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2   **Spatial variation in black-headed night monkey (*Aotus nigriceps*) vocalizations**

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29   **Abstract**

30   Quantitative acoustic analysis has been used to decipher individual differences, population structure, and taxonomic

31   diversity in numerous primate species. We previously described three distinct call types in wild *Aotus nigriceps*, and

32   now assess acoustic differences in two of these call types between social groups and spatially distinct populations.

33   Acoustic parameters for both analyzed call types exhibited significant variability between groups. Similarly,

34   geographically distant field sites were acoustically distinct from one another. Several groups also used a variation of

35   a common call: a triplet Ch Ch instead of a duplicate. Other groups made use of ultrasonic frequencies which have

36   not previously been reported in *Aotus*. Our results suggest that *Aotus nigriceps* exhibits substantial acoustic

37   variability across sites that could potentially be useful for taxonomic classification, although additional

38   geographically distant populations still need to be sampled. The possibility of individual signatures also exists and

39   will require recording vocalizations from known individuals.

40   **Key words**: vocalizations, *Aotus nigriceps*, night monkey, Peru, acoustics

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Introduction

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58   Primates use vocalizations to communicate about the presence of predators (Zuberbühler 2002; Schel et al.

59   2009), location of food sources (Slocombe and Zuberbühler 2005), nesting behavior, travel intentions and group

60   cohesion (Boinski 1996), territorial defense (Raemaekers and Raemaekers 1985; Cowlishaw, 1992), mate

61   assessment and pair bonding (Cowlishaw 1996; Geissmann and Orgeldinger 2000). Primate acoustic signals may

62   also be used for kin recognition and can convey information on age, sex, body size, and rank (Salmi and

63   Hammerschmidt 2014). The diversity of these vocal signals makes acoustics a convenient tool to explore differences

64   among primates at various taxonomic levels.

65   Despite the importance of acoustic communication in primates, evidence of population level differences in

66   primate vocalizations are relatively limited (Green 1975; Maeda and Masataka, 1987; Mitani et al., 1992; Fischer et

67   al. 1998; Mitani et al. 1999; Delgrado 2007; Wich et al. 2008; de la Torre and Snowdon 2009; Wich et al. 2012).

68   Acoustic variation between populations can exist for any of several reasons: divergence through cultural drift in

69   species that learn their vocalizations (i.e. inaccurate copying transmitted vertically or horizontally), genetic drift

70   following reproductive isolation, or local adaptation in response to sexual selection, habitat transmission properties,

71   predation pressure, or social selection pressures (Yoktan et al. 2011).

72   Most evidence suggests that non-human primates are not vocal learners; however, several recent studies

73   have found that primates can learn slight modifications to their vocalizations (Watson et al. 2015; Takahashi et al.

74   2017). Examining patterns of geographic variation in call structure can provide some evidence for or against the

75   presence of vocal learning; for example, if there is a sharp acoustic divide between two spatially contiguous areas

76   that show no evidence of genetic divergence (i.e. vocal dialects), this often suggests the presence of vocal learning.

77   Spatial variation in vocal characteristics within a species could be a valuable tool for addressing a variety of

78   ecological questions. For example, primate calls can be used to distinguish species, populations, groups, and

79   individuals (Table 1). If individuals could be distinguished from one another solely using quantitative acoustic

80   analysis, population size could be estimated by combining acoustic analysis and line transect surveys (Terry et al.

81   2005; Marques et al. 2013; Kalan et al. 2015). Moreover, variation in specific call characteristics could be used to

82   infer group membership, or be used for taxonomic classification, supplementing morphometric or genetic data.

83   Night monkeys, *Aotus* spp., are a useful model for investigating patterns of acoustic variation because

84   nocturnal and forest-dwelling species tend to rely heavily on vocalizations to communicate with one another. We

85   have previously reported on the vocal repertoire of wild *Aotus nigriceps*, describing three calls: the Squeak, Ch Ch,

86   and Long Trill (Helenbrook et al. 2018). In this study we focus on quantitatively comparing acoustic variation of

87   two of these calls between groups and distant populations.

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89   **Methods**

90   Eleven *Aotus nigriceps* groups were sampled (Fig.1): eight at the Villa Carmen Biological Station in

91   Pilcopata, Peru (12°53'39"S, 71°24'16"W), and three at CREES - the Manu Learning Center, on the edge of Manu

92   National Park (12°47′22″S 71°23′32″W). The two field sites are separated by a low mountain range (~1143m) and

93   are just over 10 km apart at their nearest borders. Villa Carmen has a long history of development, ecotourism and

94   agriculture. The groups sampled near the station lived in secondary forest, often dominated by bamboo or cane,

95   whereas groups sampled at CREES inhabited recovering clear-cut to primary rainforest where bamboo and cane

96   were largely absent. Research groups of 3-8 observers went into the field from 5:30-7:30am and 5:30-7:30pm for a

97   total of 28 days at Villa Carmen and nine days at CREES to collect acoustic data, times when *A. nigriceps* groups

98   are known to be active near their nesting sites. Several recordings also took place during the day as part of a separate

99   behavioral study.

