STATISTICAL ANALYSIS OF THE FEEDING CALL OF NESTLING/FLEDGLING BARRED OWLS (*Strix varia*) IN WEST-CENTRAL ILLINOIS

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ABSTRACT

Feeding calls of 12 barred owl (*Strix varia*) nestlings/fledglings from 5 nests, at 3 locations, in Macomb, McDonough County, Illinois, were studied during the spring and early summer from 1991 to 1993 in the laboratory and natural settings. A total of 246 nestling/fledgling feeding calls were recorded and analyzed. The duration and frequency were analyzed for each call using Canary software for the Macintosh computer. The feeding calls recorded in the laboratory were no different than those recorded in natural settings.

Principal Component and Discriminant Function analyses of the feeding calls of 12 barred owls were conducted on 4 study groups for determination of any differences. Three study groups were named based on their locations in Macomb, Illinois: Chase Street, Lafayette Street, and Spring Lake. These study groups consisted of adult barred owls and nestling/fledglings recorded at nest sites. A fourth group, the laboratory group, was comprised of 4 nestlings (2 from each nest) from 2 separate family groups recorded in a laboratory setting. The feeding calls of the 4 study groups were statistically different.

The structure of the feeding call of nestling/fledgling barred owls was simple compared to the feeding calls of other young altricial birds. The barred owl nestling/fledgling feeding call usually began between 6.5 and 7.0 kHz and maintained this frequency until the end of the call where it sharply dropped to around 4 kHz. The call was approximately one second in duration. The feeding call of barred owl

nestlings/fledglings was found not to be age-dependent. The feeding call of a nestling barred owl was the same as the feeding call of the fledgling barred owl. Discriminant Function Analysis classified the 246 nestling/fledgling feeding calls into one of the 4 study groups. On average, 84.0% of the calls were matched with the correct study group.

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INTRODUCTION

The barred owl, *Strix varia*, is an owl of the temperate forests of North America and Mexico. Adults vary in length from 405 mm to 600 mm, with females usually larger than males (Hume and Boyer, 1991). The barred owl is a territorial monogamous breeder, usually for life. The typical nesting habitat of the barred owl throughout its range is the more inner regions of large expanses of mature woods (Dunstan and Sample, 1972). Barred owls usually do not build their own nests, but prefer to nest in tree hollows or to a lesser extent, in old squirrel or hawk nests (Bent, 1938). Nest site heights range from 4.5 to 10.5 m off the ground (Johnsgard, 1988). Throughout its range, breeding behavior of the adult barred owl begins in late February and eggs are laid in early March. Typical clutch size varies between 2 and 5 eggs, with larger clutches occurring in the northern parts of the range (Bent, 1938; Murray, 1976; Johnsgard, 1988; Hume and Boyer, 1991). Barred owl young are altricial. In Minnesota, eggs hatch in late March or early April, and the young stay in the nest until 7 to 9 weeks of age (Dunstan and Sample, 1972). In Illinois, the young also hatch in late March or April, but only stay in the nest about 4 to 5 weeks (Varchmin, 1977). In the eastern parts of the range, the eggs are incubated for 21 to 28 days and the young stay in the nest until 4 to 5 weeks of age (Bent, 1938). Once the young owls leave the nest, they stay within the parental territory and are fed by the parents until well into the fall (Dunstan and Sample, 1972).

The "contact" or "ordinary" call of the adult barred owl was described by Bent (1938) as a loud, strongly accented, "*hóo-hoo-to-hóo-ooo, hoo-hoo-hoo-to-whóoo-ooo*".

In addition to the contact call, the adult barred owl also has a "cry" described by Bent (1938) as, "*ho-ho-to-whâh-ow*" or "*whah-whah-whah-tó-hóoo*". There are numerous variations of these 2 calls. Bent (1938) and Varchmin (1977) both mentioned 4 types of calls given by barred owl young present in the parental territory. These included a high frequency whistle call when feeding, a chitter call when disturbed, a bill clack for defense, and a hiss call for defense. Varchmin (1977) stated that the young nestlings (1 to 4 days old) elicit a peep call which is thought to be an early feeding call, but did not report the age of the young at which the feeding call started. The feeding call was defined by Varchmin (1977) as "plaintive, high-pitched whines given by the young owls which stimulate the adult owl to bring food to them." Bent (1938) described the feeding call as a "sibilant squeak" that could be heard at a distance of up to 100 m. The feeding call typically given in large numbers at dusk and less frequently over the night. The chitter call was described by a series of harsh chitters, with the typical number of chitters per series being 5 (Varchmin, 1977). The purpose of this study was to record and to analyze the feeding calls of young barred owls while in the nest and after fledging in west-central Illinois.

Objectives

Objectives of this study were to determine:

1. the acoustic form/structure of the barred owl nestling/fledgling feeding calls.

2. if the characteristics of barred owl nestling/fledgling feeding calls given in a laboratory environment are the same as given in the natural environment.

3. if the barred owl nestling feeding call changes with age (e.g. after fledgling).

4. if barred owl nestlings/fledglings can be classified into family groups by their feeding call.

5. how the feeding call of young barred owls compares to the feeding call of other altricial birds.

STUDY AREA DESCRIPTION

This research was done from 1991 to 1993 in a riparian forest along a section of the East Fork of the Lamoine River, and in the forested sections of the city of Macomb in McDonough County, Illinois. This county is located in west-central Illinois, has a population of approximately 37,000 people and an area of 527 square kilometers (Land Atlas and Plat Book, 1993). The northeastern portion of the county was mainly farm land and the southwestern portion was composed of pasture land and forest.

The study area included Sections 15, 16, 17, 25, 26, 34, 35, and 36 of Emmet Township (R3W, T6N) and Sections 30, 31, and 32 of Macomb Township (R2W, T6N). The riparian forest was a forested wetland, which lacked continuously standing water, but flooded frequently. It also had a poorly developed and open understory, and the forest floor was littered with rotting logs and woody debris. The typical tree species were the silver maple (*Acer saccharinum*), sycamore (*Platanus occidentalis*), and the cottonwood (*Populus deltoides*). The river birch (*Betula nigra*), shagbark hickory (*Carya laciniosa*), and pin oak (*Quercus palustris*) were common in this habitat type (R. Henry 1993, personal communication).

MATERIALS AND METHODS

Nest Locating Method

Initially, nest sites of barred owls were located by rapping a stick on all trees within the study area that fit the description of a "typical" barred owl nest tree. A typical barred owl nest tree was one that contained a hollow or an old squirrel or hawk nest large enough to support a barred owl (Bent, 1938). If an owl flew from the suspected nest site, the site was noted and later investigated visually to determine whether there was nesting in that tree. Nest site searches were conducted in late February when the owls were expected to be incubating eggs. Once nests were located, the sites were left undisturbed until the eggs hatched. When it was estimated that the eggs had hatched, the nest trees were climbed using a ladder and a nestling count was conducted.

