Pack-specific vocal dialects in African wild dogs

SCIENTIFIC REPORT

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Organisations: GAME Lab (James Cook University) & IBREAM

Location: Pretoria, South Africa
Date: May 30th, 2023
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Version: 1



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Image cover page: (Stribbling, 2022)
Image title page: (Kruger-2-Kalahari, 2022)



Abbreviations

AWD	African Wild Dog
CCP	Carnivore Conservation Programme
CCI	Cheetah Conservation Institute
EAZA	European Association of Zoos and Aquaria
EWT	Endangered Wildlife Trust
IUCN	The International Union for Conservation of Nature
NGO	Non-Government Organisation
NPO	Non Profit Organisation
TAG	Taxon Advisory Group

Glossary

Conspecifics	An individual of the same species
Heterospecific	An individual of a different species
Prevalence	The proportion of a population who have a specific characteristic in a given period

Preface

The present report is the outcome of the graduation research of a fourth-year student in the Animal Husbandry Course at the Inholland University of Applied Sciences, The Netherlands. The objective of the research was to determine whether pack-specific vocalizations differ among packs of geographically separate captive African wild dogs.

This research formed part of the PhD research of Pia Riddell under the guidance of Assoc. Prof. Damien Paris of the GAME Lab (James Cook University, Australia) and Assoc. Prof. Monique Paris the Institute for Breeding Rare and Endangered African Mammals (IBREAM, UK). I want to thank very much Pia Riddell, Damien Paris, and Monique Paris for giving me this extraordinary opportunity to conduct this research and for their guidance during the project. This experience convinced me that I want to pursue animal research with wild animals. I would like to additionally thank Leontine Wouters-Wijnands and Nicole van der Marel for their guidance during this research.

I am also grateful to Femke van der Berghe for allowing me to use her data from her studies in 2014 for my analysis and thank Bothongo Rhino and Lion Nature Reserve for letting me record their African wild dogs.

Pien ten Have, Pretoria, South Africa, May 30th, 2023, 19:00h

Summary

This report provides research on pack-specific differences in the vocalisation use of African wild dogs (*Lycaon pictus*) in captive facilities within South Africa and the United States of America. This research was done for and it forms part of the PhD research of Ms Pia Riddell under the supervision of the staff from the GAME Lab (James Cook University, Townsville, Australia) and the Institute for Breeding Rare and Endangered African Mammals (IBREAM, Edinburgh, UK). The PhD started in 2020 and aims: *"… to measure improvements in hormones, immunity, behaviour and vocalisations in response to appeasing pheromones treatment to improve metapopulation management outcome during translocation and artificial pack formations of free-ranging African wild dogs."* This research provides support to the PhD project by advancing the understanding of how vocalizations are used by African wild dogs to communicate with packmates.

Vocalizations can be indicators of well-being and social cohesion in packs of social species. The hypothesis for this research is that the packs of African wild dogs use vocalisation dialects that differ between packs held in geographically separate captive facilities. By understanding different dialects of packs, a better understanding of their emotional state and well-being can be comprehended. This can lead to changes in management practices that improve pack bonding and social cohesion.

The vocalisations used in this study were recorded at three institutes, one in South Africa and two in the USA. The South African pack was located at the Bothongo Lion and Rhino Nature Reserve, Krugersdorp (BOT; n=15) and the two American packs were located at Albuquerque Biopark Zoo, Albuquerque (ABQ; n=3), and Brookfield Zoo, Chicago (BRK; n=4). The USA packs were recorded via video recording using a Sony FDR-AX100E 4K hand-held digital video camera during Femke van den Berghe's PhD research in 2014. Vocalisations from the BOT pack were recorded using a unidirectional Rhodes shotgun microphone connected directly to the Zoom H-8 field recorder and a Sony FDR-AX100E 4K hand-held digital video camera.

Data was tested for normal distribution and each specific vocalisation was tested for significance between packs using either repeated measures ANOVA with a posthoc Tukey test or the Friedman test depending on the results of normalisation measures. For significance $P \leq 0.05$. Results showed no significant differences between the packs and each of the vocalisations measured. Interestingly, graphs of the total vocalisations for each pack showed that the BRK pack tended to use a much lower rate of vocalisation (total vocalisations = 56) than the BOT (total vocalisations = 333) or ABQ (total vocalisations = 573) packs. A Kruskall-Wallis test was used to determine whether there was a difference in the means of the total number of vocalisations recorded for each pack over the observation period. A significant difference in the mean of the total pack vocalisations was found between ABQ and BRK (P=0.004). When each vocalisation category was compared across each pack it was observed that ABQ used a larger number of twitters compared to either of the two other packs and BOT used whimpers and whines at a much higher rate than the other packs.

This study showed interesting outcomes to the statistical analysis. Finding a significance between two packs could mean there's a dialect within a pack's use of vocalisations and could be a substantial barrier to artificial pack formation. Both having a low sample size and a big variation in the detected vocalisations were the biggest influence on the outcome of said analysis. Further research can be done with a bigger sample size to increase the collected data and get a more accurate result on whether African wild dogs use pack-specific dialects.

Samenvatting

Dit rapport geeft het onderzoek naar roedel specifieke verschillen in het vocalisatiegebruik van Afrikaanse wilde honden (*Lycaon pictus*) in gevangenschap in Zuid-Afrika en de Verenigde Staten weer. Het onderzoek is uitgevoerd voor en maakt deel uit van het promotieonderzoek van mevr. Pia Riddell onder supervisie van de medewerkers van het GAME Lab (James Cook University, Townsville, Australië) en het Institute for Breeding Rare and Endangered African Mammals (IBREAM, Edinburgh, UK). Het doctoraat startte in 2020 en heeft als doel: "... *het meten van verbeteringen in hormonen, immuniteit, gedrag en vocalisaties als reactie op kalmerende feromonenbehandeling om de resultaten van meta-populatiebeheer te verbeteren tijdens translocatie en kunstmatige roedelformaties van loslopende Afrikaanse wilde honden.*" Dit onderzoek ondersteunt het promotieonderzoek door meer inzicht te krijgen in hoe vocalisaties worden gebruikt door Afrikaanse wilde honden om te communiceren met roedelgenoten.

Vocalisaties kunnen indicatoren zijn van welzijn en sociale cohesie in roedels van sociale soorten. De hypothese voor dit onderzoek is dat roedels Afrikaanse wilde honden vocalisatiedialecten gebruiken die verschillen tussen roedels die in gevangenschap worden gehouden. Door verschillende dialecten van roedels te begrijpen, kan hun emotionele toestand en welzijn beter worden begrepen. Dit kan leiden tot veranderingen in managementmethoden die de hechting van de roedel en de sociale cohesie verbeteren.

De vocalisaties onderzocht in dit onderzoek zijn opgenomen bij de drie instituten, één in Zuid-Afrika en twee in de Verenigde Staten. De Zuid-Afrikaanse roedel is gelegen aan de Bothongo Leeuw en Neushoorn natuurgebied, Krugersdorp (BOT; n=15) en de twee Amerikaanse roedels waren gelegen in Albuquerque Bioparc Zoo, Albuquerque (ABQ; n=3), en Brookfield Zoo in Chicago (BRK; n=4). De Verenigde Staten roedels zijn opgenomen via de video-opname met behulp van een Sony FDR-AX100E 4K draagbare digitale video camera tijdens Femke van den Berghe's promotie onderzoek in 2014. Vocalisaties van de BOT roedel zijn opgenomen met een unidirectionele Rhodos shotgun microfoon rechtstreeks aangesloten op de Zoom H-8 field recorder en tevens een Sony FDR-AX100E 4K draagbare digitale video camera.