100   A Zoom H1 Handy Recorder was coupled with a RØDE NTG-2 condenser shotgun microphone and shoe

101   shockmount on a micro boompole at a distance varying from 2-25m. Digital recordings were made at 48 kHz

102   sampling frequency with 16 or 24-bit amplitude resolution. Acoustic analysis was conducted using Raven Pro 1.5

103   sound analysis software (Cornell Lab of Ornithology Bioacoustics Research Program, Ithaca, New York). Calls

104   were digitized and measured spectrographically (DFT size 512, time resolution 3.1 ms, Hann window with 50%

105   overlap). Twenty-four acoustic parameters were measured for each call (Table 2).

106   Inter-group differences were analyzed using non-parametric Kruskal-Wallis tests coupled with post-hoc

107   multiple comparisons of mean ranks tests with a Bonferroni correction. A Mann-Whitney U test was used to assess

108   site differences between Villa Carmen and CREES. Stepwise discriminant function analysis was used to explore

109   acoustic parameters that could be used to classify social groups. For model selection, a stepwise forward method

110   was used (statistic, Wilk's Lamda) with the criteria $F_{to\ enter}$=3.84 and $F_{to\ remove}$=2.71, and a tolerance level of <0.01

111   (STATISTICA). This process was repeated for both call types separately. Variables that failed a tolerance test where

112   there was an almost exact linear relationship with other variables, did not enter the analysis. We used a 10-fold cross

113   validation in which 90% of the calls were randomly chosen to calculate discriminant functions, while 10% was

114   excluded for testing. Differences between observed and expected frequencies of duplicate versus triplicate Ch Ch

115   calls was measured using Fisher's Exact Test. All recordings were conducted non-invasively, minimized impact on

116   behavior, and avoided excessive disturbance, and were therefore deemed exempt from the Institutional Animal Care

117   and Use Committee approval. All applicable international, national, and/or institutional guidelines for the care and

118   use of animals were followed.

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120   **Results**

121   Three vocalizations have been described in wild *Aotus nigriceps* populations: Squeak, Ch Ch, and Trill

122   (Helenbrook et al. 2018). In this study, we analyzed acoustic variability for the two most common calls, the Squeak

123   (N=1302) and the Ch Ch (N=556; Fig. 2). For Squeaks we only measured the dominant harmonic since it was

124   consistently found across all sampled groups. The Trill was not used because of its rarity across most groups. At

125   least ten calls were analzyed from each of seven night monkey groups, ranging in size from 2-5 individuals

126   (Mean=3.7). The dominant harmonic of the Squeak ranged from a mean minimum frequency of 1591 Hz (Range:

127   74-3055 Hz; SD 470) to a mean maximum frequency of 2742 Hz (Range: 2010-4443; SD 252). The Ch Ch call

128   ranged from a mean minimum frequency of 1698 Hz (Range: 44-9092; SD 1182) to a mean maximum frequency of

129   11636 Hz (Range: 3109-23726 Hz; SD 2538).

130   Acoustic measurements varied significantly between groups (Fig. 3; Table 3). Differentiation between two

131   or more monkey groups was found for all forty-eight independent vocal characteristics (2 call types x 24

132   measurements, $p<0.001$). Discriminant function analysis distinguished among groups for both call types: Squeak

133   (Wilks' Lambda=0.06, $F_{(60,6706)}=81.98$, $p<0.0000$) and Ch Ch (Wilks' Lambda=0.06, $F_{(48,2592)}=42.58$,

134    $p<0.0000$) (Table 4 and Fig. 4). Cumulative significant functions were able to explain 87.4% of variance among

135   groups using only Squeak calls, and 87.8% of the variance among groups using only Ch Ch calls. Classification

136   accuracy was similar for both the Squeak (87.4%) and the Ch Ch (76.4%). Duration (90%) and energy parameters

137   for Squeak and Ch Ch, respectively, provided the greatest discriminatory power at the group level (Table 4).

