An analysis of nestling vocalizations in the grasshopper sparrow (*Ammodramus savannarum*)

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Introduction

Grasshopper sparrows go through 2–4 nesting cycles per season, each one lasting approximately 1 month. Young grasshopper sparrows remain in the nest after hatching for an 8–9 day nestling period. At that time, surviving nests fledge, and parents continue to feed offspring for approximately a week within the vicinity of the natal territory. The young then begin to disperse, and the adult male and female begin re-nesting. Depending on the time of year, up to 50% of nests may be depredated prior to reaching the point of fledging.

Adult grasshopper sparrows produce an array of high-pitched vocalizations (6–10 kHz), and adult vocal variation has been measured for the past 10 years in at least one well-studied population. In 2008, we discovered that nestling grasshopper sparrows also produce vocalizations, at low amplitude, in the form of begging calls that occur primarily during parental feeding visits. As these calls were undescribed in this and related species, we were interested in observing and measuring behavioral changes related to nestling vocalizations and parental care through the course of early development.

Methods

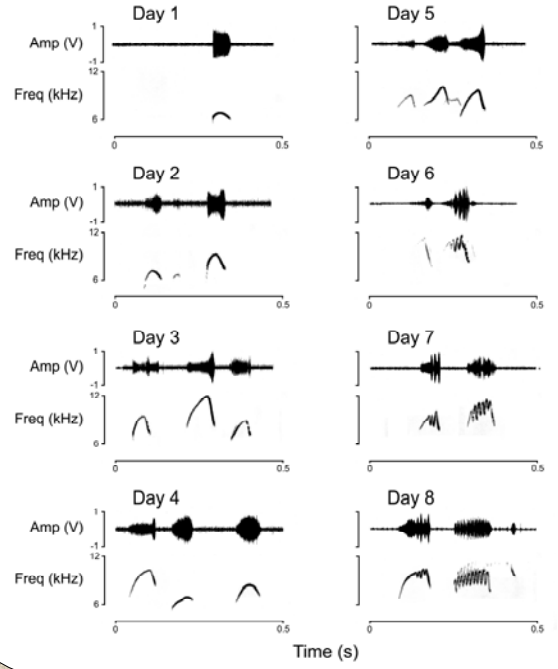
We participated in a general bird-banding and nest-finding effort that resulted in the marking of > 90% of all birds and the location of over 65 nests at the 90 ha Chester River Field Research Center, Chestertown, MD during the summer of 2008. Once nests were found, we observed parental visits and recorded nestling vocalizations for 90 min periods on 2–3 randomly selected days per nest. Observations were made at distances > 10m to avoid disturbance and alteration of normal parental patterns of nest visitation.

We recorded nestling vocalizations by clipping miniature omnidirectional lavalier microphones (Radio Shack 33-3013) directly to the edge of a nest, running a long cable to the observer, and tape recording just prior to and during parental visits.

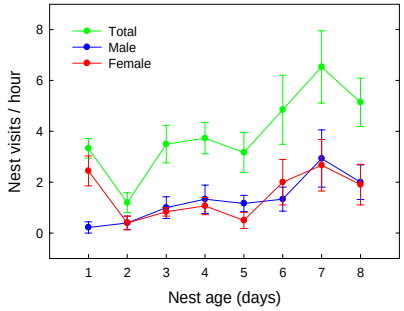
We analyzed nestling calls by sampling random, high-quality recordings from each nest available for each day post-hatch (N = 6–8 nests for each post-hatch day). Nestling calls were infrequent and very low in amplitude during the first 2 days post-hatch. Afterwards, calls increased in frequency (number) and became louder, making sampling and measurements easier. Recorded calls were filtered, digitized, and stored as 16-bit sound files according to nest and age.

As a means of evaluating changes in call structure during development, we measured the duration of each nestling call, and the acoustic frequency (pitch) at the beginning midpoint, and end of each call using the SIGNAL / RTSD sound analysis software.

Results - vocalizations



Parental Care – nest visits



The number of male and female visits to nests with food did not differ significantly ($t = 0.51$, $p > 0.05$). This suggests that males contribute as much parental investment (in terms of time budget) in the rearing of young as females, despite the additional time spent in singing (females do not sing), and other forms of territorial defense. A one-way ANOVA showed that there was a significant difference in the frequency of visits to the nest by both males and females as the nestling period progressed, with older young receiving a significantly higher rate of feeding visits ($F_{(7,37)} = 2.629$, $p < 0.05$).

Results - measurements

The complexity of nestling vocal signals increased during development, primarily with the addition of frequency modulation beginning typically at day 6 (see figure above). With increased nestling age, there was a concomitant increase in the average duration of nestling calls ($F_{7,48} = 3.1$, $p < .01$) (Figure 1). Interestingly, the acoustic frequency (pitch) of calls changed during development as well. We found a significant increase in the average frequency of calls as the nestling period progressed ($F_{7,48} = 18.6$, $p < .001$) (Figure 2). This result was not isolated to one part of the nestling call – the pitch of all portions (beginning, middle, and end) of calls became higher through the course of the nestling period ($Fs_{7,48}$ 10.5 > , ps < .001). Thus, there is a clear progression towards higher, longer, more acoustically complex calls with age.

Figure 1

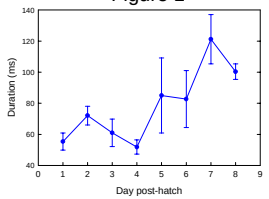
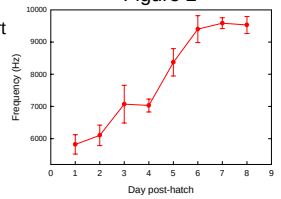


Figure 2



Conclusions

Nestling grasshopper sparrows produce vocalizations that change both qualitatively and quantitatively with age:

- **Calls become more complex during the nestling period**
- **Average call duration increases during the nestling period**
- **Call note frequency (pitch) increases during the nestling period**

Grasshopper sparrows increase the rate at which they feed nestlings as the young age, and males and females contribute equally to this aspect of parental care.

Acknowledgments

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