Evolutionary pattern of bird song complexity

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MRes. Computational Methods in Evolution and Ecology

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Background

Studies devoted in the functions of bird song have suggested a role of bird song in mainly two aspects, rival repulsion (e.g. playback experiment by Vehrencamp, 2001) and mate attraction (e.g. copulation solicitation assay by (Ballentine et al., 2004). As a complex mating signal, bird song has been considered to diverge through the interplay between morphological adaptation, habitat adaptation and species recognition and therefore contribute to the process of speciation in many bird species (Derryberry et al., 2018; Read and Weary, 1992; Seddon, 2005). For example, evidence in white-crowned sparrows (*Zonotrichia leucophrys*) has illustrated that the signal variation among populations and signal evolution within in population may contribute to the formation of reproductive barriers between and within populations (Derryberry, 2007). Understanding the evolution of bird song complexity in both social and sexual context is therefore an important aspect of understanding evolutionary diversification.

Compared to morphological traits, behavioural traits including bird songs have received less attention in regard to macroevolutionary study (Mason et al., 2017). Moreover, the ways of defining and measuring song complexity vary across research, which may lead to incongruity in conclusion. The review by Byers and Kroodsma, 2009) shows a significant inconsistence in the results of laboratory test and field observation on the effects of repository size on female mate choice. A comprehensive measurement of complexity in 12 Rock Wren birds using regular used metrics finds little correlation across individuals, which underlies the necessity of considering the validity of metrics of song complexity in research (Benedict and Najar, 2019).

Functional and evolutionary aspects of bird song require the robust measurement of song complexity. To explore this issue, this project will finalise the Bird 10,000 Genomes (B10K) song datasets (Tobias et al., unpublished) of 300 species (one species per family) and compare different ways of estimating complexity across the entire avian tree.

Aims

To complete a global song dataset and quantify the general song complexity evolutionary pattern across all birds.

Materials and Methods

Song recordings will be collected from open-access online sound archives (www.xeno-canto.org) to finalise the B10K song dataset and will be measured by Raven Sound Analysis Software. Characters will be generated from the 1st, middle and final note (Seddon, 2005) including song length, bandwidth, duration of longest notes etc. From these characters, comparisons of song complexity will be made to generalise evolutionary pattern, taking into account the role of ecological and social selection. The relationships between different methods of defining complexity metrics in previous studies will be examined to assess the validity of song character measurements.

Anticipated Outputs and Outcomes

There is a positive or negative correlation between bird song complexity and ecological, social or sexual selection.

Project Feasibility

Timeline of tasks:

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Literature reading and theory development									
Finalising song datasets									
Song analysis (Raven Pro)									
Data analysis									
Report: Introduction									
Report: Methods									
Report: Results and Discussion									
Report: Final									

Budget

Software	Cost
Raven Pro 1.5 – Student 1yr License @ $100/Yr	£77.00
TOTAL	£77.00

References

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"I have seen and approved the proposal and the budget"

[DR. JOSEPH A. TOBIAS]
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