Recording Methods

Calls of the nestlings/fledglings were recorded under 2 different environments; in the wild and in the laboratory. In 1992, 4 nestling-age owls from 2 nests were removed from the nests at dusk and brought to the Department of Biological Sciences at Western Illinois University. Each was placed in a separate box identified as an individual from a specific nest site, and their sounds recorded.

The sequestered nestlings did not call readily, but were stimulated into giving feeding calls by simultaneously presenting a stuffed barred owl along with a dead laboratory mouse (*Mus musculus*). The calls of each nestling were recorded as they responded to the presentations. The nestlings were kept far enough apart during the recording sessions so that any simultaneous vocalizations from the subjects were not

recorded. Once each nestling gave 35 to 45 vocalizations, it was fed a dead mouse after which the calling usually subsided. After a successful recording session, nestlings were fed additional food and returned to their respective nests at dusk.

The removal and return of the nestlings was done at dusk to: 1) minimize the risk of predation on the nestlings, 2) match the natural daily feeding rhythms of nestlings by parent birds, and 3) capitalize on the natural food calling rhythms of hungry nestlings (i.e., calling after dark). Once returned, the well being of the nestlings was monitored for the next few weeks to ensure that parental feeding and care continued.

A potential maximum of 8 fledglings from 3 nests were recorded in trees as individuals of family groups in 1993. A recording method in which the young were not sequestered was used to document fledgling barred owl calls in the wild environment. Young within the nest cavity, nest tree, or nearby perch tree were recorded as they called during the night. Recording in the wild was more difficult because young called irregularly, or simultaneously so they could not be recorded individually as they perched or moved together among trees. Recording sessions at the nest sites were conducted over multiple days and identification of unmarked individual owls was difficult from day to day.

Recording Equipment

All recordings were made on 60-minute audio cassette tapes with a Sony TC-D5M stereo cassette recorder, and an Electro-Voice RE55 dynamic omnidirectional microphone. The frequency response of the microphone was linear from 40-20,000 Hz. The frequency response of the cassette recorder was linear from 30-14,000 Hz $\pm$ 3 dB.

To prevent overloading, owl calls in the laboratory were recorded with attenuation set at -20 dB. Owls in the wild were recorded with the same equipment plus a parabolic reflector around the microphone. To maximize reception, owls were recorded in the wild with the recording attenuations set at 0 dB.

Sound Analysis

All sounds were analyzed using the computer software program Canary: The Cornell Bioacoustics Workstation version 1.1 for the Macintosh, (Charif et al., 1993) on a Macintosh model SE/30 computer. Hardcopies were printed with an ImageWriter II dot-matrix printer and examined for basic acoustic structure.

Variables measured for each call were: duration, frequency, minimum frequency, maximum frequency, and peak time. All measurements of time were in seconds (sec), frequency was measured in kiloHertz (kHz). The acoustical analysis displays used for this research included the sonogram (frequency versus time display). Duration was defined as the time from the beginning of the call to the end of the call. Minimum frequency was defined as the lowest measured frequency in the call fundamental. Maximum frequency was defined as the highest measured frequency in the call fundamental. The recording equipment was not calibrated so amplitude was only a relative measure. The dominant frequency was defined as the frequency at which the peak amplitude occurred. Peak time was defined as the time into the call at which the peak amplitude occurred.

The fundamental frequency structure of sounds was determined by adjusting the input level of the sound analyzer to develop a sonogram of only the fundamental

frequency. The same call was analyzed at decreasing input levels until approximately all noise structure disappeared. This process as described in Thomas (1979) is illustrated in Figure 1. Figure 1-A was the call as it was recorded initially (input level = 0 dB). Figure 1-B was the call at an input level of -20 dB, and Figure 1-C at an input level of -25 dB. Figure 1-C represents the clarity of the calls used in the call analysis.

Statistical Analysis Procedure

Statistical analyses for this study were done using SYSTAT, version 6.0 for DOS (Wilkinson, 1995). In the analysis of avian sounds, univariate statistical methods have been found inadequate because they are "incapable of identifying complex relationships among songs and calls" (Sparling and Williams, 1978). Sparling and Williams (1978) recommended using different classification methods on the same data. Principle component analysis (PCA) alone was not able to adequately classify data for a seal study (Ballard, 1993). Therefore, for this study both PCA and discriminant function analysis (DFA) were used to test the grouping of young barred owl feeding calls.

PCA was used in the analysis of relationships among variables. PCA transforms an original set of variables into a new, smaller set of components that reflect the effects of single or multiple variables. The transformation makes the components mutually orthogonal and arranges the variables with component loadings in numerical order. The first component accounts for as much of the variability in the original data as possible. The second component accounts for the next largest amount of variance, and so on. These components are used as axes and the scores plotted. This plotting indicates major groups of calls, if any (Abbot et al., 1985). Therefore, PCA was an

