Acoustic Parameters of Vocalizations in Neotropical Deer

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Previous studies of deer vocalizations have demonstrated the striking variety and conspicuousness of male rutting vocalizations, mainly in Old World polygynynous deer, especially different species of red deer (*Cervus*) and *Dama*. The vocalizations also vary a great deal from one species or subspecies to another. Acoustic analyses have shown that they provide important information about the size and quality of the caller which is used by other deer.

Deer vocalizations have been used to make a phylogeny of the family Cervidae (Capp *et al.*, 2008).

However, there are no recordings or analyses of the vocalizations of Central and South American deer, just some verbal descripciones.
### Courteship Calls

<table>
<thead>
<tr>
<th>Species</th>
<th>Call Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovis gmelini</td>
<td>Ausente</td>
</tr>
<tr>
<td>Moschus moschiferus</td>
<td>Ausente</td>
</tr>
<tr>
<td>Hydropotes inermis</td>
<td>Silbido</td>
</tr>
<tr>
<td>Capreolus capreolus</td>
<td>Gruñido rasposo</td>
</tr>
<tr>
<td>Alces alces</td>
<td>Gruñido</td>
</tr>
<tr>
<td>Odocoileus virginianus</td>
<td>Gruñido complejo</td>
</tr>
<tr>
<td>Rangifer tarandus</td>
<td>Gruñido</td>
</tr>
<tr>
<td>Muntiacus muntjak</td>
<td>Cacareo</td>
</tr>
<tr>
<td>Dama dama</td>
<td>Gemido</td>
</tr>
<tr>
<td>Cervus elephas</td>
<td>Rugido</td>
</tr>
<tr>
<td>Cervus corsicanus</td>
<td>Rugido</td>
</tr>
<tr>
<td>Cervus nippon</td>
<td>Gemido</td>
</tr>
<tr>
<td>Cervus canadensis</td>
<td>Clarin</td>
</tr>
</tbody>
</table>

*Species and Spectrograms Used in Making a Phylogeny*  
*Capp et al. 2008*
Neotropical Deer Vocalizations (especially Brocket Deer)

- Neotropical deer are known to produce bleats or grunts in various contexts:
  - Courtship in males
  - Searching for and answering fawns in females
  - Answers to mothers and care-seeking by fawns
- Species identification in the genus brocket deer genus *Mazama* is difficult, since there are currently 10 species recognized, from México to Argentina and Uruguay. Many are morphologically very similar.
Objectives

• Our first idea was to see whether these vocalizations could be used to identify species using differences in acoustic parameters.

• We were also interested in determining the functions of these calls, perhaps in species and individual identification and in courtship.
Methods

• Recordings were made at the Deer Research and Conservation Center (NUPECCE), FCAV, UNESP, Jaboticabal, SP, Brazil, and the Reserva Experimental Horco Molle in Tucuman, Argentina. Deer were allowed to interact with humans (in the case of hand-raised deer) or males with a female deer.

• Vocalizations were analyzed with Praat 5.1.37 using the Sound Edit menu to determine fundamental frequency (pitch) and duration parameters. Pitch parameters analyzed included F0 Mean, Maximum and Minimum in each call.

• The following species were recorded: *Mazama americana* (5 males, 4 females, 1 fawn), *M. gouazoubira* (4 males, 3 females, 1 fawn), *M. nemorivaga* (3 males), *M. nana* (1 male), *Odocoileus virginianus* (1 male), *Hippocamellus antisensis* (1 male) and *Blastocerus dichotomus* (1 male).
For the 3 species of brocket deer for which we had data on more than one animal, the data were analyzed using a linear mixed model with the program R. Fixed effects were species, sex and age and random effects were individual, individual call, and year of recording.
The Species