138   Twelve acoustic parameters were significantly different between Villa Carmen and CREES biological field

139   stations (Table 6). Discriminant function analysis identified seven Squeak parameters that significantly distinguished

140 locations: low and high frequency, bandwidth, duration (90%), delta time, IQR duration, and max time – the first of

141 which contributed the greatest discriminatory power; and eight Ch Ch parameters significantly distinguished

142 locations: low and high frequencies, bandwidth, energy, peak frequency, Q1 frequency, frequency (5%) and center

143 time– the last of which contributed the greatest discriminatory power. The two sites were found to be significantly

144 different based on Squeak (Wilks' Lambda=0.77, F(13,1281)=29.09; p<0.0000) and Ch Ch (Wilks' Lambda=0.40,

145 F(13,526)=61.77; p<0.0000). Classification accuracy was 93.8% for Squeak (5 out of 13 CREES measurements and

146 116 out of 116 at Villa Carmen), and 100.0% for Ch Ch. Cumulative significant functions were able to account for

147 47.7% of variance between locations using the Squeak, and 77.7% using the Ch Ch call.

148 Other differences were observed between groups as well. The Ch Ch was predominately found in a series

149 of two ("in duplicate") (88.3% of cases); however, four groups also produced calls in triplicate (i.e. Ch Ch Ch). Out

150 of 556 total Ch Ch calls, 65 were in triplicate (11.7%), with 2.8% in T2A, 1.3% in A, 50.4% in B, and 2.8% in E.

151 The distribution of triplicate calls across groups differed significantly from even distribution across groups, with

152 Group B exhibiting nearly four times as many triplicates as expected (p=0.0000). In addition, two groups were

153 observed using ultrasonic frequencies as part of the Ch Ch call (>20kHz): group C (N=3) at Villa Carmen and T2A

154 (N=1) at CREES.

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Discussion

157 The majority of acoustic parameters for both calls differed significantly between groups and geographic

158 locations, though single acoustic parameters alone were not sufficient to predict group membership. Variance of

159 acoustic parameters overlapped in nearby groups, making absolute classification difficult. However, there was a

160 consistent pattern whereby calls from the same groups and population tended to cluster together based on similar

161 acoustic measurements. Population level classification was more accurate, largely driven by acoustic parameters of

162 the Ch Ch call. Quantitative analysis of acoustic traits may therefore be useful in elucidating group and population

163 level differences and may provide useful insight into the underlying phylogenetic relationships between groups,

164 populations and potentially species of *Aotus*. However, additional recordings are needed both at the group and

165 population levels, preferably with more distant populations included.

166 We were unable to investigate individual acoustic variability because of our inability to pair calls to

167 specific individuals in a complex environment at night. Based on various other primate studies it is likely that

168 individuals can be differentiated based on vocal signatures (Table 1). However, confirmation of vocal individuality

169 will require either analysis in captivity or pairing video and audio recordings in wild nesting groups. If recordings

170 can be attributed to specific individuals, then acoustic analysis could be used to establish whether individual

171 conspecifics vary predictably in their vocalizations. Establishing the ability to vocally differentiate individuals

172 would be particularly useful for a nocturnal species such as the black-headed night monkey, allowing researchers to

173 study group composition solely based on vocal recordings.

174   Aside from differences in acoustic parameters, two other acoustic differences were discovered among

175 groups. First, a triplet Ch Ch call was found in recordings from groups T2A, A, B, E. Though relatively rare within

176 the sampled populations (11.7% of cases), over half of these cases were found in Group B. The other groups at Villa

177 Carmen that used the triplet call are likely of the same population since they are isolated on all but one side and in

178 relative proximity to group B (<1300m at furthest extent). The prevalence of the triplet call in Group B suggests that

179 this is not an aberration but rather a consistent modification of a common call. The fact that the triplet call only

180 occurred in certain groups could reflect any number of possibilities including increased prevalence of a particular

181 behavioral context, or a vocal innovation (genetic or learned). Alternatively, it is possible that the presence of both

182 duplicate and triplet Ch Ch calls is the ancestral state and the absence of the triplet call is derived. Either way,

183 additional sampling of nearby groups – coupled with underlying population genetics analysis - would confirm

184 whether this is a relatively unique acoustic irregularity which is independent of underlying population structure, or

185 whether this call variation routinely arises and is widespread. Likewise, being able to obtain calls specific to

186 individuals through video and audio pairing in nests would allow us to decipher whether all individuals within a

187 particular group use the triplet call.