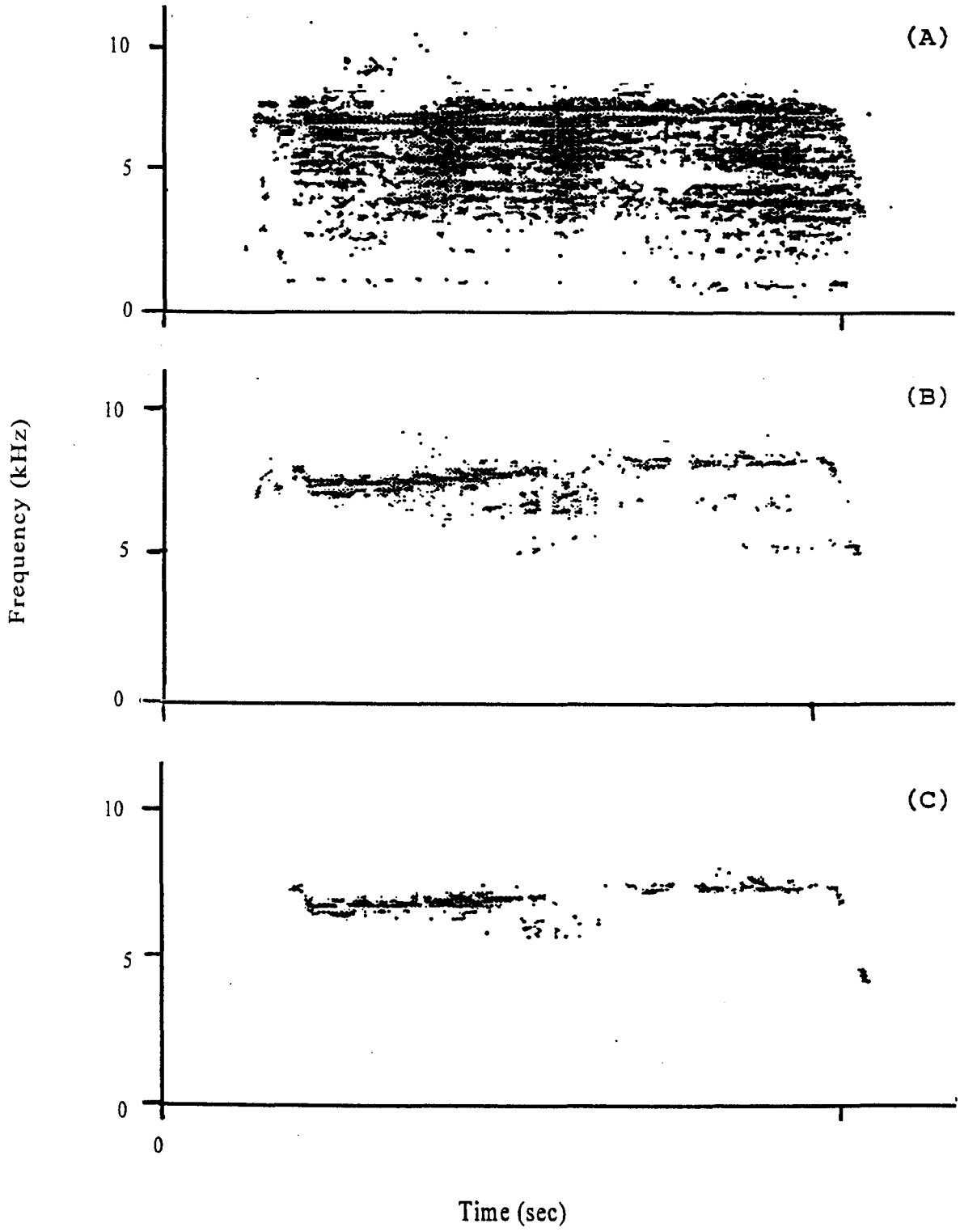

Figure 1. Procedure for determining fundamental frequency of a barred owl nestling/fledgling feeding call by progressively decreasing the input level on the sound analyzer. *A*: 0 dB; *B*: -20 dB; *C*: -25 dB.

exploratory analysis used to reveal unforeseen patterns in call data.

DFA was used to analyze preclassified groups of data (Abbot et al., 1985). DFA is similar to PCA in that the original variables are transformed into components, the components are used as axes, and the scores from the analysis are then plotted on these axes. However, DFA gives greater data cluster separation. In addition to this quality, DFA allows the classification of unknown data into predetermined groups.

The primary uses of multivariate statistics, such as PCA and DFA, include classification and prediction (Sparling and Williams, 1978). In biological studies, multivariate statistics have been used in ethological and acoustical studies. Schnell (1973) used PCA to compare morphological and song variations in buntings (*Passerina sp.*). Rowher (1972) used PCA to study morphological variations in meadowlarks (*Sturnella sp.*). Emlen et al. (1975) used DFA to study plumage characteristics in buntings (*Passerina sp.*) and then to compare the plumage characteristics with song characteristics. The response of white-throated sparrows (*Zonotrichia albicollis*) to song playbacks to determine individual recognition was studied by Falls and Brooks (1975) using DFA. Goldstein (1978) used DFA in analysis of the bobwhite quail (*Colinus virginianus*) "hoy" call. Clark (1982) used PCA to correlate behavior and sound types in right whales (*Eubalaena glacialis*). Ballard (1993) used PCA and cluster analysis to classify the calls of 4 seal species. Multivariate statistics have been recommended by Soucek and Vencil (1975) and Morgan et al. (1976) in analyzing note sequences within songs.

RESULTS AND DISCUSSION

Nest Sites

All barred owl nests occurred in cavities or hollows within trees. In 1992, a total of 5 active barred owl nest sites were found. Four of the 5 nest sites were located within the riparian forest along the East Branch of the Lamoine River. The one remaining nest site was located within the city of Macomb, Illinois. Of these 5 nest sites, young owls were removed from only 2 nests. These nestlings were from nests located along the Lamoine River. The other 3 nests were not used for the following reasons; one nest was too tall to climb with a ladder, one nest cavity was too deep and the nestlings could not be removed without possible injury, and finally, the nestlings from the third nest had fledged and were inaccessible as they branched throughout the tree tops.

In 1993, a total of 7 active nest sites were found. Three of these nest sites were located within the riparian forest along the Lamoine River and 2 were in the city of Macomb. A sixth nest site was located at Spring Lake Park north of Macomb, Illinois. A seventh nest was located at Argyle State Park in Colchester, Illinois. Young from 3 of the 7 nest sites were recorded. Two nest sites were within the city of Macomb, and the other at Spring Lake Park. The 4 remaining nest sites could not be used for recording because all eggs at these nest sites were destroyed prior to hatching.

Breeding Success

In 1992, a total of 12 eggs were laid among four nest sites. Only one of the 12 eggs laid did not hatch. At least 4 of the 11 nestlings lived to fledgling age. The fate of the remaining 7 nestlings/fledglings was not determined.

In 1993, 9 eggs were laid among 3 of the 7 nests. All 9 eggs hatched. Two of the nest sites were located within the city of Macomb, and the third nest site was located at Spring Lake Park. Three of the 4 remaining nest sites were located along the Lamoine River and the fourth nest site was located at Argyle Lake State Park. The number of eggs laid at these 4 nest sites could not be determined because the clutches were all destroyed prior to hatching.

Nestling/fledgling and Number of Calls Recorded

In 1992, 4 nestlings were recorded from nests located along the Lamoine River. In 1993, the total number of nestlings/fledglings recorded was not definitely determined. However, there was a maximum of 8 nestlings from 3 different nest sites that could have been recorded and included in these analyses. As discussed above, recording of the nestlings/fledglings in the wild was difficult because they called irregularly, or simultaneously and could not be recorded as individuals as they perched together or moved among perch trees. Recording sessions at these sites were conducted over multiple days and identification of unmarked individual owls was difficult from day to day .

For this study, 247 barred owl nestling/fledgling feeding calls from a maximum possible number of 12 young were recorded. Of these, 246 calls had adequate qualities for analysis. The nestling and fledgling owls from which these calls were recorded were estimated to be between 28 and 40 days of age and from 4 different study groups. For identification purposes in this writing, 3 study groups were named by their Macomb location: Chase Street, Lafayette Street, and Spring Lake. This sample represented

fledglings recorded at nest sites. A fourth study group, the laboratory group, was comprised of 4 nestlings (2 from each nest site) from 2 separate family groups.

Basic Barred Owl Nestling/fledgling Feeding Call

The basic barred owl nestling/fledgling feeding call had slight variation in form and qualities. The call typically begins at a frequency between 6.5 and 7.0 kHz and then drops sharply near the end of the call to about 4.0 kHz. The duration was approximately one second. There are slight variations in duration and frequency that make up the basic structure of the call among individual birds as noted during visual examination of the sonograms and by values of the call component data. Representative sonograms of each study group are illustrated in Figures 2-8.