Red Brocket Deer
*Mazama americana*
Male *M. americana*

Female de *M. americana*
Brown or gray brocket deer

* Mazama gouazoubira *
Female *M. gouazoubira*

Male *M. gouazoubira*
Amazonian Brown Brocket Deer *Mazama nemorivaga*
Male *M. nemorivaga*
Dwarf Brocket Deer *Mazama nana*
Male Mazama nana
White-tailed Deer
*Odocoileus virginianus*
Male *Odocoileus virginianus*
Taruka
Hippocamellus antisensis
Male *Hippocamellus antisensis*
Marsh Deer
*Blastocerus dichotomus*
Male *Blastocerus dichotomus*
Brown brocket fawn
Red brocket fawn (distress call)
General Differences in Acoustic Parameters in Males in the Seven Species: Duration
General Differences in Acoustic Parameters in Males in the Seven Species: Frequency
• Duration was the parameter that provided the greatest number of differences. The duration of calls was significantly greater in females than in males (in red and brown brockets)
• The duration of bleats in male Amazonian brockets is greater than that of brown brockets (p=.008). There is no difference between red and brown brockets.
Duration of Calls in Three species of Brocket Deer

Duration (Sec)

<table>
<thead>
<tr>
<th>Species</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mazama nemorivaga</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mazama americana</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mazama gouazoubira</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Statistical Analysis of Main effects in Red, Brown and Amazonian Brocket Deer

• Mean frequencies are somewhat higher in red brockets than in brown brockets (p=.089), but do not reach significance. There is no difference with Amazonian brown brockets.

• Maximum frequencies (F0max) showed the same results as F0 mean. Minimum frequencies showed no differences.

• Mean frequencies (F0 mean) are higher in juveniles than in adults (p=.0014).
Mean Frequency of Calls in Three species of Brocket Deer
Adults and Fawns

- There are significant differences between adults and fawns in both red and brown brockets (minimum frequency in brown brockets and all frequency parameters in red brockets), but there were only 2 fawns.
Discussion:
Differences among Species and Individuals

- There are species differences in acoustic parameters. However, there is no way to differentiate reliably among different species of brocket deer. There is too much variability in individuals and in calls.
- Since individuals are distinguishable by their calls, they could serve as “signature calls”, in individual recognition.
- In species such as fallow deer (*Dama dama*), fawns can recognize the calls of their mothers and use them to come out of hiding.
In classical papers on red deer and amphibians, it was claimed that the Fundamental Frequency (F0) was correlated with body size. Many papers since have shown that F0 is independent of body size when considering different species.

These results support the independence of F0 and body size. Within Mazama, the largest species (red brocket) has the highest F0, the smallest species (dwarf brocket) has an intermediate F0 and the other 2 species studied, which are of the same size and intermediate to the other two, had the lowest F0s.

The largest genus and species studied (marsh deer) had one of the higher frequencies. The white tail had the lowest F0, and the other fairly large species (taruka) had the highest F0.
Functions of the Male Calls

• Since the males produce their grunts and bleats during sexual interactions, these calls should probably be considered courtship calls.

• We suggest that they may serve to stimulate the females, and, in some species, may be used by females to choose a mate.

• In brocket deer, however, Roldan & Carranza indicate that female choice is usually nonexistent because of the territorial nature of these species, where a female only encounters one male during her estrus.

• All males do not vocalize during courtship. In captivity anyway, vocalizations are characteristic of certain males and the majority do not vocalize.
Conclusions

- Males of 4 species of brocket deer, white tailed deer, marsh deer, and taruka produce similar short courtship calls, which differ in their acoustic parameters (Duration, F0 mean, F0 min y F0 max).
- Females of red and brown brockets have significantly longer calls than males; fawns have significantly higher frequencies.
- There are significant differences in males in Duration between brown and Amazonian brown brockets; and differences in frequency that almost reach significance (F0 promedio, F0 min y F0 max between red and brown brockets).
- The differences are not enough to be of taxonomic significance.
- F0 is not correlated with body size.
Acknowledgments

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