188   It is uncertain whether the use of ultrasonic frequencies in night monkeys is rare or whether this is a

189 common response to environmental pressures such as inter-species competition for lower frequencies or predator

190 avoidance. Of course, other nocturnal primates (i.e., *Tarsius*, *Galago*, *Microcebus*, *Nycticebus*) and some diurnal

191 neotropical primates (i.e., *Callithrix* and *Cebuella*) produce calls containing ultrasonic frequencies, though only the

192 tarsiers produce calls entirely within the ultrasonic range, with the other species always producing dominant

193 frequencies in the human audible range (Ramsier et al. 2012). In several species, the use of ultrasound appears to be

194 context specific, often in the presence of predators, including humans (e.g. Rahlfs and Fichtel 2010; Gursky-Doyen

195 2013).

196   *Aotus* currently consists of eleven described species based on both phenotypic and genotypic evidence.

197   Night monkey taxonomy has been revised considerably based on differences in karyotypes, morphology, molecular

198   sequencing, malaria sensitivity, immunological responses, and geographic isolation (Menezes et al. 2010). Despite

199   this, few specimens from any one study have come from *Aotus nigriceps* despite this species having one of the

200   largest ranges of any *Aotus* species. Moreover, the current taxonomic classification lumps *A. nigriceps* populations

201   from areas with considerably different elevations and from areas separated by significant river systems. Thus, the

202   possibility remains that further evolutionary and conservation management units may exist. Considering the distinct

203   differences in call types previously described between *Aotus* species and the use of quantitative acoustic sampling to

204   differentiate many other primate species, we anticipate that further analysis would prove useful in differentiating

205   population-level or species-level taxonomy.

206   Finally, *Aotus nigriceps* likely produce more than the three described call types since captive *Aotus* species

207   have exhibited larger vocal repertoires. In captive situations it is easier to record night monkeys at close distances

208   and calls can be induced in different situations, which could facilitate observation of a wider variety of call types.

209   We anticipate that with continued sampling these additional call types could also be recorded in the wild.

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211   **Conflict of Interest**

212   The authors declare that they have no conflict of interest.

213

214   **References**

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303 **Fig. 1** Field research conducted at Villa Carmen Biological Station (eight black-headed night monkey groups) and
304 CREES – Manu Learning Centre (three groups), in southeastern Peru. A mountain ridge separates the two field
305 stations (10.1km at nearest points)
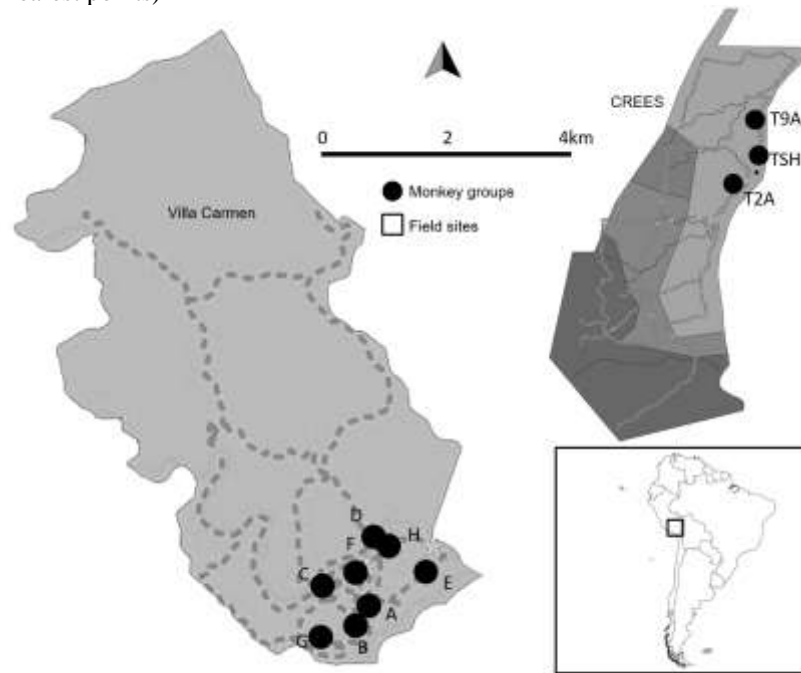
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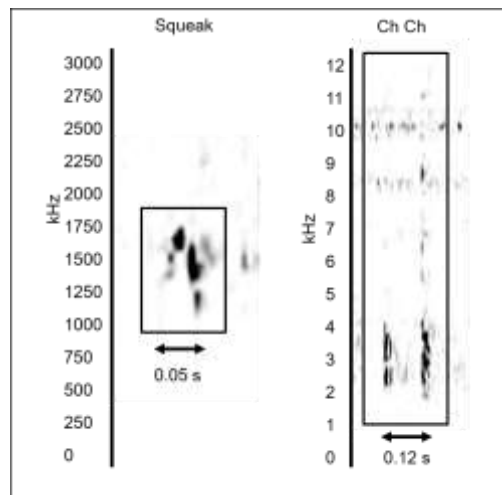309 **Fig. 2** Spectrogram representing both calls quantitatively analyzed in this study: the Squeak (left) and the Ch Ch
310 (right). Both calls have been previously described (Helenbrook et al. 2018). In this example, a duplicate Ch Ch is
311 depicted. The upper range of the spectrogram is faint, partially a result of minimizing backgound noise in the 7-8
312 kHz from insects

