THE VOCAL SIGNATURE OF THE MALE NORTHERN ELEPHANT SEAL

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1. INTRODUCTION

In the late 1800s, the northern elephant seal (*Mirounga angustirostris*) was extensively hunted for blubber. Consequently, the population was reduced to fewer than 100 individuals located on Guadalupe Island off the coast of Baja California. Since then, the northern elephant seal population has steadily recovered and grown to more than 175,000 individuals. This species, therefore, provides an opportunity for researchers to better understand the lasting effects of a severe population bottleneck on the communication and behavior of a recovering mammalian species.

Northern elephant seals breed annually during the winter months at islands and mainland rookeries along the western coast of the United States and Mexico. These animals maintain a highly polygynous breeding system in which adult males establish dominance hierarchies that determine access to estrous females. Males typically arrive in early December and establish their dominance position within the colony and stay until mid-March, a period extending over three months without access to food or water. Competition between males is intense, with only a small subset of individuals gaining access to breeding females. While dominance relationships may be established through physical contact, these hierarchies are maintained through the use of stereotypic threat displays that include distinctive vocalizations (Bartholomew and Collias, 1962; Le Boeuf and Peterson, 1969) and associated visual and seismic cues. These complex displays play an important role in settling otherwise costly interactions between competing males, as stereotyped acoustic signals often elicit appropriate behavioral responses from spatially separated individuals without physical contact.

The acoustic threat displays of these males have been described as 'an extremely loud resonant clapping sound with a metallic quality which suggests the exhaust noise made by a diesel engine' (Le Boeuf and Peterson, 1969). While many early accounts of the temporal features of these calls define them as containing short pulses with regular spacing (Shipley, 1981) and some variations of this call type have been noted, no study to date has attempted to describe in detail the various call types within breeding populations. Additionally, while several studies have investigated the function of these signals in maintaining social structure (Bartholomew and Collias, 1961; Sandegren, 1976; Shipley, 1981), the manner in which these vocalizations convey information to receivers remains unknown.

The aim of this study is to: (1) describe the variability in the stereotypic calls of male northern elephant seals within an established breeding rookery; (2) examine the acoustic characteristics of individual male threat vocalizations to evaluate whether they are stable within and across breeding seasons; and (3) evaluate the spectral and temporal features of these signals for their dependence on body size and dominance rank. These objectives, particularly (3), enable an assessment of whether honest signaling serves to communicate resource holding potential in this species, or alternatively, whether it is likely that these calls serve as an individual signature that males use to identify one another through learned association.

2. METHODS

More than 200 sub-adult and adult male elephant seals were identified and observed between the months of December and March over two consecutive breeding seasons at the Año Nuevo Rookery in San Mateo County, California, USA, located 60 miles south of San Francisco. To identify focal males within the breeding season, males were temporarily marked using black hair dye. A subset of individuals were opportunistically tagged with numeric plastic roto-tags inserted into the hind flipper to facilitate tracking between seasons. GPS coordinates were recorded daily for the location of each focal male at the main study site at Año Nuevo to assess movement patterns and rival familiarity during each of the two breeding seasons. Dyadic interactions between breeding males were opportunistically scored throughout the season, and the outcome of these interactions fed into a linear ranking system to quantitatively evaluate the dominance level of each individual. Body size parameters for focal individuals were derived through repeated photometric sampling. High-quality, complete calling bouts were digitally recorded and analyzed from sub-adult and adult males to evaluate spectral, temporal, and sound pressure characteristics across both seasons. These call qualities were evaluated for dependence on body size and rank in order to assess the possible role of honest signaling. Calls from a subset of individuals that were repeatedly sampled within and across seasons were investigated to determine whether the calls of

male northern elephant seals are individually reliable and easily discernible from one another.

3. RESULTS

Several call types with varying structural and temporal patterns were identified and described at the Año Nuevo breeding colony. These distinctive vocal signatures were present across age-classes, and were not segregated by the size or dominance status of the caller. The lack of obvious correlations between the call type displayed by an individual and his resource holding ability was consistent with earlier observations that the outcome of a vocal challenge could not be predicted on the basis of call parameters alone.

The results of the individual acoustic analysis did confirm a significant divergence among sexually mature males, even among those males sharing the same call type. The calls of individuals displayed certain unique temporal, spectral, and phrasing patterns that were easily recognizable and statistically reliable. These individual differences were retained across multiple years.

4. DISCUSSION

By their very nature elephant seals are an ideal mammalian system for studies of vocal communication, as they congregate in large, easily accessible groups each year in predictable locations and are relatively undisturbed by human presence. We have found that the calls of male northern elephant seals are individually unique; with the structural and temporal patterns of the call being easily recognizable to even the human ear. In this species, where individuals spend a significant amount of time fasting during the breeding season and thus need to conserve energy, selective pressures for avoiding harm and conserving energy would favor the accurate assessment of dominance stature between competing males. Analysis of the calls indicates that there are no obvious honest indicators of resource holding potential within the construct of the vocalization, lending weight to the hypothesis that these signals serve as reliable vocal signatures that males use to identify one another during the breeding season. Males may be learning the individually unique vocal signatures of their rivals through experience and using this information in decision-making regarding when to engage in competitive interactions for access to females. The opportunity we have to study this species at this field site allows us to pursue questions about the role of associative learning in animal communication by combining both observational and experimental approaches.

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