Barred Owl Nestling/fledgling Feeding Calls Compared to Other Altricial Birds

When comparing the feeding call of barred owl young with those of other bird species, the call of young barred owls is relatively simple. Redondo and De Reyna (1988) compared the feeding calls of 5 altricial bird species [carrion crows (*Corvus corone*), jackdaws (*Corvus monedula*), azure-winged magpies (*Cyanopica cyana*), magpies (*Pica pica*, and blackbird (*Turdus merula*)] and found that the feeding call of the young of all 5 species consisted of numerous syllables and contained harmonic structure. Zigon (1967) described the feeding call of young elf owls (*Micrathene whitneyi*) as a high-pitched trill, but did not mention the frequency modulation of the call. Because of the attenuation of the vocalizations in the present study, and only one syllable in the barred owl nestling/fledgling feeding calls, the feeding calls of other young bird species appear to be more complicated.

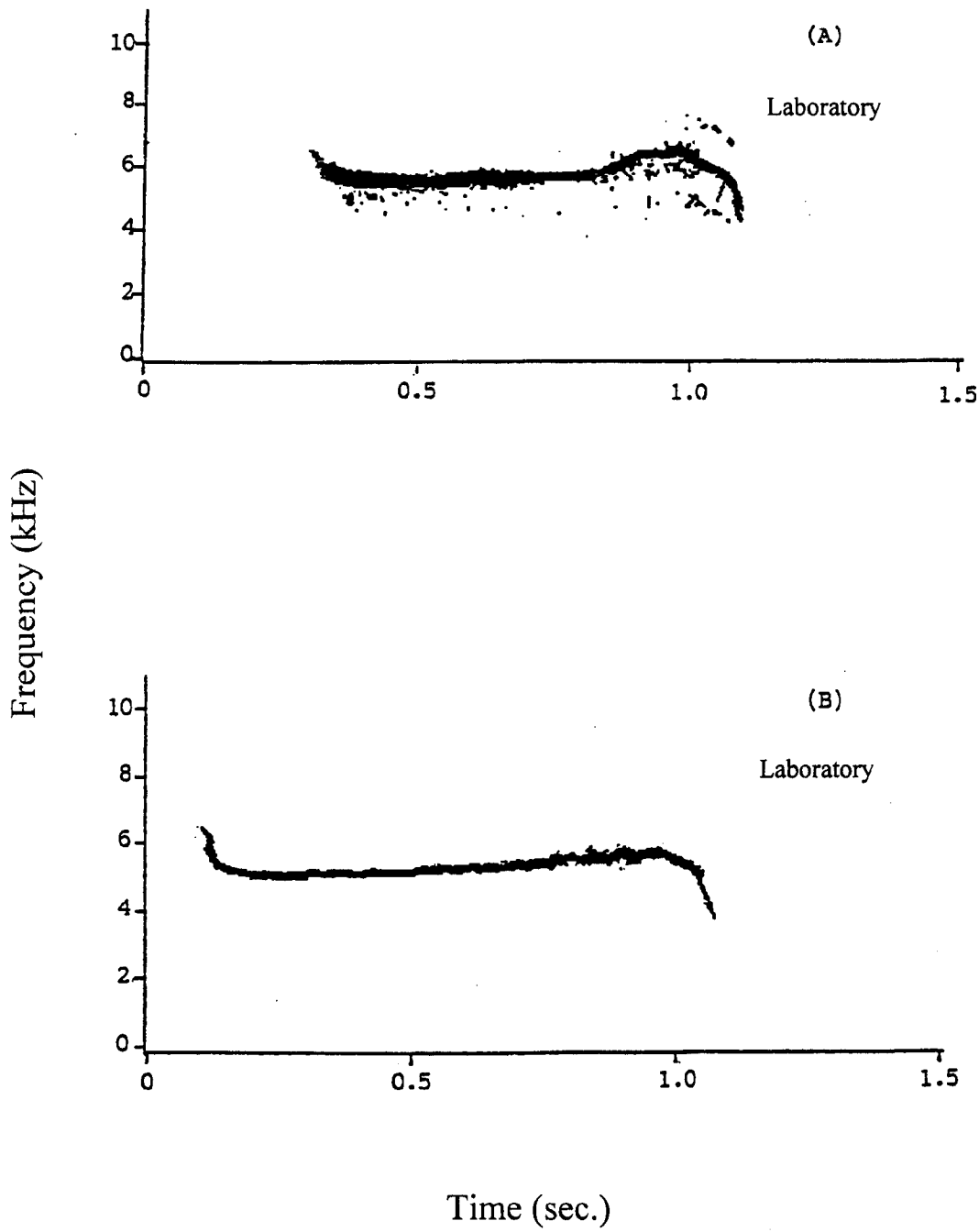

Figure 2. Representative sonograms of nestling/fledgling (A) and (B) in the Laboratory study group.

