



Call variations between sub-regional Florida Scrub Jay (*Aphelocoma coerulescens*) populations

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Introduction

The Florida Scrub Jay (*Aphelocoma coerulescens*) has been observed to have distinct sounding female hiccup calls in different populations (Woolfenden and Fitzpatrick, 1996). An early indicator of divergent evolution can be witnessed in the development of distinct call dialects. By recording the female hiccup calls of the three largest sub-regional populations (Atlantic Coast sub-region, Ocala sub-region and the Lake Wales Ridge sub-region), the divergence in dialects can be quantified. Using digital recording equipment and two popular sound analysis programs, 12 color banded birds from each sub-region can be compared for similarity.



Fig. 1. Recording took place within the Atlantic Coast, Ocala and Lake Wales Ridge sub-regions

Materials and methods

From June through August of 2004 and January of 2005, recordings were made digitally (24-bit depth, 44 kHz rate) (Fig. 2). Calls underwent a 1000Hz High Pass filter and then normalized. Calls were selected based on the greatest signal to noise ratio and relative freedom from other bird songs as per Baker and Logue (2003). The four clearest beginning sequential hiccups (syllables) were selected for each bird at each population for similarity analysis in two different programs (Fig. 3).

The first method of analysis was Cornell Laboratory of Ornithology's *Canary 1.2.4* which compared call files using Spectrogram Cross-Correlation (SPCC) (Charif et al. 1995). *Canary* produced a triangular matrix of similarity values (0 - 1). Principal Coordinate Analysis (PCoA) was then performed followed by a Linear Discriminate Analysis (LDA) performed in *SPSS version 12* (Cortopassi and Bradbury 2000; Baker and Logue 2003).

Fig. 3. Recording without tapes compression, or 3.5 mm mini jack plugs increased sound quality and allowed data analysis in the field.

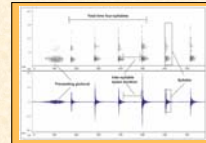
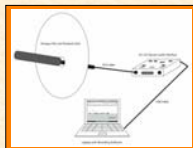


Fig. 3. Female hiccup call displayed above as a spectrogram and below in wave form. Note the four-syllable duration and Inter-syllable duration space.

The female hiccup call is very simplistic for this reason *Sound Analysis Pro* was used to measure features instead of producing a similarity matrix (Tchernichovski and Mitra 2004). These measurements determined the inter-syllable space duration and the total time for each four-syllable call. An ANOVA test and a (univariate) nested factorial model were executed in *SPSS version 12* and *Minitab version 14* respectively. The ANOVA test was performed on the 36 four-syllable total time durations while the (univariate) nested factorial model was used on the inter-syllable space duration call samples.



Results

Principal Coordinate Analysis

The PCoA and LDA produced a scatter plot which shows that there are significantly distinct dialects at each sub-regional location (Fig. 4) (LWR v. O, $p < 0.001$; LWR v. AC, $p < 0.001$; AC v. O, $p < 0.001$).

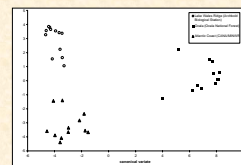


Fig. 4. Clustering of calls into distinct sub-regional dialects. Canonical variates obtained from LDA which was performed on eigenvectors from PCoA.

Analysis of Variance

The ANOVA test showed significant difference in the sub-regional call overall durations, $F(2, 33) = 174.8$, $p < .001$ and Tukey's HSD results are shown in Figure 6.

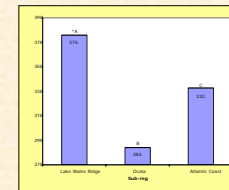


Fig. 6. This graph demonstrates that there are significant differences in the length of call delivery between each sub-regional population.

Analysis of variance for interaction between sub-region and inter-syllable space duration showed a significant difference between populations, $F(4, 66) = 44.6$, $p < .001$. The means were separated out and the results of the inter-syllable space interaction with inter-syllable space mean duration and sub-region are displayed in Figure 7.

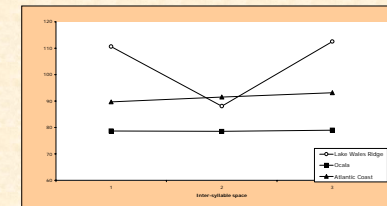


Fig. 7. The Lake Wales Ridge sub-region is significantly different than the other two in inter-syllable space duration deliveries (slow-quick, slow-quick). The Atlantic Coast and Ocala sub-regions are not significantly different from each other in their delivery of inter-syllable space duration, each duration delivery is of approximately the same length every time (quick-quick-quick-quick).

Conclusions

For the first time, this study statistically demonstrates that significant dialectic variation in the female hiccup call exists between the three largest sub-regional populations of the Florida Scrub Jay (Fig. 8). Mean duration and sub-region are displayed in Figure 7.

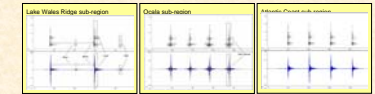


Fig. 8. Visual representations of each of the three sub-regional dialectic variations.

Due to the distinctive and recognizable nature of the female hiccup call, it seems especially important that a general description and knowledge of dialects be presented to the general public. Typically, commercial audio birdcall collections only contain the Lake Wales Ridge variety of the female hiccup.

Hopefully, this re-examination of one of the most noticeable Florida Scrub Jay calls will lead to further investigation and a more detailed classification of the calls with specific consideration for dialects.

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For further information

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