Gegevens zijn getest op een normale verdeling en elke specifieke vocalisatie is getest op significantie tussen roedels met behulp van repeated measures ANOVA met een posthoc Tukey-test of de Friedman-test, afhankelijk van de resultaten van normalisatie uitkomst. Voor significantie $P \leq 0{,}05$. De resultaten toonden geen significante verschillen tussen roedels en elk van de gemeten vocalisaties. Opvallend is dat de grafieken van de totale vocalisaties voor elke roedel lieten zien dat de BRK roedel minder verschillende soorten vocalisaties gebruikte (totaal vocalisaties = 56) dan de BOT (totale vocalisaties = 333) of ABQ (totale vocalisaties = 573) roedels. Een Kruskall-Wallis-test is gebruikt om te bepalen of een verschil was in het gemiddelde van het totale aantal geregistreerde vocalisaties voor elke roedel gedurende de observatieperiode. Een significant verschil is gevonden in het gemiddelde van de totale roedelgeluiden tussen ABQ en BRK (P=0,004). In de vergelijking van elke vocalisatiecategorie voor elke roedel, werd waargenomen dat de ABQ roedel een groter aantal twitters gebruikte in vergelijking met elk van de twee andere roedels en dat de BOT roedel veel sneller 'whimpers' en 'whines' gebruikte dan de andere roedels.

Deze studie liet interessante resultaten uit de statistische analyse zien. Het vinden van een significantie tussen twee roedels kan betekenen dat de roedels een dialect binnen hun gebruik van vocalisaties hebben en kan een aanzienlijke barrière voor kunstmatige roedelvorming vormen. Zowel het hebben van een lage hoeveelheid roedels in de steekproef en als de grote variatie in de waargenomen vocalisaties, hadden grote invloed op de uitkomst van de analyse. Verder onderzoek kan gedaan worden door meer roedels te onderzoeken en een meer nauwkeurig resultaat te creëren of Afrikaanse wilde honden gebruiken pack-specifieke dialecten.

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1. Introduction

This study formed part of the PhD research of Pia Riddell under the supervision of staff from the GAME Lab (James Cook University, Australia) and the Institute for Breeding Rare and Endangered African Mammals (IBREAM, UK). The PhD started in 2020 and aims: *"… to measure improvements in hormones, immunity, behaviour and vocalisations in response to appeasing pheromones treatment to improve metapopulation management outcome during translocation and artificial pack formations of free-ranging African wild dogs."* This study provided support to the PhD by enhancing the understanding of individualisation and pack use of African wild dog vocalisations.

The African wild dog (*Lycaon pictus*) is a socially complex carnivore that is endangered according to the IUCN Red List, with 6600 individuals in the wild. Currently, free-ranging African wild dog populations are found mainly within protected areas such as game reserves and conservation parks throughout Southern Africa and southern regions of Eastern Africa, though wild populations also exist in reduced numbers outside protected zones. The decrease in numbers is caused by loss of prey populations, infectious diseases, habitat loss and fragmentation, accidental snaring, small population sizes, and conflict with humans - particularly interaction with livestock and game farmers as well as diseases carried by domestic dogs. The African wild dog is an efficient predator that plays an important role in maintaining ecosystem balance. Therefore, dramatic changes in African wild dog numbers can significantly impact local biodiversity.

Vocalizations can indicate well-being and social cohesion in social species. Communication among African wild dogs is hypothesized to consist of pack-specific dialects. By understanding different dialects of packs, their emotional state and well-being can be better understood. This can lead to changes in management practices that improve pack bonding and social cohesion. Through this study, IBREAM & the GAME Lab can help managers of captive and wild African wild dogs develop improved conservation strategies to aid in reversing the decline of this endangered population. This work will help develop a tool which can be used to measure the welfare of AWDs during conservation initiatives. If found that vocalisations are used differently between packs, this could influence how quickly social cohesion is achieved during artificial bonding events as animals may need to adjust vocalisations to effectively communicate. Furthermore, a period of learning individual calls by pack members may be necessary to facilitate social bonds.

This study aims to determine whether vocalizations differ among African wild dog packs to advance the understanding of how vocalizations are used by African wild dogs to communicate with packmates. This can be addressed through three objectives, (i) determine the composition, and social structure/hierarchy of an African wild dog pack, (ii) characterize the baseline range and quantity of vocalisations within each pack, and (iii) compare the range and quantity of vocalizations between the three packs. With these objectives, a main question was formulated: *"How do different packs of African wild dogs use vocalisations?".*

These research objectives and the main questions proposed above were tested by measuring the vocalisations of three packs of African wild dogs located within South Africa and the United States of America over three days within their enclosures. Vocalisations were then visualised and counted as total counts of the specific vocalisations proposed by Robbins (2000). Statistical analysis was then performed to determine whether there were differences in how packs used specific vocalisations and the rate of total vocalisations per day. Additionally, observation of trends was visualised of the specific total vocalisation use between packs to make recommendations for future research arising from this pilot study.

2. Literature

In this section, the literature is reviewed. It describes the African wild dog (Lycaon pictus), its social structure, cooperative breeding/rearing/hunting strategy, its conservation status, distribution & threats, the current conservation strategies for the species and their limitations. Additionally, the vocal communication and dialects in socially complex species including canids are described.

2.1. Relevant biology of the African wild dog

The African wild dog (AWD; *Lycaon pictus*) is a medium-sized canid weighing 20 to 25 kg (Creel & Creel, 1995; Bucci, Nicholson & Krausman, 2022). They have a lean posture and have large, rounded ears covered in dark short hair. The dogs have long and slender legs with four toes, differentiating them from other canids. Each animal has a distinctly unique coat. It is a colouration of mottled black, white and yellow-brown as seen in the figures (Fig. 1a & b; Bouley et al., 2021; Bucci, Nicholson & Krausman, 2022). They have a characteristic dark muzzle with a stripe extending between the ears and a lightly coloured forehead (Bucci, Nicholson & Krausman, 2022). AWDs mostly hunt ungulates ranging from 15 to 200 kg (Creel & Creel, 1995; Bucci, Nicholson & Krausman, 2022). Their prey selection depends on the abundance in an area and typically consists of species such as Impala (*Aepyceros melampus*), wildebeest (*Connochaetes taurinus*), Steenbok (*Raphicerus campestris*), Duiker (*tribe Cephalophini*), Greater Kudu (*Tragelaphus strepsiceros*), and Thomson's gazelle (*Eudorcas thomsonii*; Kruuk, 1967; Creel & Creel 2002; Woodroffe & Sillero-Zubric, 2020).



Figure 1. a) African wild dog (Lycaon pictus) pack from behind and b) front-on (Kruger-2-Kalahari, 2022).

2.2. Social structure and cooperative breeding/rearing/ hunting strategy

African wild dog packs consist of an alpha pair, which almost exclusively breeds once a year (Creel et al, 1993; Creel & Creel, 2002; Darnell, 2014). The subordinates consist mostly of juveniles from previous litters and adult males and females related to the breeding pair (Creel & Creel, 2002; Creel et al, 1993; Holekamp & Sawdy, 2019). This is also known as the parental family structure (Holekamp & Sawdy, 2019). Their breeding system is similar to those of grey wolves *(Canis Lupus)* and meerkats *(Suricata suricatta)*. Subordinate females seldom bear pups. The help of subordinate animals is needed to hunt for food, and help feed and raise the litter. The incidence of a pack simultaneously raising multiple litters to different females is rare, due to a doubling of effort needed to hunt for sufficient food to raise both litters (Fuller et al., 1992; Van den Berghe et al., 2012; Darnell, 2014 Castelló, 2018). When a litter is born to a subordinate female, the dominant female will often kill or steal the subordinate's pups (Robbins and McCreery, 2000; Thomas et al., 2006). The AWD is a social carnivore living in large packs (Maddock & Mills, 1994; De Villiers et al., 2003). Packsize can range from three to 20 mature members, and up to 44 individuals when including pups and yearlings in counts (Maddock & Mills, 1994; Creel & Creel, 1995).

Juvenile females and males usually disperse from their natal packs as single-sex groups to start their own (Woodroffe & Ginsberg, 1997a in Woodroffe, Ginsberg & Macdonald, 1997d; Creel & Creel, 2002). When dispersing from a pack, the genetic pool of the wild dogs increases. This causes, as Creel & Creel stated in their research (2002), "*immigration and emigration which may produce a complex web of genetic relatedness within packs"*. The same goes for the complex social structure (Creel & Creel, 2002). The destination and timing of dispersal are dependent on the relatedness of a pack. When the relatedness to the alpha pair is low, the individuals will disperse less far than when relatedness is high (Bucci, Nicholson & Krausman, 2022). AWD females and males disperse at different ages. Females start to disperse at the age of 13 months and males at the age of 33 to 37 months respectively (Behr, 2020). AWD packs have been found to disperse up to 35 kilometres in four hours and up to 54 kilometres in 24 hours (Cozzi et al., 2020; Bucci, Nicholson & Krausman, 2022).