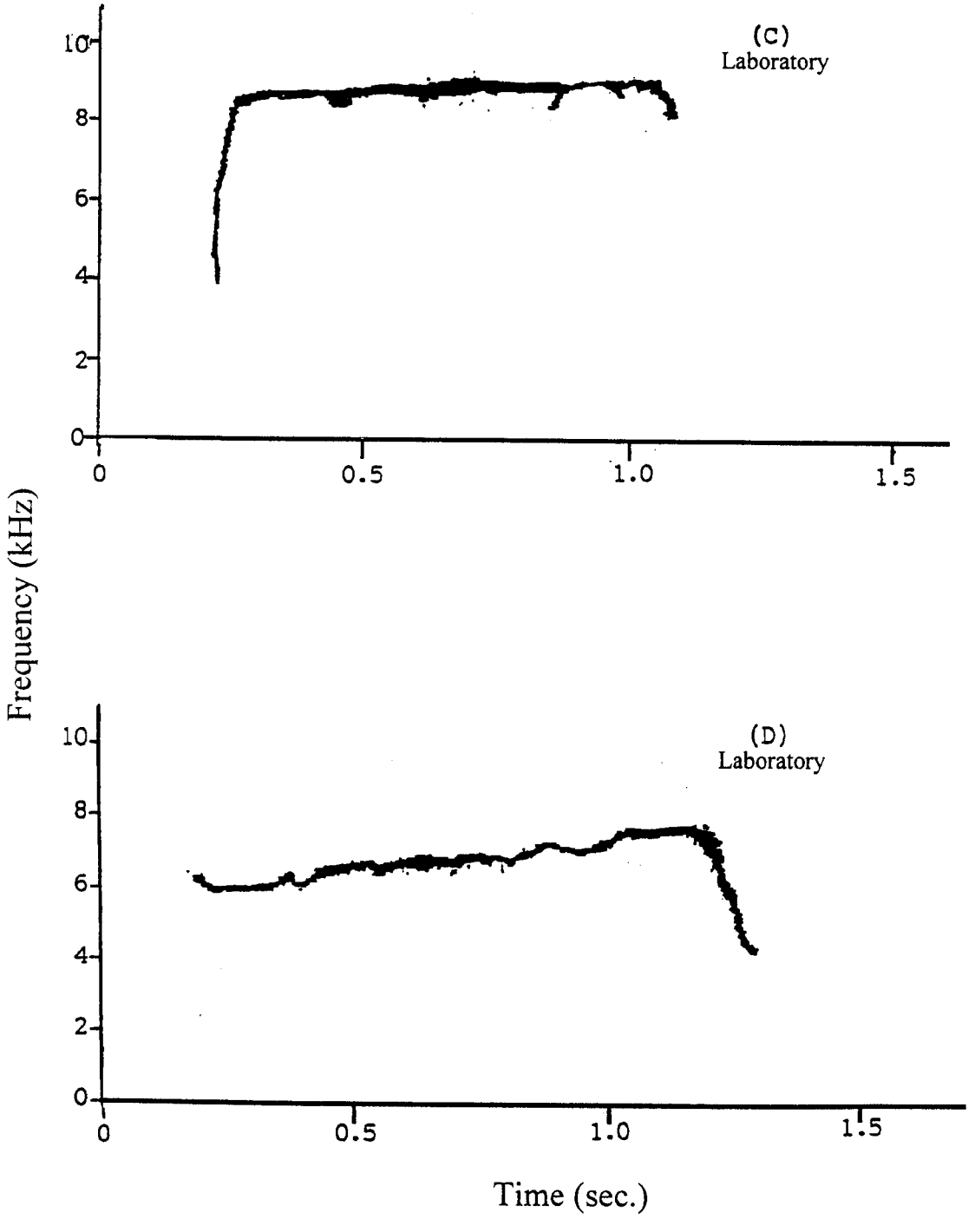

Figure 3. Representative sonograms of nestling/fledgling (C) and (D) in the Laboratory study group.

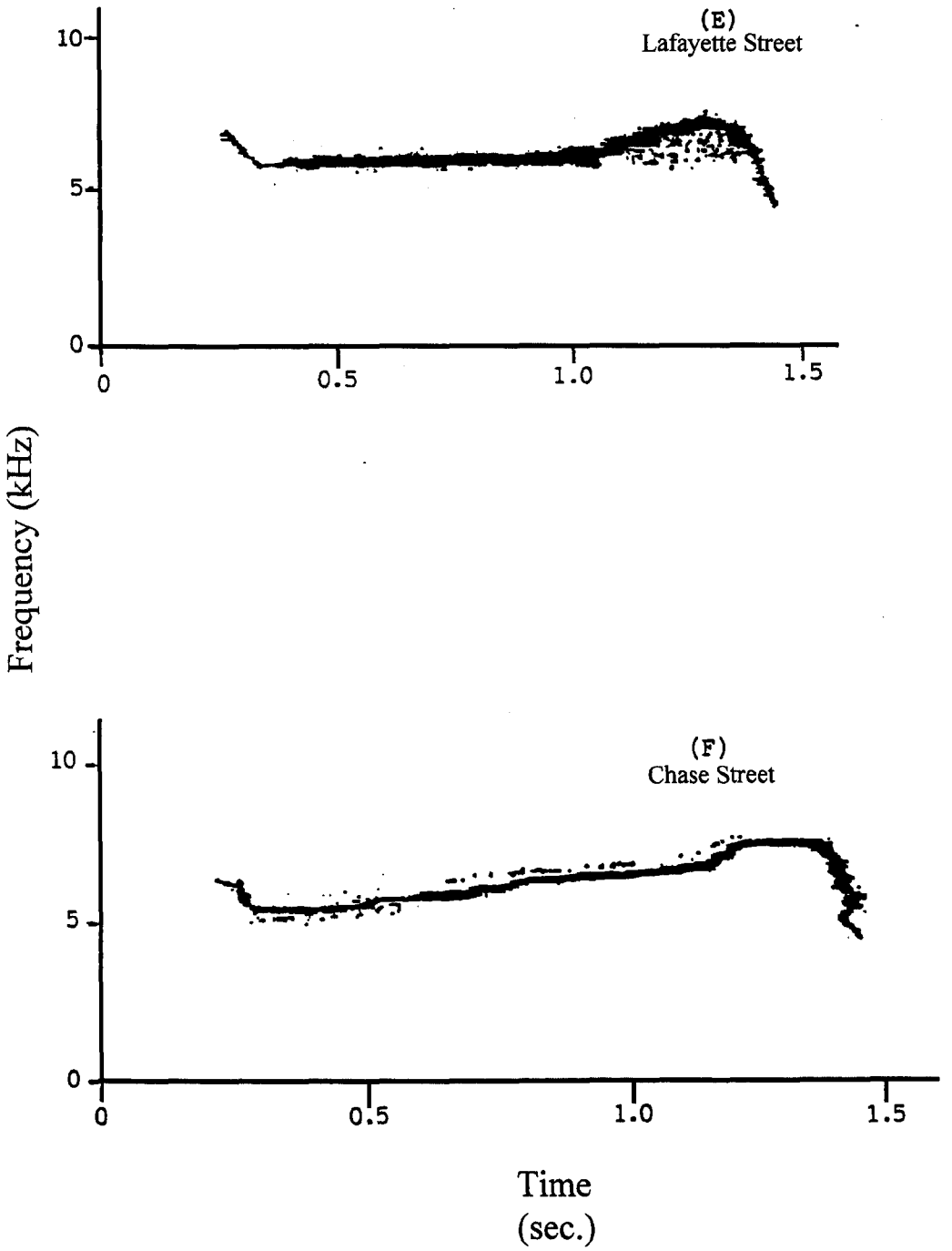

Figure 4. Representative sonograms of nestling/fledgling (E) Lafayette Street and (F) Chase Street study groups.