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317 **Fig 3** Boxplot plate of four descriptive acoustic measurements (e.g., duration, maximum frequency, minimum
318 frequency, and bandwidth) for the Squeak and Ch Ch across all groups. Median represented by solid box, box plot is
319 25-75% of call variability, and whiskers are minimum and maximum which do not signify significance, rather
320 distribution of values is depicted. Note that inter quartile ranges are depicted instead of standard error or deviation
321 because of the non-parametric nature. T2A, TSH, and T9A groups are from CREES while A-H are from Villa
322 Carmen. Significant differences illustrated in Table 3
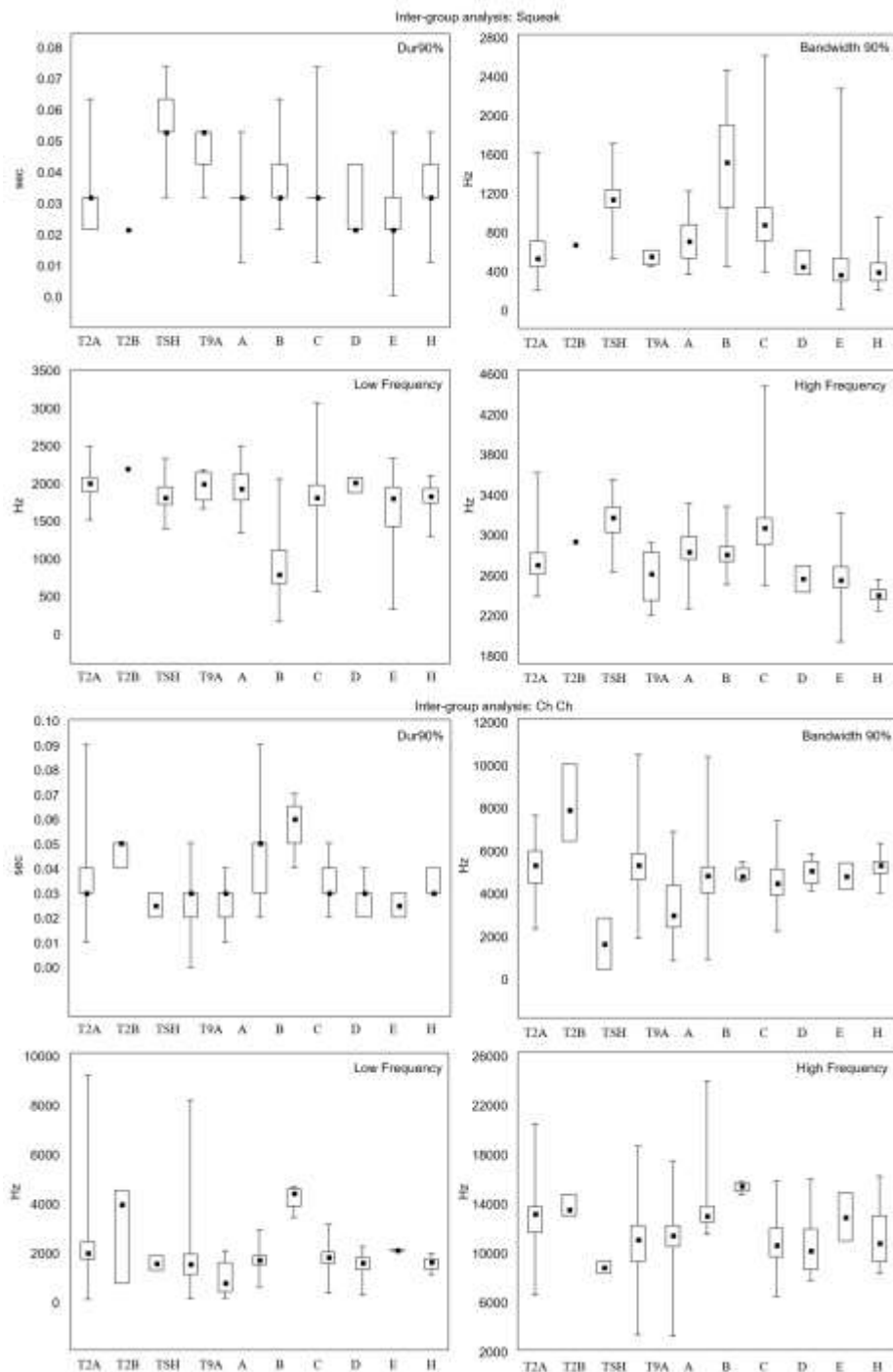
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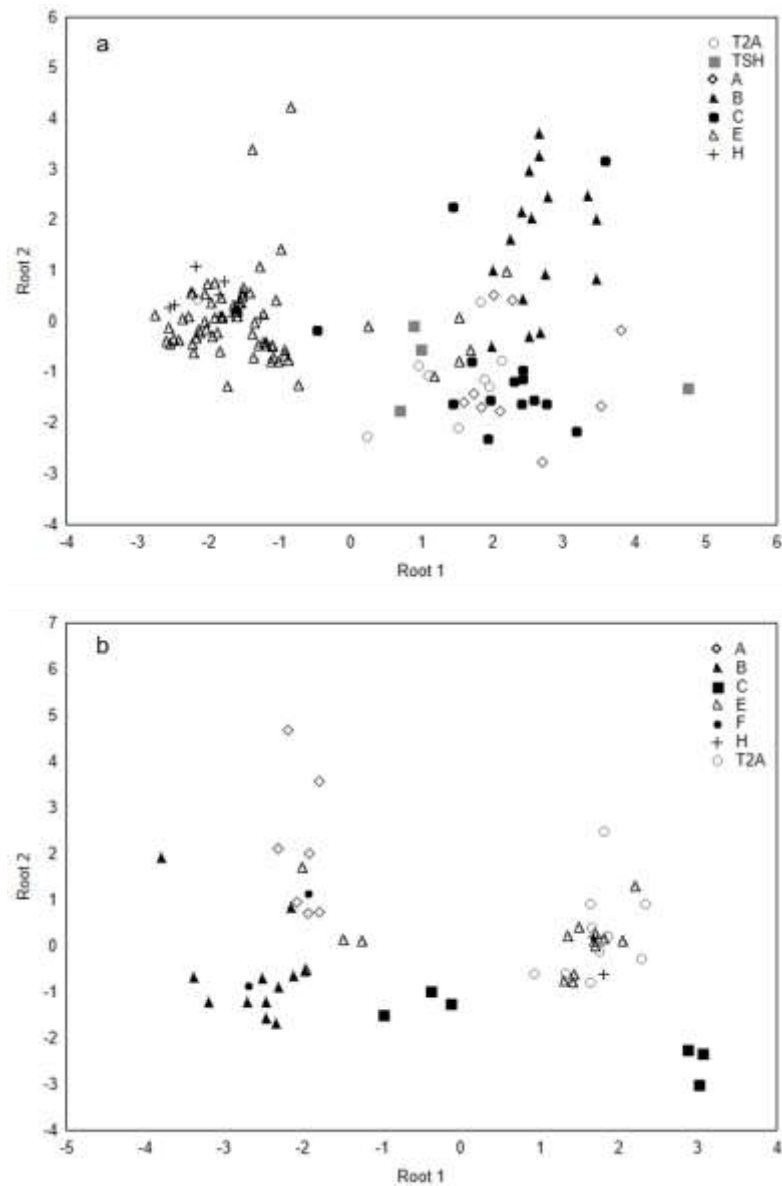326   **Fig 4** Canonical score scatterplot. The biplot axes are the first two canonical variables. These define the two
327   dimensions that provide maximum separation among groups. We used a 10-fold cross validation in which 90% of
328   the calls were randomly chosen to calculate discriminant functions. Here we present the results of the 10% excluded
329   for testing