AWDs have tremendous endurance running at speeds of 37 mph for three miles (60 km/h) or more to pursue prey. Their long legs and large lungs help them run long distances without becoming fatigued. If they were to get tired, they have a social mechanism to keep up with their prey. During the hunt, one or two dogs are at the front of the running group chasing the prey. When they tire, the wild dogs switch to the next one or two dogs to keep the hunt alive (Hubel et al., 2016a; Hubel et al., 2016b). By out-manoeuvring the prey the dogs can bring down larger antelope with relative ease. Furthermore, Wild dogs are coursing predators, meaning that they do not select their prey until after the chase has begun (Kruuk, 1967). Communication is very important during the hunt for prey choice, where to run to, and communicating when the prey is killed (Woodroffe & Ginsberg, 1997a in Woodroffe, Ginsberg & Macdonald, 1997d; Hubel et al., 2016a). They decide on whether they want big, small, old, or young prey, depending on the pack size. The bigger the pack, the bigger size of prey they can take down and is required to feed all individuals within the pack (Woodroffe & Ginsberg, 1997a in Woodroffe, Ginsberg & Macdonald, 1997d; Hubel et al., 2016a).

2.3. African wild dog conservation status, distribution and threats

Currently, free-ranging wild dog populations are found mainly within protected areas such as game reserves and conservation parks throughout Southern Africa and southern regions of Eastern Africa, though wild populations also exist in reduced numbers outside protected zones (IUCN/SSC, 2007). According to The International Union for Conservation of Nature (IUCN), the AWD is extant in 19 African countries, being: Angola, Benin, Botswana, Burkina Faso, Central African Republic, Chad, Ethiopia, Kenya, Malawi, Mozambique, Namibia, Niger, Senegal, South Africa, South Sudan, Sudan, United Republic of Tanzania, Zambia, and Zimbabwe. The species is possibly extinct in eight African countries and is confirmed extinct in 11: Burundi, Cameroon, Egypt, Eritrea, Eswatini, Gabon, Gambia, Ghana, Mauritania, Rwanda, and Sierra Leone (Woodroffe & Sillero-Zubiri, 2020). AWDs occupy thick shrub woodlands in southern Africa (Fuller et al.,1992; Mills, 1998; Leigh, 2005). Lindsey, Du Toit & Mills. (2004) found, based on a typical prey profile, the predicted territory for a pack (*n*=10, five mature wild dogs and one litter of five) in eastern South Africa to be 144 km^2 respectively.

The species is endangered with approximately 1400 free-ranging mature individuals living in the wild and 6600 free-ranging individuals in total (Woodroffe & Sillero-Zubiri, 2020). The range of AWD has declined immensely in the last 50 years (Fig. 2 a & b). This is because of several threats such as loss of prey populations, infectious diseases, habitat loss and fragmentation, accidental snaring, small population sizes, and conflict with humans - particularly interaction with livestock and game farmers, as well as diseases carried by domestic dogs (Van den Berghe et al., 2012; Murray et al., 2023). The African wild dog is an efficient predator that plays an important role in maintaining ecosystem balance. Thus, dramatic changes in wild dog numbers can significantly impact local biodiversity (Rafferty, 2019).

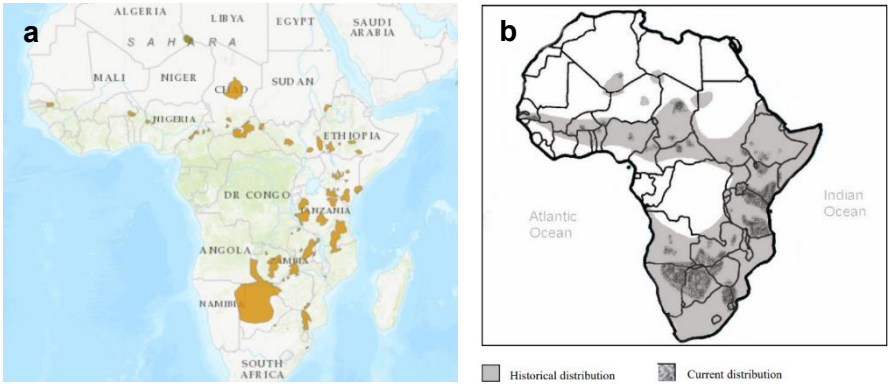


Figure 2. a) Geographic range of the African wild dog in Africa in 2020 (Woodroffe & Sillero-Zubiri, 2020), and b) the historical distribution (Woodroffe, 1997).

Within Africa, poaching is still widely used as a method to capture wild animals for food or to sell specific body parts for luxury items or traditional medicine (Mudumba et al., 2021). Snaring is a method of poaching where wild animals are caught using wire traps (Ray et al, 2013). Snaring influences the prey populations available to top-order carnivores (Mudumba et al., 2021). The snares are mostly placed to capture ungulates but accidentally cause 10% of adult deaths in wild dog populations living inside protected areas (Woodroffe & Ginsberg, 1997b in Woodroffe, Ginsberg & Macdonald, 1997d). In South Africa, human-caused mortality of radio-collared wild dogs (i.e. shooting, snaring, and road kills) accounts for 30% of mortality (Woodroffe et al., 2007).

The AWD coexists in its territory with cheetahs *(Acinonyx jubatus),* lions *(Panthera leo)*, and hyenas *(Crocuta Crocuta*; Van der Weyde, 2013; Bucci, Nicholson & Krausman, 2022). Hyenas are the main predator and are reported to steal prey (Van der Weyde, 2013; Bucci, Nicholson & Krausman, 2022). AWDs can fend off hyenas, but not lions from their kills. Lions cause significant mortality of juvenile and adult AWDs (33% in Kruger National Park; Bucci, Nicholson & Krausman, 2022). AWDs do poorly in an area with a high density of these predators (Van der Weyde, 2013; Bucci, Nicholson & Krausman, 2022), and typically respond by moving to areas of lower predator density or changing their hunting times (Van der Weyde, 2013). Predator avoidance and reduced available natural land increase the chance of encountering human-wildlife conflict (Creel and Creel, 1996; Bucci, Nicholson & Krausman, 2022).

Furthermore, canids like AWDs are also susceptible to multiple diseases, such as parvovirus (*Canine parvovirus*), Rabies, and canine distemper virus (CDV; Creel et al., 1995; Woodroffe et al. 2012; Bucci, Nicholson & Krausman, 2022). Parvovirus causes intestinal damage (Evermann & Kennedy, 2011). Rabies is caused by the rhabdovirus (Burrow, 1992), and CDV is caused by the paramyxovirus (Evermann & Kennedy, 2011). Parvovirus, CDV, and Rabies have caused the largest population declines in different AWD packs across their distribution (CDV and Rabies - Gascoyne et al., 1993; Parvovirus - Woodroffe et al. 2012). At times, the impact of the disease has shown to be major, wiping out whole packs such as the Serengeti wipe out (Jackson et al., 2019). Additionally, because habitat fragmentation drives interaction with humans, AWDs are exposed to these deadly pathogens from contact with domestic dogs (Woodroffe et al. 2012; Ray et al., 2013).

2.4. Current conservation strategies for the species and their limitations

Current conservation strategies for African wild dogs are undertaken at several different levels including by zoos, non-government organisations (NGOs), non-profit organisations (NPOs), private reserves, and state and national governments. The Endangered Wildlife Trust (EWT) is one of these organisations which has been active with the Carnivore Conservation Programme (CCP) in X. Similar actions are done by the Cheetah Conservation Institute (CCI). CCI works on field projects, conservation programs and with government wildlife authorities to support and promote activities and interventions that effectively address the threats to African wild dogs and other carnivores (Cheetah Conservation Initiative, 2022). The EWT conducted a census of the population of Wild Dogs occurring outside of protected areas. This is to replicate the research conducted by Lindsey, Du Toit & Mills in 2004 (Lindsey & Davies-Mostert, 2009).