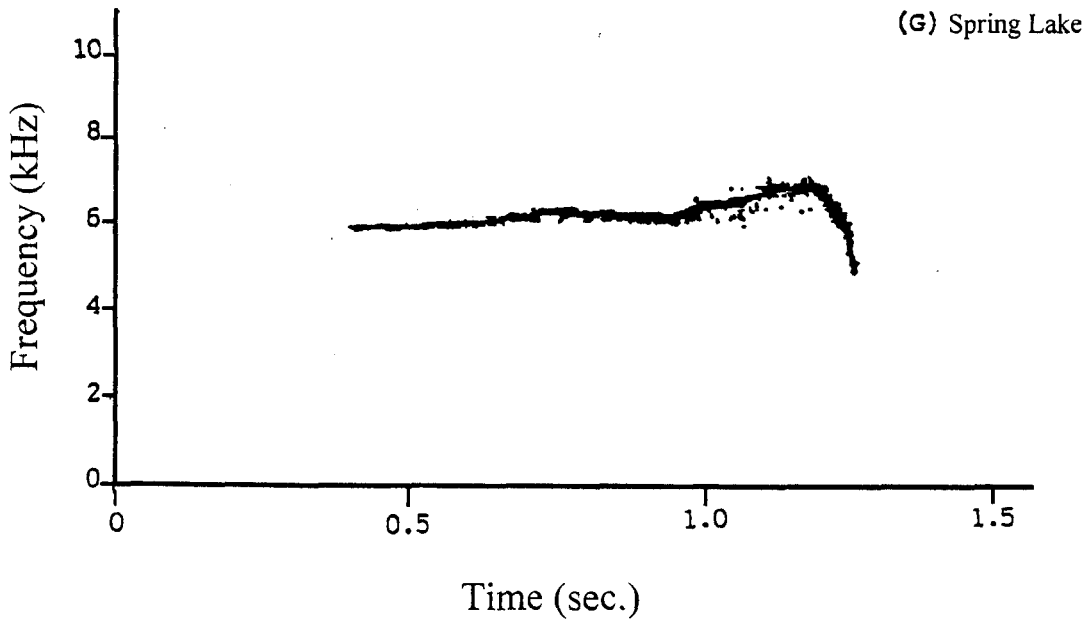

Figure 5. Representative sonogram of nestling/fledgling (G) Spring Lake study group.

Based on the findings of Redondo and De Reyna (1988) concerning non-owl altricial species, it can be stated that since barred owls are also altricial cavity nesters, they could also suffer less predation than open nesting species. The authors stated that feeding calls of young cavity nesters and the young of open nesting species differ in the amount of frequency modulations and the complexity of the call. This could be related to the contrasting adaptive survival strategies and nesting ecology of the 2 groups. The young cavity nester feeding call has a greater frequency range (4.61 $\pm$ 1.40kHz) and a lower (less attenuable) medium frequency range (4.1 $\pm$ 1.20kHz), whereas the open nesters have a high frequency more complex feeding call, according to the authors. This high frequency feeding call attenuates more, therefore confusing the predators as to the location of the young (Redondo and De Reyna, 1988). The nests of cavity nesting species are typically more inaccessible to predators than the nests of open nesting species (Redondo and De Reyna, 1988). Therefore, cavity nesters can afford to have a louder, less attenuable, and more easily located, feeding call. Because the cavity nesters suffer a lower predation rate, they do not need a high degree of complexity in their feeding calls to confuse possible predators.

Statistical Analysis of Nestling/fledgling Feeding Call

Summary statistics on each of the variables appear in Table 1. Also shown are the means $\pm$ SE for each measured variable. Principle component and discriminant function analyses also were conducted on these call variables. PCA was used to determine which set of variables account for the most variance among study groups. Through this analysis, two components (duration, and general frequency) characteristics were determined to

Table 1. Summary of measured variable means ± SE.

	Study Group ($\bar{x}$ ± SE)				
Variables	Lafayette Street n=44	Spring Lake n=22	Chase Street n=38	Laboratory n=142	Study Group $\bar{x}$
Duration (sec	1.187 ± 0.012	0.813 ± 0.025	1.141 ± 0.028	0.896 ± 0.010	0.978
Minimum Frequency (kHz)	3.553 ± 0.047	4.486 ± 0.169	4.843 ± 0.089	4.006 ± 0.052	4.097
Maximum Frequency (kHz)	7.016 ± 0.073	6.636 ± 0.241	7.080 ± 0.057	7.334 ± 0.059	7.175
Dominant Frequency (kHz)	5.028 ± 0.103	5.729 ± 0.415	5.902 ± 0.111	5.847 ± 0.057	5.701
Peak Time (sec.)	1.043 ± 0.049	0.697 ± 0.041	0.523 ± 0.055	0.629 ± 0.026	0.963

describe the nestling/fledgling call. These components accounted for 74.14% of the total variance among study groups. The results of the PCA are summarized in Table 2.

The possibility young barred owls have different feeding calls at different locations was addressed using PCA and DFA. The canonical scores, determined from PCA, for each call are presented in Figure 4. In Figure 4, there was a high degree of overlap among the study groups. This indicates that there was not an appreciable study group difference among data being plotted. Therefore, the nestling/fledgling feeding calls given in the laboratory were indistinguishable from the feeding call given in the wild. The importance of this finding is that future sound recording and analysis work can be done under the more controlled environment of the laboratory without a bias to the results.

In addition to PCA, DFA was done on the nestling/fledgling feeding calls. The purpose of DFA was to develop a comparison on a two-dimensional scale that discriminates among the calls by some value of maximum separation (Morrison, 1976). DFA also gives a greater separation of clustered data than PCA (Abbot et al., 1985). The results of the DFA have been plotted in Figure 5. An F-test analysis of the means supported that all variables within DFA were significant ($p<0.001$) at the $P\leq 0.05$ level. As in PCA, a high degree of overlap among study groups indicated a high degree of similarity amongst data.

However, there was not enough separation of calls in Figure 5 to suggest that the feeding calls among study groups were different. Therefore, DFA as with PCA, does support that the feeding calls given in the laboratory were not different than calls given in

Table 2. Summary of Principle Component Analysis.

Variables		Eigen-Values	Component Loadings	% Variance Explained
Duration	Factor 1	1.75	-0.700	34.926
Peak time			-0.794	
Dominant frequency			0.708	
Dominant frequency	Factor 2	1.57	0.434	31.383
Maximum frequency			0.912	