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337   **Table 1** Evidence of primate acoustic variation at various taxonomic levels.

Primate species (N)	Individual	Group	Population	Subspecies	Species	Call description	Study
Cebidae, Callitrichinae (28)	-	-	-	-	Yes	Long call	Garbino 2018
Galago spp. (8)	-	-	-	-	Yes	Loud call	Zimmermann 1990
Galago alleni	-	-			Yes	Loud call	Ambrose 2003
Galago crassicaudatus, G. garnettii	-	-	-	-	Yes	Loud call	Masters 1991
Galago senegalensis, G. moholi	-	-	-	-	Yes	14 calls	Zimmermann 1988
Gorilla gorilla	Yes	-	-	-	-	8 calls	Salmi et al. 2014
Hylobates muelleri	Yes	-	No	-	-	Great call	Clink et al. 2017
Hylobates muelleri	Yes	-	Yes	-	-	Great call	Clink et al. 2018
Lepilemur spp. (10)	-	-	Yes	-	-	Loud call	Méndez-Cárdenas et al. 2008
Microcebus spp. (3)	-	-	-	-	Yes	Whistle, Purr, Chitter	Hending et al. 2017
Microcebus spp. (3)	-	-	-	-	Yes	Advertisement call	Braune et al. 2008
Microcebus murinus	-	-	Yes	-	-	Trill	Hafen et al. 1998
Tarsius spp. (4)	-	-	-	-	Yes	Loud call (Duet call)	Nietsch 1999
Varecia variegata	-	-	-	Yes	-	Loud call	Macedonia and Taylor 1985

