Revisiting MacArthur's Classic Study of Niche Partitioning of Spruce Wood Warblers

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Introduction:

In 1956 and 1957, Robert H. MacArthur studied the ecology of five species of the genus *Setophaga* (wood warbler), resulting in contributions to the theory of niche partitioning. MacArthur asserted that the five *Setophaga* are sympatric species that evolved to occupy separate behavioral niches. His observations were conducted in Acadia National Park, Maine, USA. In the breeding seasons of 2014 and 2015, I repeated MacArthur's study in the same location, to reassess warbler niche partitioning and observe possible changes over time.

Species Composition:

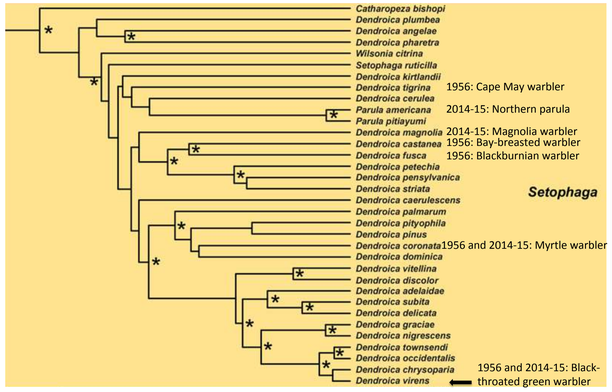

Fig. 1. The newly accepted phylogenic reconstruction for the family Parulidae (original figure from Lovette et al., 2010). The relative relationships of the study species of both the 1950s study and the current study. Two species of the genus are still present breeders, three are no longer present and two additional species are present.

Distribution:

Each of the four species were observed in all quadrats of the plot at some time during the field seasons. Additionally, each species was seen with each other species in the same tree, at least once during the observation period. However, there were spatial differences in density of territorial males during the mapping surveys (Fig.2).

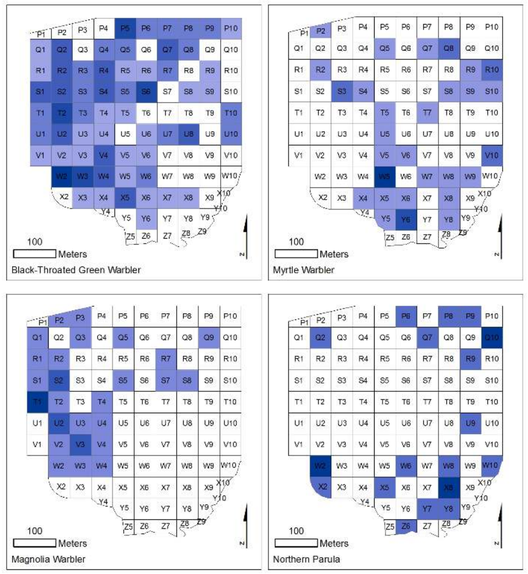

Fig. 2. The study boundaries are shown along with the 50 meter square quadrats labeled with ID numbers. The darker blue represents quadrats where singing males were encountered more frequently during surveys and white quadrats represent quadrats where there were zero encounters with the species.

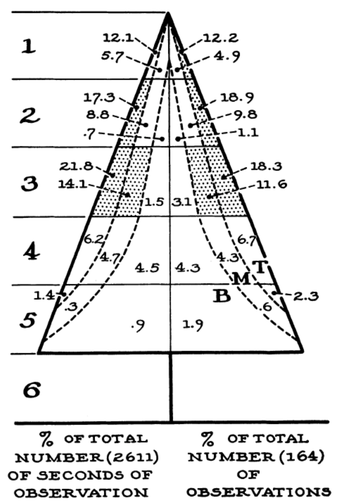

FIG. 4. Black-throated green warbler feeding position. The zones of most concentrated activity are shaded until at least 50% of the activity is in the stippled zones.

Fig 3. This template was used in the original study to illustrate zones of foraging. MacArthur (1958) asserted that each warbler preferred a different zone. The simplification of foraging substrate and stratum habitats are rudimentary but are necessary for new methodology to be comparative.

Fig. 4. Foraging heights and substrate measurements.

The yellow circles represent heights and substrate type (in this case branch tips) where a female black-throated green warbler foraged on June 29, 2014.

Height from lowest portion of canopy to top

Height from ground to lowest portion of canopy.

Methodological Comparison and Advancement:

The methodology was designed to allow a direct comparison with the original study, while utilizing current technology and allowing flexibility in the analysis. My analysis will involve a direct application of my data to MacArthur's tree template (Fig. 3) and will also allow me to apply alternative templates (Fig. 4).

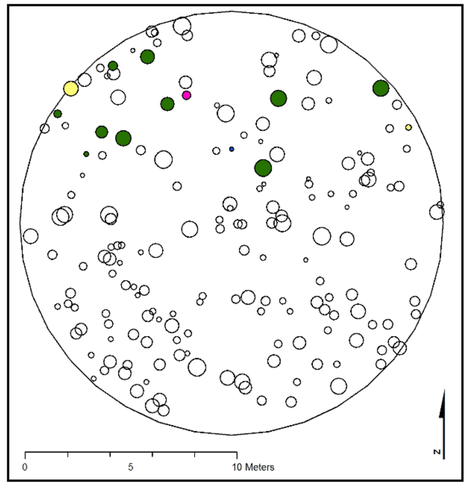

Fig. 5. Depicted is one of 17 forest structure plots. The outer circle represents the 20m diameter boundary. Each tree over 3m tall was identified, measured and mapped. Each tree is represented as a circle where size is proportional to the diameter at breast height. Fill color represents species: white is red spruce, green is balsam fir, yellow is American larch, pink is paper birch, and blue is mountain ash. Large diameter trees are evenly spread while small diameter trees have patchy distribution and red spruce are evenly distributed, while other species are patchy.

Forest Structure Assessment:

MacArthur (1957) described the plot at Bass Harbor Head as a mature stand of white spruce (*Picea glauca*) approximately 60-70 feet in height. The area today is predominantly shorter red spruce (*Picea rubens*). To evaluate availability of size and species of trees in the plot, I established 20m diameter plots in which trees over 3m were measured and mapped to establish total heights, canopy heights, stem density, and size class spacing.

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