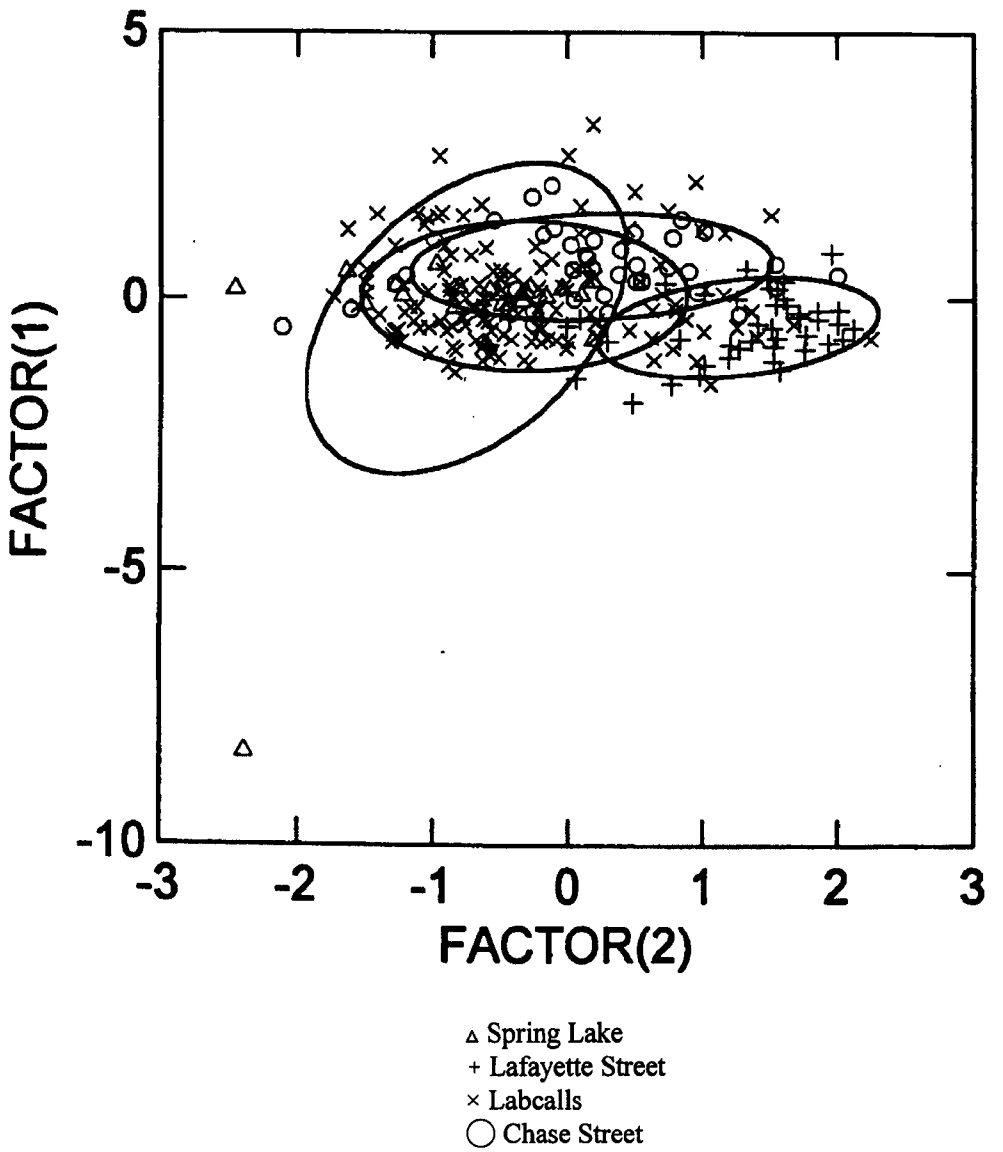

Figure 6. Plot of canonical scores for each measured call as calculated through principle component analysis.

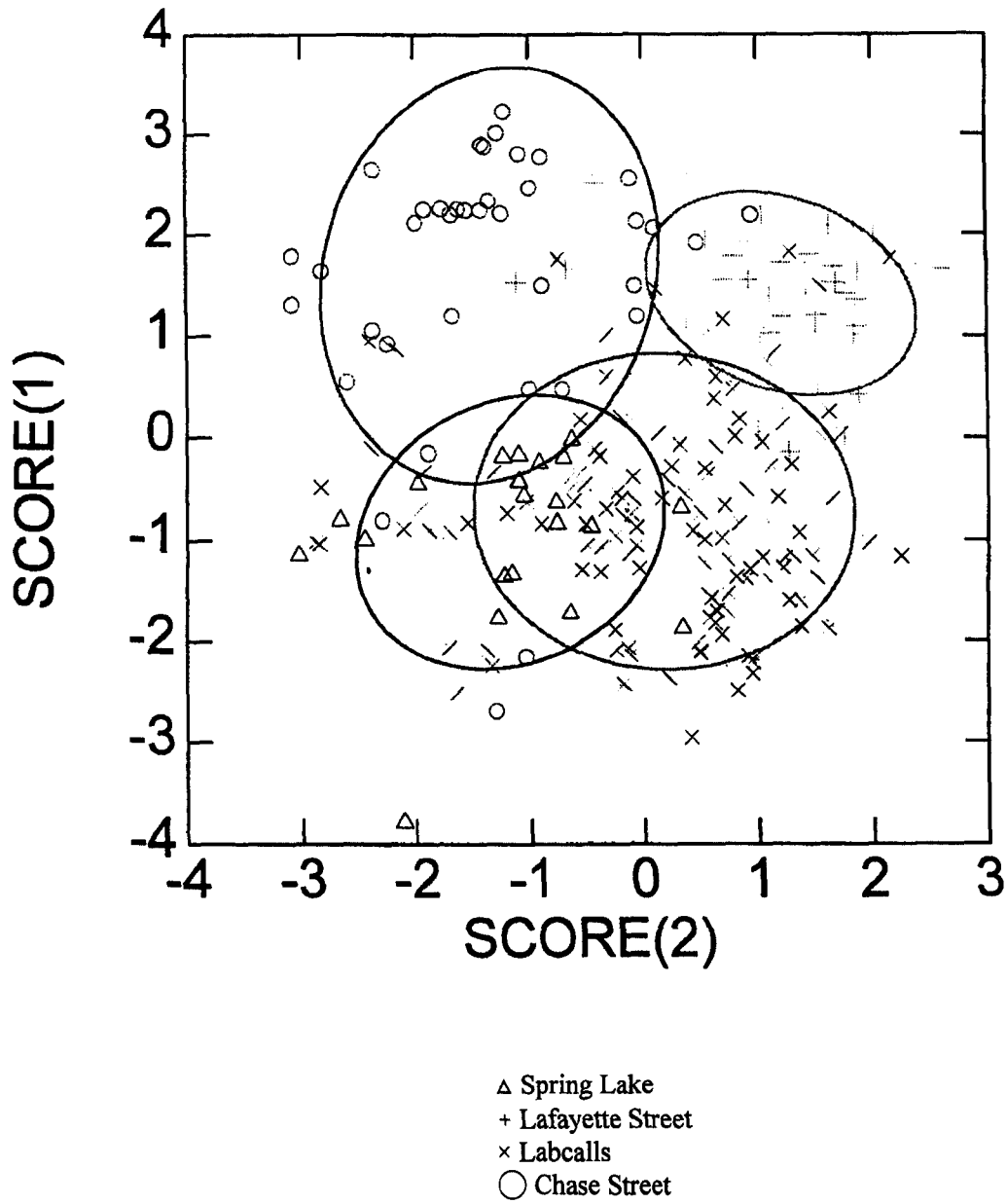

Figure 7. Plot of canonical scores for each measured call as calculated through discriminant function analysis.

the wild. The use of DFA to address this question also serves as an additional check on methods. Again, the results suggest that owls brought into the laboratory did not undergo any type of behavioral change that caused them to alter their feeding call.