338

339 **Table 2** Name and description of acoustic parameters measured. Not all parameters were included in discriminant
340 function analysis because of redundancy.

Parameters	Description
Low frequency (Hz)	The lower frequency bound of the selection
High frequency (Hz)	The upper frequency bound of the selection
Bandwidth 90%	The difference between the 5% and 95% frequencies
Energy (dB)	The total energy within the selection bounds
Dur90%	The difference between 5% and 95% times
Delta frequency (Hz)	The difference between the upper and lower frequency limits of the selection
Peak frequency	The frequency at which max power occurs within the selection
Delta time (s)	The difference between the begin and end time for the selection
Center frequency (Hz)	The frequency that divides the selection into two frequency intervals of equal energy
Q1 frequency (Hz)	The frequency that divides the selection into two frequency intervals containing 25% and 75% of the energy in the selection
Q3 frequency (Hz)	The frequency that divides the selection into two frequency intervals containing 75% and 25% of the energy in the selection
Max power	The maximum power in the selection.
Frequency 5%	The frequency that divides the selection into two frequency intervals containing 5% and 95% of the energy in the selection
Frequency 95%	The frequency that divides the selection into two frequency intervals containing 95% and 5% of the energy in the selection
Center time	The point in time at which the selection is divided into two time intervals of equal energy
Q1 time	The point in time that divides the selection into two time intervals containing 25% and 75% of the energy in the selection
Q3 time	The point in time that divides the selection into two time intervals containing 75% and 25% of the energy in the selection
IQR duration (s)	The difference between the 1st and 3rd quartile times
Time 5%	The point in time that divides the selection into two time intervals containing 5% and 95% of the energy in the selection
Time 95%	The point in time that divides the selection into two time intervals containing 95% and 5% of the energy in the selection
Max time	The first time in the selection at which a spectrogram point with power equal to max power occurs

372 Quantitative acoustic characteristics analyzed (Raven).

374 **Table 3** All *Aotus nigriceps* vocal measurements were found to have significant (p<0.001) inter-group differences.
375 Post-hoc analysis was conducted using multiple comparisons of mean ranks with Bonferroni adjustment. All
376 associations significant at p<0.05.
377

Call Measurement	Group	Significant Associations (p value)
Ch Ch		
Dur90%	A	C(0.00); D(0.04)
	B	C(0.00); D(0.01)
	C	E(0.00); F(0.01); T2A(0.00)
High frequency	A	C(0.00); D(0.02); T2A(0.00)
	B	C(0.00); D(0.04); T2A(0.00)
	C	E(0.00); F(0.00); H(0.01)
	D	E(0.01); F(0.01); T9A(0.05)
	E	T2A(0.00)
	F	T2A(0.00)
Low frequency	A	B(0.00); D(0.03); T2A(0.00)
	B	C(0.00); D(0.00); E(0.00); T2A(0.00)
	C	T2A(0.02)
Bandwidth 90%	A	B(0.00); E(0.00)
	B	C(0.00); E(0.00); F(0.00); H(0.00); T2A(0.00); TSH(0.00)
	E	T2A(0.00)
	TSH	T9A(0.04)
Squeak		
Dur90%	A	B(0.00); E(0.01); TSH(0.00)
	B	C(0.02); E(0.00); T2A(0.00); TSH(0.00)
	C	E(0.00); TSH(0.00)
	E	H(0.00); T2A(0.00); TSH(0.00); T9A(0.05)
	H	TSH(0.00)
	T2A	TSH(0.00)
High frequency	A	C(0.03); E(0.00); H(0.00); TSH(0.02)
	B	C(0.00); E(0.00); H(0.00); TSH(0.00)
	C	E(0.00); H(0.00); T2A (0.00)
	D	TSH(0.04)
	E	H(0.00); T2A(0.00); TSH(0.00)
	H	T2A(0.00); TSH(0.00)
Low frequency	A	B(0.00); E(0.00)
	B	C(0.00); D(0.01); E(0.00); H(0.00); T2A(0.00); TSH(0.00); T9A(0.00)
	C	T2A(0.00)
	E	T2A(0.00)
	H	T2A(0.00)
Bandwidth 90%	A	B(0.00); E(0.00); H(0.00); TSH(0.01)
	B	C(0.00); E(0.00); H(0.00); T2A(0.00)
	C	E(0.00); H(0.00); T2A(0.00)
	E	T2A(0.00); TSH(0.00)
	H	T2A(0.01); TSH(0.00)