Woodroffe and Ginsberg (1997c) wrote a Status Survey and Conservation Action Plan on the African wild dog. Such an Action Plan assesses the conservation status of the species and their habitat and specifies conservation priorities. They suggested three main strategies to manage the remaining African wild dog population in Africa:

(1) *Maintaining large (> 10,000 km2) contiguous tracts of land set aside for wildlife*. The most important strategy is to conserve the species. Large areas can support viable dog populations and contain a core area protected from human activities. Measures taken could be: establishing cross-border parks and linking reserves by corridors. These protected areas could also serve as a haven from poachers and have restrictions on high-speed roads.
(2) *Integrated carnivore management programmes*. These programmes can be established to resolve conflicts where wild dogs and humans coexist. Having an assessment of the predator impact could help minimize livestock losses, zoning of areas to define habitat to control hunting, and having compensation programs to help compensate farmers for killed livestock. These are a few examples of programmes that could help the wild dogs and involve human parties.
(3) *Establishing tiny populations in small, fenced reserves*. Controlling the areas the dogs live in may be the only way to conserve the species. Periodically translocating animals between reserves by managing several populations together as a metapopulation could improve conservation.

For conservation purposes, it is necessary to know the base natural behaviour of a wild endangered species. Species-specific natural behaviour should be an indicator of positive welfare (Bracke & Hopster, 2006). Observation of captive animals may not be able to be applied to wild counterparts due to differences in the normal behaviours of wild and captive populations (Sadler & Ward, 1999). However, research on captive animals may allow new information, which might be difficult to capture in wild conspecifics to come forward. Captive observations give more visibility to a species. For the

conservation and welfare of the African wild dog, this could mean getting more information to better artificial pack bonding and assist thereby in artificial pack formation and thus enlarging the gene pool (De Villiers et al., 2003; Downs, 2019). When creating artificial packs, communication and the need to bond are important factors to take into account. Hill & van Hooff (1994) state that a useful way of measuring an affiliative relationship is by researching the strength of social bonds between group members in primates. The same can be done in African wild dogs by researching the communication, behaviour and hierarchy within a wild captive pack.

Potgieter et al. (2015) looked at both a failed and successful bonding attempt. These two subpopulations occurred during human management. The African wild dogs were translocated and brought together with the intention of a pack forming within a captive facility. Comparing data to determine whether the behavioural cues which can be used to predict the outcome of artificial pack formation. The research that the frequency of vocal communication between groups may be a useful indicator bonding success of African wild dogs (Potgieter et al., 2015). The groups were single-sex which mimics the natural dispersal of African wild dogs when forming a new pack (Marneweck et al., 2019).

2.5. Vocal communication and dialects in socially complex species including canids

Auditory signals or vocal communication have advantages over other forms of communication such as visual or olfactory. Auditory signals can reach an audience in any instance whether they are near or far and at any time of the day (Rendall et al., 1996). It does not require attention from the receiver for it to be effective. An influence on effectiveness can be the distance between the sender and receiver. In animal vocal communication, research has demonstrated that the identity of the sender plays a role in how a receiver demonstrably responds (Rendall et al., 1996 in Bekoff et al. 2002). Moreover, field experiments show some species react to the playback of calls, confirming that they can distinguish group members by individual vocalisation (Bekoff et al., 2002). Holekamp et al. (2007) wrote on the comparison of social behaviour and the recognition of third parties and conspecifics in spotted hyenas (*Crocuta crocuta*) and several primate species, including vervet monkeys (*Cercopithecus aethiops*). Communication is used among conspecifics in multiple circumstances, including challenging competitors, reconciling fights, and redirecting aggression, among others (Bachmann & Kummer 1980; Seyfarth & Cheney 1989; Holekamp et al., 2007).

Demartsev et al (2018) found that meerkats (*Suricata suricatta*) increase their call frequency upon hearing a conspecific call. This is a clear demonstration of subjects showing call timing modulation in a group (Demartsev et al., 2018; Pika et al., 2018). This is also known as take-turn communication (Pika et al., 2018). A similar result was found by Takahashi et al. (2013) in Marmoset monkeys (*Callithrix jacchus*). Takahashi (2013) found the animal can recognize another individual and wait before responding to another conspecific. When researching four primate species, red-capped mangabeys (*Cercocebus torquatus*), Campbell's monkeys (*Cercopithecus campbelli*), Guereza colobus monkeys (*Colobus guereza*), and De Brazza monkeys (*Cercopithecus neglectus*), Candiotti (2013) found that the four primate species can, regardless of whether conspecific or heterospecific, discriminate unfamiliar and familiar individuals vocalisations from playback sounds. No significant differences were found when analysing the species separately, showing all species were similarly able to discriminate between familiar and unfamiliar individuals equally. During the experiments, all individuals were at least two meters distanced from each other. In contrast, Balieiro & Monticelli (2019) found maned wolves (*Chrysocyon brachyurus*) can discriminate different extended barks of conspecifics over long distances. Their experiment with playback sounds shows the species can perceive differences in individual vocalisations and recognize or discriminate unfamiliar individual vocalisations from their vocalisations of packmates (Balieiro & Monticelli, 2019). This is a distinction between recognition and discrimination between individuals (Carlson, Kelly & Couzin, 2020).

The prevalence of dialects in mammals is not widely reported, although conspecific local population differences in vocalisations have been found in tamarins, (*Saguinus l. labiatus*) and chimpanzees (*Pan troglodytes*; Weilgart & Whitehead, 1997). In contrast, to the playback sounds with the maned wolves, research on the howls of the Iberian wolf (*Canis lupus signatus*), which has been isolated for 10.000 years and is a species in the Canidae family, has shown to not have different dialects (Wayne & Vila, 2003; Palacios, font & Márquez, 2007). Howls help wolves communicate over several kilometres (Harrington & Asa, 2003). Palacios, Font & Márquez (2007) state: "*Nevertheless, the fact that acoustic structure of howls is individually specific does not imply that wolves use this information for individual recognition. To confirm this hypothesis would require playback experiments*." Mentioned are the

morphological characteristics of the vocal apparatus and its having been influenced by fundamental frequency which best discriminates individuals in mammal vocalisation. Examples are calls of bush elephants (*Loxodonta africana*; McComb et al., 2003), and canids such as the whistle call of dholes (*Cuon alpinus;* Durbin, 1998) and barks of domestic dogs (*Canis familiaris;* Yin and McCowan 2004; Palacios, font & Márquez, 2007). Additionally, Palacios, Font & Márquez (2007) state that the modulation of frequency has an important role plays in individual recognition. Simultaneously, the recognition of strangers to pack members is part of a dialect or individual vocal recognition (IVR). Having IVR improves the cooperation between kin (Carlson, Kelly & Couzin, 2020). This is seen in Australian sea lions (*Neophoca cinerea*; Charrier & Harcourt, 2006) when parents try to find their offspring and in chimpanzees (*Pan* troglodytes; Schel et al., 2013) when calling for reinforcements in case of danger (Carlson, Kelly & Couzin, 2020).

As African wild dogs live in family-oriented packs, IVR helps with the recognition of next of kin (Creel & Creel, 2002; Creel et al, 1993; Holekamp & Sawdy, 2019; Carlson, Kelly & Couzin, 2020). In humans, recognizing individuals by voice is an important social behaviour. This is an adaptive trait shown among territorial and social species (Belin et al., 2004; Perrachione, Del Tufo & Gabrieli, 2011). Pack members using unique individual calls known within that specific pack or group can identify each other easier (Carlson, Kelly & Couzin, 2020). When an individual cannot be recognized, the reaction can become aggressive as seen in North American bullfrogs (*Rana catesbeian*; Davis, 1987; Bee & Gerhardt, 2002), and black howler monkeys (*Alouatta pigra*; Briseño-Jaramillo, Estrada & Lemasson, 2014; Carlson, Kelly & Couzin, 2020). This could lead to fatalities as seen in the research of Potgieter et al. (2015) where three African wild dogs were killed after artificial pack formation (Carlson, Kelly & Couzin, 2020).