It was thought that as young birds get older, their feeding call changes (Redondo and De Reyna, 1988). Was this true for young barred owls? This question was answered by again using PCA and DFA. Four study groups were set up to answer this question. The first group (laboratory group) consisted of 4 nestlings from two different nest sites and family groups. The other 3 study groups consisted of eight fledglings from 3 different family groups from the Chase Street, Lafayette Street, and Spring Lake sites. Nestlings and fledglings represent 2 somewhat different age classes of owls and 2 different spatial distributions, (ie. nestlings are clustered within a cavity and fledglings are scattered throughout the tree tops). Because there was no significant difference among the feeding calls, as discussed previously, it appears that the feeding call of the barred owl nestling does not change when it becomes a fledgling, at least a relatively young one, and moves about within the family territory. This differs from the findings of Redondo and De Reyna (1988) for the feeding calls of 5 altricial bird species. Redondo and De Reyna (1988) stated that at an early age (before the eyes open) nestlings compete with one another for food through their sounds (the "squeaky wheel gets greased" theory). Then once the eyes open, the nestlings compete for food by competing for position in the nest where most of the food is delivered, and not so much by sounds. Therefore, the feeding call is not as important later in the nestling stage as it is in the early nestling stage. Redondo and De Reyna (1988) cited an example of magpies (*Pica pica*) whose feeding

call frequency range was higher prior to the eyes opening. However, in this barred owl research no difference in feeding calls of nestling, with eyes open, and fledgling young was found. Representative sonograms from a nestling and fledgling are illustrated in Figure 8. It should be noted that during the 1993 year, nestlings and fledglings were combined into one group for analysis. If the feeding call changes with age, it would be a gradual change and therefore comparing means could mask the change. To positively determine if the barred owl nestling/fledgling feeding call changes with age, beyond several weeks as a fledgling, an extensive sequence of calls from the same birds would be needed over an entire breeding season until their dispersal from the nesting territory.

Classification of Feeding Calls into Study Groups

To determine whether the nestling/fledgling calls of barred owls could be classified into family groups by their feeding calls, both of the laboratory family groups were combined with the Chase Street, Lafayette Street, and Spring Lake family groups to create 4 study groups, and a potential total of 5 family groups. Table 3 is a summary of predictions which grouped all 246 of the feeding calls used for analysis into the 4 study groups on the basis of measured variables. Via computer analysis the correct call was matched with the correct study group an average of 84.0% of the time. Computer analysis correctly identified 76.0% of the Chase Street calls, 81.0% of the Laboratory calls, 93.0% of the Lafayette Street calls, and 95.0% of the Spring Lake calls. Even though the 246 analyzed feeding calls were so similar that they could not be separated through PCA or DFA, there was enough variability among the calls that they could be correctly classified (statistically) into study groups a high percentage of the time. This

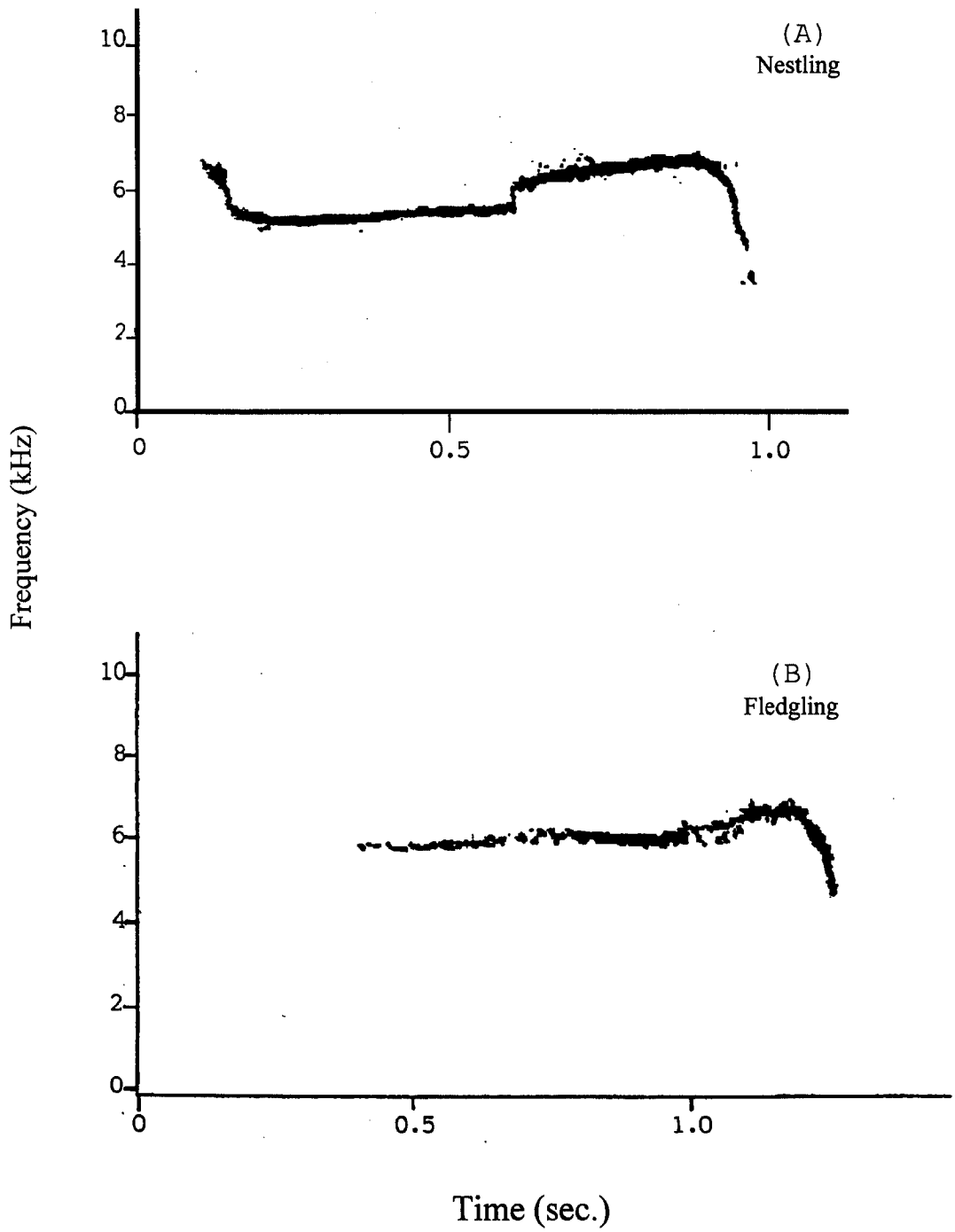

Figure 8. Representative sonograms of calls from a nestling (A) and fledgling (B).

Table 3. Table of predictions generated by Discriminant Function Analysis to determine whether the feeding call of the barred owl nestling/fledgling could be classified into the correct study group.

	Study Group				
	Chase Street	Lab Calls*	Lafayette Street	Spring Lake	Percent of calls correctly matched**
Chase Street	29	1	3	5	76.0%
Laboratory Calls	8	115	5	14	81.0%
Lafayette Street	3	0	51	0	93.0%
Spring Lake	0	1	0	21	95.0%
Total	70	117	49	40	84.0%***

*Two family groups of nestlings were combined to form the lab call study group.
**Calculated by dividing the number of calls correctly matched for each study group by the total number of calls for each analysis group.
***Calculated by adding the percent of calls correctly matched for each analysis group and dividing by four.

indicates minor differences which could be influenced by location or genetic differences among nestlings/fledglings.

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