The reasoning behind some interesting branches

1. The (a) Hooded Warbler and (b) American Redstart are traditionally classified into the genera Wilsonia and Setophaga. DNA evidence shows that they’re closely related to Dendroica. In fact, some Dendroica species from the Caribbean (not shown here) branch off even earlier than these two species.

2. The endangered Kirtland’s Warbler has no close relatives. It is the sole representative of one of the oldest Dendroica evolutionary lineages. Were it to go extinct, we would be losing a unique evolutionary line.

3. The two “blue” warblers—(a) Black-throated Blue and (b) Cerulean—are not closely related to each other, suggesting that they evolved their blue plumages independently.

4. The (a) Northern Parula and its close relative the (b) Tropical Parula are closely allied with the Dendroica group. This was a surprise to us, but it has been confirmed by many independent lines of DNA evidence.

5. Birders know that the eastern (Myrtle) and western (Audubon’s) forms of Yellow-rumped Warbler look quite different. They are very close genetically, but their patterns of evolution past and present are being actively studied by several research groups. Should they be classified as one species, or two? We’ll soon have lots of new data to add to that longstanding debate.

6. The Prairie Warbler has a close relative, the Vitelline Warbler (not shown here) which is found only on the Cayman Islands in the Caribbean. Some Prairie Warblers overwinter on those islands, and the ancestors of the Vitelline Warbler were probably Prairie Warblers that long ago crossed over from the mainland.

The coming year marks the 200th anniversary of Charles Darwin’s birth and the 150th anniversary of his publication of On the Origin of Species by Means of Natural Selection, or the Preservation of Favored Races in the Struggle for Life. Darwin was one of the first scientists to understand that evolutionary relationships could be drawn in the form of a branching tree. His crude sketch (above) in one of his private notebooks began a process of discovery that continues today, with the goal of understanding the history of ancestry and descent among all life on earth.
Wood-Warbler Tree of Life

ago stayed on to breed in the Caymans, instead of migrating back to the continent.

7. Another surprise from the DNA analysis is the close relationship of (a) Black-throated Gray and (b) Grace’s warblers, because in many ways Grace’s Warbler looks and behaves much more like the Yellow-throated Warbler.

8. (a) Hermit and (b) Townsend’s warblers are genetically very similar. They have partly overlapping breeding ranges in parts of the Pacific Northwest. These two species hybridize in the locations where both occur.

This diagram depicts the evolutionary relationships among the North American wood-warblers in a group that ornithologists classify into the genus *Dendroica* and some of its close relatives. Some of these species, such as the Yellow Warbler, occur across the continent and are familiar to nearly all birders. Others, such as the endangered Kirtland’s and Golden-cheeked warblers, are rare species with restricted ranges and highly specialized breeding requirements. These warblers are a special group for many birders, particularly during spring or fall migration when many of these species can be found flocking together as they refuel. I grew up in California, and as a young teen birder, I recall looking with great envy at the warbler plates from Roger Tory Peterson’s *A Field Guide to the Birds* and imagining what it must be like to visit a migratory warbler hot spot in the East, or to experience a spectacular migration fallout. Now I have the good fortune to live in the area with the world’s highest diversity of breeding warblers. Over the past two decades I have enjoyed researching their biology, especially the interplay between their evolution, ecology, and behavior.

This evolutionary tree was generated as part of the grand “Tree of Life” initiative sponsored by the National Science Foundation. Here in the Fuller Evolutionary Biology Program at the Cornell Lab of Ornithology, we have sequenced lots of DNA from all of the world’s wood-warbler species. By comparing those DNA sequences, we can determine which species are closely related to one another, and which have more distant shared ancestors. Since we are dealing with hundreds of species and thousands of DNA differences, performing these calculations requires a supercomputer. But once all those comparisons are crunched through, the output is an evolutionary tree like the one drawn here.

To read this tree, you can start from the base or from any of the tips. The way this particular tree is drawn, the position of the various branches in relation to other branches is all-important, but the relative length of each branch is not. By looking at the branch positions, you can see that, for example, Blackpoll Warbler and Chestnut-sided Warbler are each other’s closest relatives. Down near the base of the tree, you can see that Hooded Warbler branched off very early; it is equally distantly related to all of the other species.

This particular tree diagram is modified from a 2008 paper on warbler evolution in collaboration with Cornell Ph.D. student Dan Rabosky. The major discovery in our analysis of this tree is that speciation in this group was very rapid several million years ago when the group was young. Over time as more species arrived or evolved on the North American continent, the rate of species proliferation declined. We propose that this decline came about because as existing warbler species occupied more and more ecological niches, new species had fewer niches to radiate into.

Iruby Lovette, director
Fuller Evolutionary Biology Program