Vocal dialects are known to be a part of the communication of the killer whale (*Orcnius orca*), a cetacean (Filatova et al., 2015; Abramson et al., 2018). It is believed dialects are transmitted through social learning within the killer whale family, between mother and offspring (vertical transmission) but also the line of descendent with the intervening generations of mothers (horizontal transmission; Ford et al., 1991; Deecke, Ford & Spong, 2000; Janik, 2000; Filatova et al., 2015; Abramson et al., 2018). Filatova et al. (2012) found, in a study on the North Pacific killer whale populations, similar acoustic features are different between populations in the same area. Meaning this does not correlate with geographical distances. Because the populations showed a dialect, the possibility of having learned this through social learning is plausible (Weilgrt & Whitehead, 1997; Filatova, 2012; Abarmson et al., 2018). Adding on the work of Filatova on killer whales on diverse patterns of geographic variation, the ability to learn vocalizations has been found in bats (Boughman, 1997), hummingbirds (Wiley, 1971), and parrots (Wright, 1996) to list few. The parrots, the yellow-naped amazon (*Amazona auropalliata*) were reported to alternate calling bouts of dialects with conspecifics by using neighbouring dialects after normalizing the data with an averaged correlation matrix. This matrix averaged the set of each pair of birds making them comparable (Wright, 1996). Because these species show differences in dialects even though located in the same area, dialectal regions can be considered. As combining packs could improve the gene pool, these dialectal regions can be considered a substantial barrier to artificial pack formation (Reynolds, Hayes & Wiley, 2010; Wright & Dahlin, 2018).

Vocalisations of African wild dogs are some of the most complex of the Canidae family with at least 11 vocal classes, many of which (e.g. begging cries, and twitters) are unique to AWDs (Robbins, 2000; Robbins and McCreery, 2003). Their vocal repertoire includes twitters, barks, begging, moans, rumbles, growls, yelps and squeals, whines, whimpers, hoo-calls, and pack calls (Robbins, 2000). These are presented in a table in the appendix (Appendix I & II). The most common vocalizations tend to be twitters, which are subcategorised into social, spar, mob and attack twitters. These are emitted with play, pursuit, and general social interactions and can also be used as a warning. Whimpers are emitted during social greetings and when approached by conspecifics. Begging squeals are often given during greeting ceremonies. Growls and barks are emitted during aggressive encounters. Growls can also serve as pack warnings. Barks can be an indication of an alarm or threat. Begging cries are used during food solicitation, greeting ceremonies, or by a distressed individual. Whines are an indication of frustration and solicitation, the same applies to moans. Yelps and squeals are submission calls (Robbins, 2000; Robbins and McCreery, 2003; Bucci, Nicholson & Krausman, 2022). It is obvious many of these calls are used in similar social contexts, however, no studies so far have investigated whether these calls might be used differently at the individual or even pack-specific level. Robbins (2000) stated that when having social interactions, African wild dogs use acoustic communication. He claims this to have an important role in intrapack as well as interpack dynamics.

It is hypothesised that packs of African wild dogs that are housed at separate captive facilities and do not have contact with one another will have different patterns of vocalisation use (a possible local dialect). This study aims to determine whether vocals dialect exists across different geographically separated packs of African wild dogs. If vocalisations are used differently between packs, this could influence how quickly social cohesion is achieved during artificial bonding events as animals may need a longer period of learning to adjust their vocalisations and communicate effectively. Furthermore, a period of learning individual calls of pack members may be necessary to facilitate social bonds. This study will help develop a tool which can be used to measure the welfare and social cohesion of AWDs during conservation initiatives and will be able to be used to detect pack dialects or individuality which could be used to predict the length of time required for bonding to occur.

3. Methods

This section shows the research design of the present study and gives justification for the choices. It provides information on African wild dog packs (including composition, location and ages), how the vocalisations were recorded, how the audio data were extracted and analysed, and lastly how the statistical analysis of the audio data was performed.

3.1. Animals

This study formed part of a larger research project containing seven captive packs across four captive institutes. A total of three packs were analysed (*n*= 22 adults), consisting of three to fifteen mature individuals per pack. These packs consisted of a mixture of male-only, and mixed-sex packs and yielded a total of 16 males and six females in the analysis. Due to planning and availability, this study looked at one pack based in a semi-natural open-range style enclosure (60.000 m^2) at Bothongo Rhino and Lion Nature Reserve (BOT) in South Africa and two smaller traditional urban-zoo style enclosures (range 634 - 1226 m^2 for Albuquerque Biopark Zoo, ABQ and Brookfield, BRK respectively) in the USA (Table 1). All packs were housed in permanent captivity (Van Den Berghe, 2019b). Vocalisations from the South African BOT pack were recorded in person by the researcher in mid-April, while vocalisations from the two USA packs were extracted from video recordings made in May (ABQ pack) and June (BRK pack) in 2014 by Van den Berghe et al. (2019b). All recordings were done in the morning after sunrise and the afternoon before sundown.

A self-owned vehicle was used to conduct observations of wild dogs within the enclosure of Bothongo Rhino & Lion Nature Reserve (Table 1). Where possible visitor numbers (number of visitor cars or safari vehicles) were recorded. These were collected by scan sampling every fifteen minutes, at the end of a video and audio recording. The minimum and maximum mean of the recordings per pack and the total have been added to the overview (Table 1).

Table 1. Demographics and observation strategies for the captive African wild dog (Lycaon pictus) packs in South Africa and the United States of America were used in this study.

Pack	Location	Pack size	♂	♀	Age range	Viewing style	Mean (min-max) recordings (h)
ABQ	Albuquerque, NM, USA	3	3	0	7 years (in 2014)	Public viewing	0.70 (0.55-0.89)
BOT	Krugersdorp, GP, SA	15	10	5	2-10 years (in 2023)	Self-drive	1.43 (0.56-2.67)
BRK	Chicago, IL, USA	4	3	1	3-9 years (in 2014)	Public viewing	0.55 (0.42-0.74)
Total mean (min-max) recordings (h)			2.68 (1.64-4.29)				
ABQ, Albuquerque Biopark Zoo; BOT, Bothongo Rhino & Lion Nature Reserve; BRK, Brookfield Zoo							

Three (baseline) days were used from the existing data of the ABQ and BRK. Due to the invasive nature of interventions in Van den Berghe's (2019a) pheromone study, the choice was made to only use the baseline days 1-3 from the data collected to avoid potential intervention influence on vocalisation. The visited pack was Bothongo Rhino & Lion Nature Reserve. The BOT pack was recorded for three days, to make sure the data was comparable (Table 2).

Table 2. Dates in which audio recordings were undertaken at Bothongo Lion and Rhino Nature Reserve, Albuquerque Biopark Zoo and Brookfield Zoo according to date.

Captive institute	Day 1	Day 2	Day 3
BOT	April 11th, 2023	April 12th, 2023	April 13th, 2023
ABQ	May 12th, 2014	May 13th, 2014	May 14th, 2014
BRK	June 23rd, 2014	June 24th, 2014	June 25th, 2014

3.2. Recording of vocalisations

Before the new audio recordings were undertaken, previously recorded vocalisations were used to familiarise the researcher with the African wild dog vocal ethogram of Pia Riddell (Appendix I). Additionally, the researcher became familiar with the audio analysis software, Kaleidoscope Basic Software (5.5.0).

Vocalisations were recorded with a unidirectional Rhodes shotgun microphone connected directly to a Zoom H-8 field recorder and video was captured using a Sony FDR-AX100E 4K hand-held digital video camera for the recordings at BOT. This footage was not specifically analysed for this project but was collected for analysis in a larger study for individual animal recognition in behaviour analysis. For the recordings at ABQ and BRK, the same video camera was used but no audio equipment. The audio recordings of these two packs were stripped from the videos using Adobe Audition (7.0) and reformatted in Audacity software (3.3.2). for use in Kaleidoscope basic software (5.5.0). Vocalisations were recorded for four hours per day, with fifteen minutes per recording. Two hours in the morning, two hours in the afternoon, from just outside the enclosure (ABQ and BRK) or from a car inside the enclosure (BOT). Each day, the start and end times were noted to keep track of the cumulative hours. These periods were chosen as they reflect the most active times for the diurnal patterns of African wild dog packs (Hubel et al., 2016a; Hubel et al., 2016b). At BOT, the dogs were fed two out of three recording days, once in the afternoon (April 12th) and once in the morning (April 13th). The BOT is fed in group feedings of carcasses. The ABQ and BRK packs were fed daily individual feeds of mixed dog biscuits, meat and blood. The recordings at BOT were also stripped and reformatted using the same method as for ABQ and BRK. This yielded a total of 8 hours of recordings across three packs to analyse.