429 **Table 4** Stepwise discriminant function analysis of all non-redundant measured acoustic parameters.
430

431	Call Measurement	Wilks' Lambda	Partial Lambda	p value
432	*Squeak*			
433	Bandwidth 90%	0.07	0.85	0.00
434	Energy	0.06	0.92	0.00
435	Dur90%	0.07	0.82	0.00
436	Frequency 95%	0.06	0.88	0.00
437	Max power	0.06	0.89	0.00
438	IQR duration	0.06	0.96	0.00
439	Center frequency	0.06	0.98	0.00
440	Q1 frequency	0.06	0.93	0.00
441	IQR bandwidth	0.06	0.90	0.00
442	Max time	0.06	0.88	0.00
443				
444	*Ch Ch*			
445	Energy	0.17	0.33	0.00
446	Dur90%	0.06	0.92	0.00
447	Bandwidth 90%	0.05	0.94	0.00
448	IQR duration	0.06	0.96	0.00
449	Frequency 95%	0.06	0.89	0.00
450	Center frequency	0.09	0.65	0.00
451	Delta frequency	0.07	0.77	0.00
452	Q1 frequency	0.07	0.79	0.00

453
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456
457 **Table 5** Discriminant function analysis correct classification utilizing 10-fold cross validation at group level.
458
459 Squeak alone

Group	% Correct	A	B	C	E	H	T2A	TSH
A	66.7	**6**	0	3	0	0	0	0
B	75.0	4	**12**	0	0	0	0	0
C	78.6	0	2	**11**	1	0	0	0
E	89.9	4	1	0	**62**	1	1	0
H	75.0	0	0	0	2	**6**	0	0
T2A	44.4	3	0	0	1	0	**4**	1
TSH	75.0	0	0	1	0	0	0	**3**

460 Ch Ch alone

Group	% Correct	A	B	C	E	F	H	T2A
A	100	**7**	0	0	0	0	0	0
B	83.3	2	**10**	0	0	0	0	0
C	83.3	0	1	**5**	0	0	0	0
E	66.7	3	1	0	**10**	0	0	1
F	0	1	1	0	0	**0**	0	0
H	0	0	0	0	1	0	**0**	1
T2A	90.9	0	0	0	1	0	0	**10**

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465 **Table 6** Mann Whitney results comparing group acoustic parameters between distant locations (~10km). Sample
466 size (Ch Ch: CREES 108 and VC 441) and (Squeak: CREES 136 and VC 1150). *All associations significant at
467 p<0.05.
468

Call Measurement	CREES Mean	VC Mean	U	P-value
Squeak				
Low Frequency	1896	1557	41532	0.00*
High Frequency	2905	2715	48217	0.00*
Bandwidth 90%	737	633	57946	0.00*
Energy (dB)	75	89	51471	0.00*
Dur90%	0.036	0.28	50231	0.00*
Peak Frequency	2577	2395	47752	0.00*
Delta Time	0.049	0.041	51588	0.00*
Center Frequency	2525	2370	40555	0.00*
Q1 Frequency	2341	2242	56039	0.00*
Q3 Frequency	2687	2477	37523	0.00*
Frequency 5%	2079	1951	71783	0.11
IQR Duration	0.02	0.015	51031	0.00*
Max Time	99	222	47045	0.00*
Ch Ch				
Low Frequency	2504	1497	12490	0.00*
High Frequency	12901	11268	13405	0.00*
Bandwidth 90%	4991	4263	16333	0.00*
Energy (dB)	112	88	11554	0.00*
Dur90%	0.03	0.03	23617	0.89
Peak Frequency	5904	5596	20661	0.03*
Delta Time	0.04	0.04	23239	0.70
Center Frequency	5703	5541	23653	0.91
Q1 Frequency	4585	4740	17581	0.00*
Q3 Frequency	6810	6235	18448	0.00*
Center Time	376	98	8585	0.00*
IQR Duration (s)	0.02	0.02	23220	0.68
Frequency 5%	3255	3215	20142	0.01*