find coelecences in lineages. Morphological or ecological data does not lend itself to this sort of analysis. In short, there is not enough information in, say, body size measurements to reconstruct history that goes back thousands of generations and that has been so far un-clearified by previous genetic markers. For Lamichhaney et al. (2018) however, morphological comparisons are essential to their argument: intermediate phenotypes relating to bill size, of known importance to fitness in Galapagos Finches, explain the ecological viability of the developing species. In terms of the complexity differences in the questions of the two papers, praise must be given to Kautt et al. (2016) for re-analysis including multiple statistics with different assumptions to put forth a consensus model of sympatric speciation in the cichilds. While less complex, the description of a rare event by a migrant potentially initiating a new species can vastly change our notion of how quickly speciation occurs. Interestingly, both papers describe realatively rapid speciation events, further dismanteling then antiquated notion that evolution happens glacially slow.

One quote included in ﻿Lamichhaney et al. (2018) stood out: “…to understand the mechanism of speciation, the focus should be on cases of incipient speciation rather than on completed ones” (Nolte & Tautz, 2010). Again, this gets at the question of is there a “the” mechanism of speciation. Allopatric speciation would certainly be considered complicated, however would probably be infeasible to detect in incipient stages. Although this quote was used to augment the authors argument, it was almost contradictory when compared with the other paper. The crater lake cichlids are generally considered to be separate species, and thus “completed,” while the “Big Birds” have only existed for a few generations and are thus incipient. However, reproductive isolation is strong for the finches, but strong hybridization between at least two populations of cichlids in lake Xiloa is apparent. This begs the question: is there such thing as a completed species? For me, I think no; the speciation continuum is in essence continuous.

**References**

Kautt, A.F., Machado-Schiaffino, G. & Meyer, A., 2016. Multispecies Outcomes of Sympatric Speciation after Admixture with the Source Population in Two Radiations of Nicaraguan Crater Lake Cichlids. *PLoS Genetics*, 12(6), pp.1–33.

Lamichhaney, S. et al., 2018. Rapid hybrid speciation in Darwin’s finches. *Science*, 359(6372), pp.224–228.

Nolte, A.W. & Tautz, D., 2010. Understanding the onset of hybrid speciation. *Trends in Genetics*, 26(2), pp.54-58.

Ungerer, M.C. et al., 1998. Rapid hybrid speciation in wild sunflowers. *Proceedings of the National Academy of Sciences*, 95(20), p.11757 LP-11762. Available at: http://www.pnas.org/content/95/20/11757.abstract.