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Speciation

750 words

Speciation is the process by which two populations of a species segregate usually due to a variety of scenarios and result in reproductive isolation, forming a new species. There are many scenarios in which a new species can develop such as allopatric (i.e. geographic or temporal isolation) and sympatric speciation (i.e. genetic polymorphism). While allopatric speciation is well-documented and undisputed such as finches in the Galapagos, it is difficult to support the concept of sympatric speciation outside of theoretical modeling. However, one proposed ecological example of sympatric speciation includes the Crater lake Cichlids in Nicaragua.

Finches have been a model organism for examining evolution. In one study, conducted by Lamichhaney *et al*. (2018) examined the rapid hybrid speciation in finches in the Galapagos. In this particular study they observed a rare event in which two species of finches flew to the island Daphne and mated. Due to inbreeding and specific bird calls, this hybrid rapidly became reproductively isolated from the rest of the island in a few generations, while normally it takes centuries.

In one study, conducted by Kautt *et al*. (2017), they used admixture, principle component plots, and modeling to argue that the different populations of cichlids two crater lakes (Lake Apoyo and Lake Xiloa), which were filled by two separate source lakes (Lake Nicaragua and Lake Managua), developed as a result of sympatric speciation. When they examined the populations within the crater lakes they found that there was little mixture between the populations, despite some geneflow and hybridization between *A. xiloaensis* and *A. sagittae* in lake Xiloa, resulting in distinct genetic clusters within the lakes. This supports the idea that these populations are experiencing sympatric speciation, however, they are in the beginning stages of separation. In addition, they found that there were multiple clusters being formed indicating that this is an example of multispecies sympatric speciation. Using the SNP data of four individuals from each cluster, they used SNAPP to develop cloudograms, from which they developed phylogenetic trees of the development using complete data of the five clusters in each crater lake and their corresponding source lake. In lake Apoyo they found that the five clusters seemed to be rapidly evolving whereas the cluster in lake Xiloa seemed to branch off one at a time. In addition, they examined for possible secondary colonization, but they did not find any evidence for admixture before the separation of the five clusters. They then examined the two populations in the source lakes and found that both populations were equally distant from the five clusters in each crater lake. Using this information, they developed a variety of models before settling on the models in figure 4A, supporting the idea that this is an excellent ecological example of sympatric speciation and that, while very effective, geographic isolation is not necessary for speciation to occur.

While both studies examine speciation in the natural environment, the finch study is using biological concepts to support the concept that the observation of this hybrid is an example of rapid reproductive isolation. However, in the cichlid study, they are using the observation of cichlids to support the concept of sympatric speciation, a very controversial speciation process. In addition, the cichlid study used observations to construct a model of how the different populations developed to further support their claim that this was an example of sympatric speciation. The finch paper used genetics but also observation by catching and tagging to develop a phylogeny. Unlike the cichlids, this method for the finches was feasible since the population and the island they were inhabiting were so small. However, given the small population size there is the concern of whether this hybrid will even continue to survive or if it will die out. Given the fact that the “n” in figure 1 seems to decrease by generation F6, it seems unlikely to continue. However, despite this, the fact that this study was able to capture this example of rapid evolution is novel and helps to enrich our understanding of the development of reproductive barriers. While the cichlid study had large enough populations, there was the issue that the data was so large that they could only use SNPs from four individuals to form the cloudogram. Such a low “n” could be problematic especially if there is a lot of variation. In summary, while each paper had a different overall goal, both provided ecological examples of theoretical speciation concepts that have been difficult to support beyond theoretical models.