3.3. Audio extraction and analysis

Vocalisation data were extracted from three days of consecutive audio recordings for each pack and analysed using Kaleidoscope basic software (5.5.0); the type and number of vocalisations within each pack were scored for each day of observation using two ethograms of Pia Riddell based on the works of Robbins (2000; [second ethogram is not published]; Appendix I &II). For example, an audio data file of one pack could have 30 twitters, 10 growls and 40 barks. The frequency of the vocalisations per pack was noted and accumulated per vocalisation type. This created a dataset with vocalisations and the frequency per vocalisation within a pack. The total amount of extracted audio containing vocalisations equated to 2.11h (ABQ), 1.64h (BRK) and 4.64h (BOT). To compare vocalisations between packs, the total count for each vocalisation type was divided by the total recorded vocalisations hours to yield an hourly rate of each vocalisation type per pack. These were referred to as normalised data.

3.4. Statistical analysis

This study aimed to determine whether separate packs of African wild dogs use vocalisations differently in pack dialects. The hypotheses were:

H_0: Vocalisation type and frequency are different between the three packs.
H_1: Vocalisation type and frequency are similar between the three packs.

All statistics were performed using SPSS statistical software (version 28.0.1.0, IBM Statistics, USA). All data were tested for normal distribution and equal variance using descriptive statistics, the Shapiro-Wilk test and histograms, and were transformed using log10 if necessary.
The hourly rate of each vocalisation type was grouped by the pack. The relatedness of the wild dogs per pack was plotted against the accumulated vocalisations. If data were normally distributed they were compared by repeated measures ANOVA with a posthoc Tukey test. If data were not normally distributed, the Friedman test was performed. Lastly, a Kruskall-Wallis test was performed to determine statistically significant differences between the three packs. As not all vocalisations were used between all packs. Results were considered significant at $P \leq 0.05$ with a 95% confidence interval.

4. Results

This section shows relevant details of the recording analysis and the results of the statistical tests, descriptive statistics, ANOVA repeated measures, Friedman test and the Kruskall-Wallis test.

A cumulative total of 8.04 hours (over 81 files, containing n=969 vocalisations) of recordings were analysed (Appendix IV). The cumulative total vocalisations per pack from the three days of recordings are shown (Fig. 3). A Kruskall-Wallis determined that the vocalisations utilised by ABQ and BRK differed statistically significantly (P=0.004), with a mean rank vocalisations score of 28.85 ± SEM for ABQ and 2.80 ± SEM for BRK. Attack twitters, gurgles, full moans, tremelo alarm barks and hoo calls were not detected in the audio data.

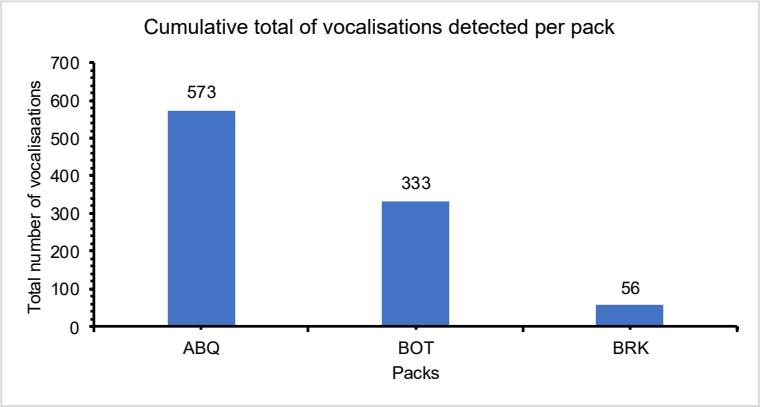


Figure 3. Cumulative total of vocalisations detected per pack

Six vocalisation types were emitted by all three packs (spar twitters, begging squeals, whimpers, yelps, begging cries and yelp barks; Fig. 4a-4f). Spar twitters were the most frequent vocalisation at 41.9 ± 24.2 call/h, no significant differences were detected in packs (P=0.423; paired comparison ABQ-BOT P=1.000 respectively; Fig. 4a). Spar twitters gave a near-significance when comparing the three packs (Friedman test; X^2=4.667, P=0.097). Hourly rates for combined begging squeals were 13.7 ± 7.9 calls/h, and no significant differences were detected between packs (P=0.123; paired comparison ABQ-BOT P=0.556, BOT-BRK is P=1.000 and ABQ-BRK is P=0.471 respectively; Fig. 4b). Hourly rates for combined whimpers were 13.0 ± 7.5 call/h no significant differences were detected between packs (P=0.156; Fig. 4c). Hourly rates for combined yelps were 4.4 ± 2.5, call/h, no significant differences were detected between packs (P=0.097; Fig. 4d). Hourly rates for combined begging cries were 4.0 ± 2.3 call/h, no significant differences were detected between packs (P=0.761; Fig. 4e). Yelps gave a near-significance when comparing the three packs (Friedman test; X^2=4.667, P=0.097). Hourly rates for combined yelp barks were 0.4 ± 0.3 call/h, and no significant differences were detected between packs (P=1.000; Fig. 4f).

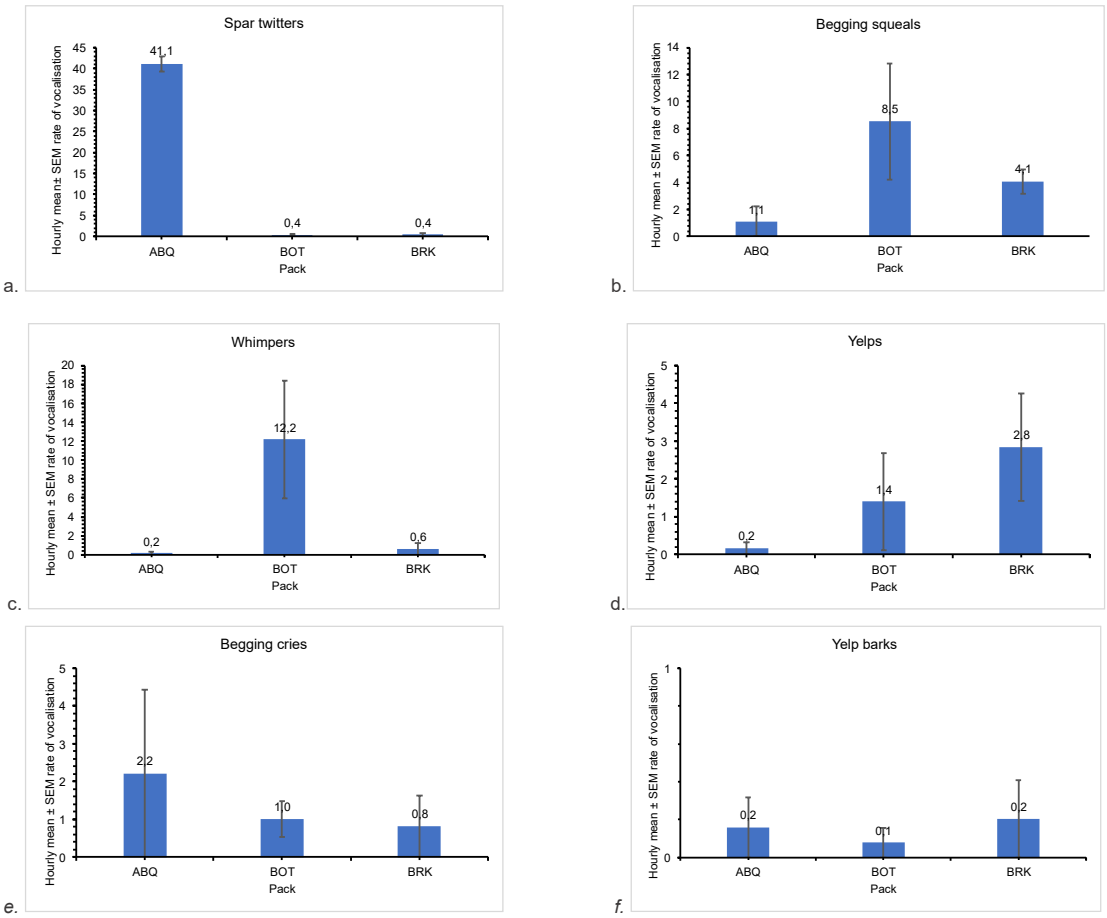


Figure 4. This figure shows the graphs with the normalised mean rate with standard error per vocalisation type per hour a) spar twitters, b) begging squeals, c) whimpers, d) yelps, e) begging cries, f) yelps barks used by all three packs. ABQ, Albuquerque Biopark Zoo; BOT, Bothongo Rhino & Lion Nature Reserve and BRK, Brookfield Zoo.

Four vocalisation types were emitted by two packs (social twitters, whistle squeals, whines and rumbles; Fig. 5a-5d). Hourly rates for combined social twitters across these two packs were 34.9 ± 20.2 calls/h, no significant differences were detected between packs (*P*=0.368; Fig. 5a). Hourly rates for combined whistle squeals were 3.,06 ± 1.,225 calls/h, no significant differences were detected between packs (*P*=0.355; Fig. 5b). Hourly rates for combined whines were 1.8 ± 1.0 calls/h, no significant differences were detected between packs (*P*=0.202; Fig. 5c). Hourly rates for combined rumbles were 1.3 ± 0.7 calls/h, significant differences were detected between packs (*P*=0.368; Fig. 5d).

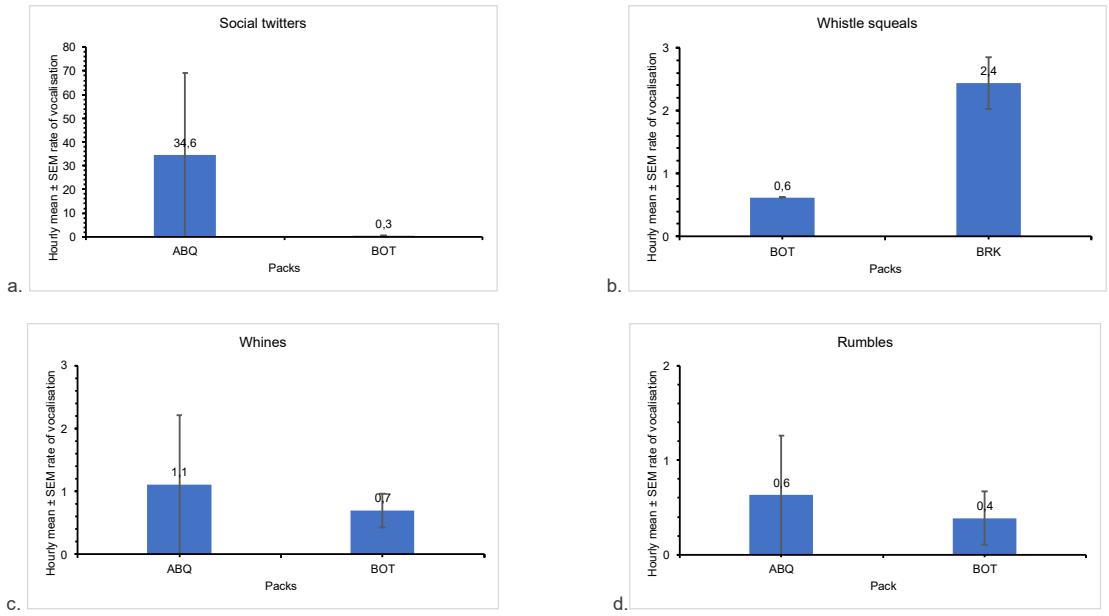


Figure 5. This figure shows the graphs with the normalised mean rate with standard error per vocalisation type per hour a) social twitters, b) whistle squeals, c) whines, d) rumbles used by two packs. ABQ, Albuquerque Biopark Zoo; BOT, Bothongo Rhino & Lion Nature Reserve and BRK, Brookfield Zoo.

Ten vocalisation types were only emitted by one pack (mob twitters, social growls, clear barks, common alarm barks, huffs, buzz gurgle moans, threat barks, alarm growls, howl barks, and sneezes; Fig. 6a-6j). Hourly rates of the mob twitters in the ABQ pack were 4.9 ± 4.9 call/h (*P* =0.423; paired comparison for ABQ-BOT *P*=1.000 respectively; Fig. 6a). Hourly rates for combined social growls in the ABQ pack were 1.1 ± 0.7 call/h (*P*=0.249; paired comparison for ABQ-BOT *P*=0.748 and ABQ-BRK *P*=0.748 respectively; Fig. 6b). Hourly rates for combined clear barks in the ABQ pack were 0.8 ± 0.6 call/h (*P*=0.301; paired comparison for ABQ-BOT *P*=0.903 and ABQ-BRK *P*=0.903 respectively; Fig. 6c). Hourly rates for combined common alarm barks, and huffs were in the ABQ pack each 0.8 ± 0.8 call/h (*P*=0.368; Fig. 6d+e). Hourly rates for combined buzz gurgle moans in the BOT pack were 0.2 ± 0.2 call/h (*P*=0.368; Fig. 6f). Hourly rates for combined threat barks in the ABQ pack were 0.6 ± 0.4 call/h (*P*=0.368; Fig. 6g). Hourly rates for combined alarm growls in the BQ pack were 0.6 ± 0.4 call/h (*P*=0.270; paired comparison for ABQ-BOT *P*= 0.811 and ABQ-BRK *P*=0.811 respectively; Fig. 6h). Hourly rates for combined howl barks in the ABQ pack were 0.5 ± 0.5 call/h (*P*=0.368; Fig. 6i). Hourly rates for combined sneezes in the BOT pack were 0.2 ± 0.2 (*P*=0.368; Fig. 6j).

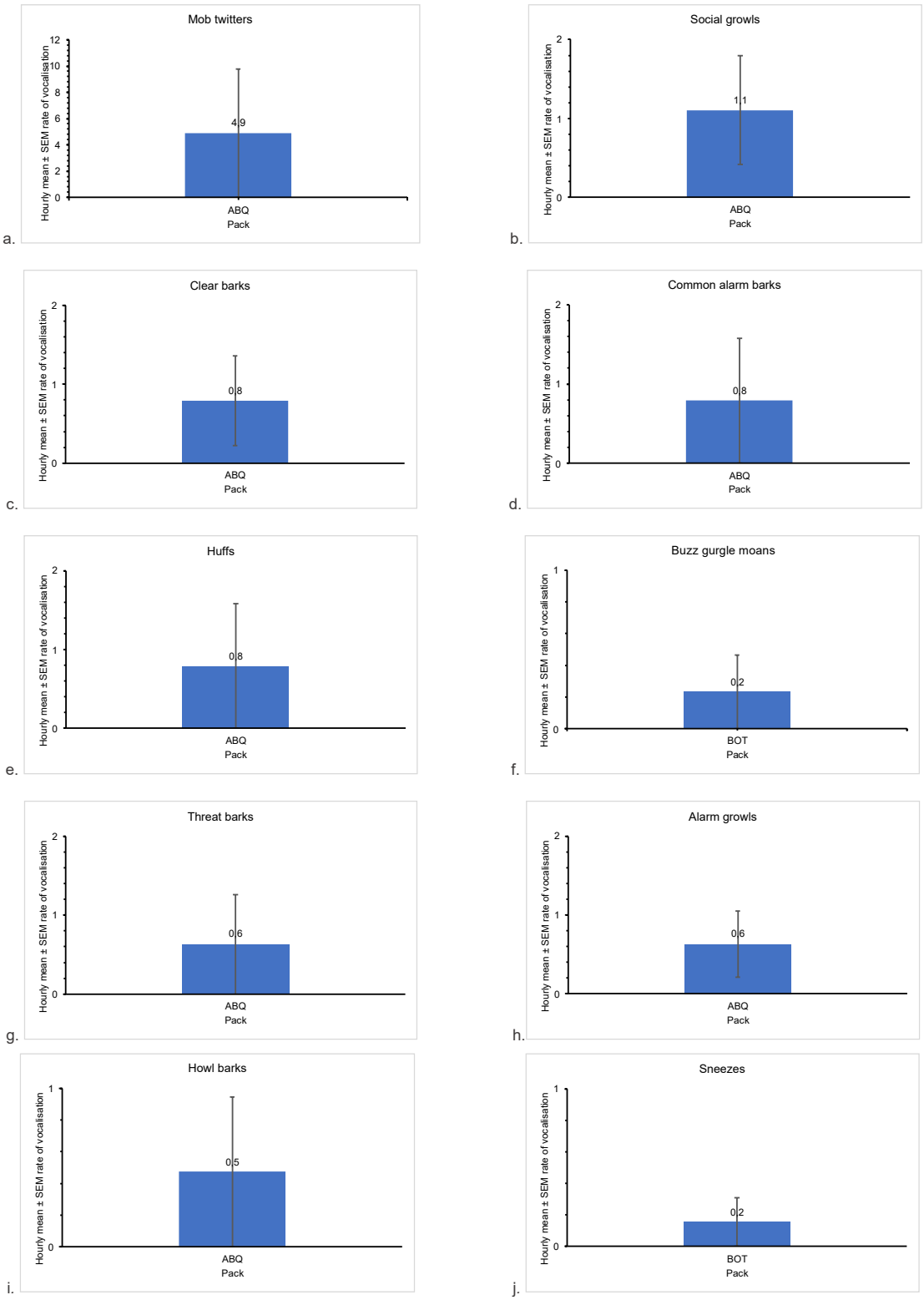


Figure 6. This figure shows the graphs with the normalised mean rate with standard error per vocalisation type per hour a) mob twitters, b) social growls, c) clear barks, d) common alarm barks, e) huffs, f) buzz gurgle moans, g) threat barks, h) alarm growls, i) howl barks, j) sneezes used by all three packs. ABQ, Albuquerque Biopark Zoo and BOT, Bothongo Rhino & Lion Nature Reserve.

The cumulative number of 696 vocalisations recorded per pack is shown (Fig. 7). Most vocalisations were detected in the ABQ audio recordings. The least in the BRK audio recordings. ABQ predominantly used social, spar and mob twitters and begging cries (*n*= 219, 260, 31 & 14). ABQ used an equal number of begging squeals, whines, and social growls (*n*=7) and an equal number of yelps, whimpers, and yelp barks (*n*=1). BOT predominantly used begging squeals, whimpers, yelps and begging cries (*n*=110, 157, 18 & 13). BRK predominantly used begging squeals and yelps (n=20 & *n*=14). Yelp barks were detected in even numbers across the three packs (Friedman: X^2=0.000, *P*=1.000). Begging cries were the most similar of the vocalisations besides yelp barks (Friedman: X^2=0.545, *P*=0.761) in comparison to the other vocalisations (Friedman: X^2=2.000, 0.097≤*P*≥0.368). Sneezes were the least detected in total (*n*=2).

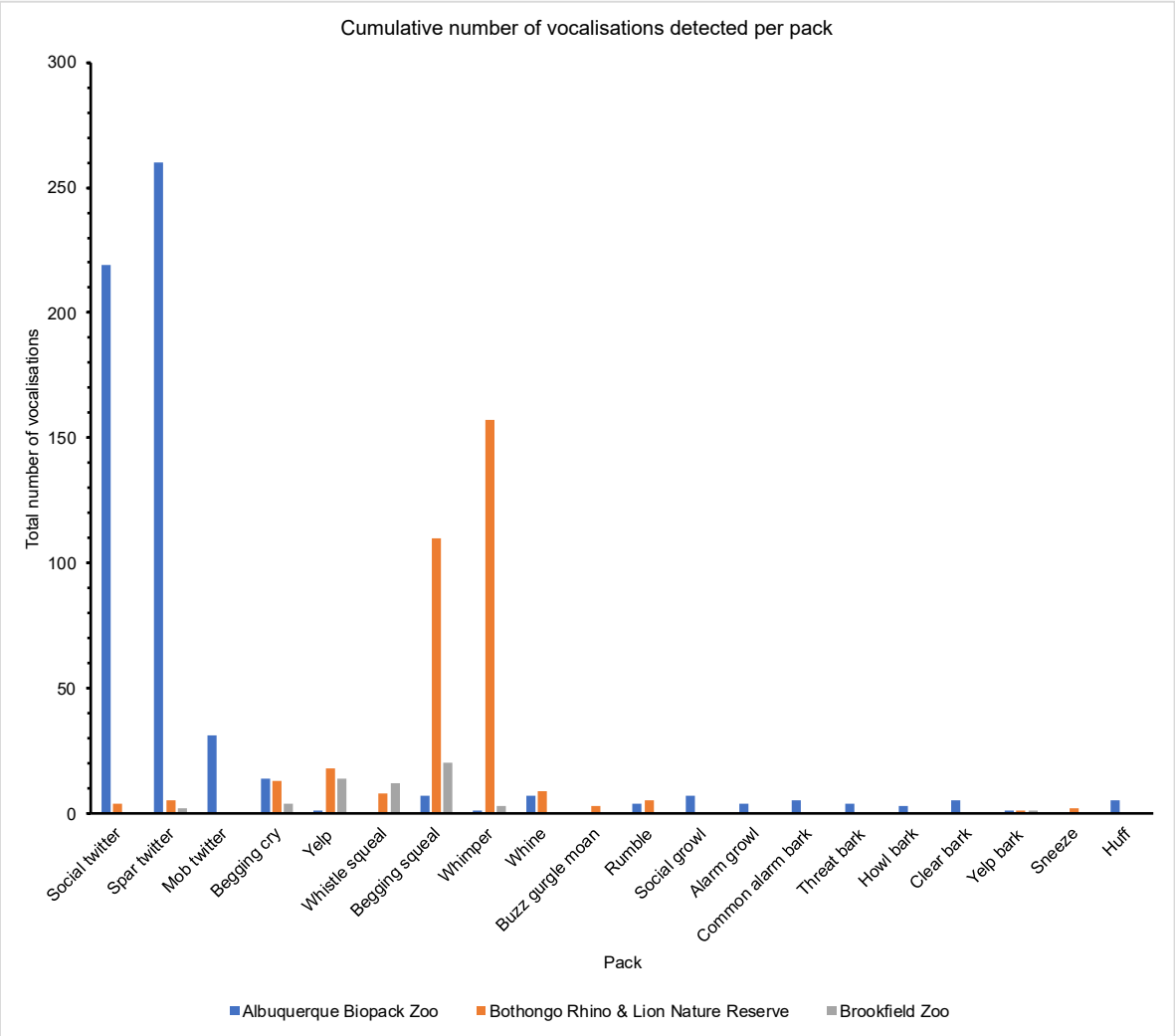


Figure 7. Cumulative number of 20 detected vocalisation types per the three packs, Albuquerque Biopark Zoo, Bothongo Rhino & Lion Nature Reserve and Brookfield Zoo.

5. Discussion

In this section, the results are discussed and compared with the found literature.

African wild dogs (AWD) are social canids living in large packs with some of the most complex vocal repertoires of the Canidae family (Maddock & Mills, 1994; Creel & Creel, 1995; Robbins, 2000; De Villiers et al., 2003; Robbins and McCreery, 2003). In the current pilot study, analysis of the audio of three packs measured over three days showed a great number of detected vocalisations and a difference was seen in the total number of vocalisations per vocalisation type between packs. Despite the difference in numbers per vocalisation type, all of the vocalisation types were determined non-significant when analysing the vocalisations individually, mostly due to large amounts of variation in the number of each vocalisation emitted by each pack across the observation days. Per pack, a trend was seen in using different rates of specific vocalisation types. These differences could be explained by the lower sample size and short duration of the current study, these results could become significant when researching more packs and/or completing data collection over an increased number of days.

In the current study, it was determined, when comparing the three analyzed packs, that there was a significant difference for two out of three packs (ABQ and BRK, which emitted the most and least number of calls over the three days). This shows that these two packs emitted different rates of vocalisations in the analysed data. Additionally, it was determined that the remaining pack (BOT) which emitted the second highest rate of vocalisations did not differ compared to the other two packs. The variation in the detected number of vocalisations during the analysis could be a plausible cause for the significant difference between ABQ and BRK and the non-significance between the other comparisons.

The ABQ pack emitted the most detected vocalisations of the packs, despite having a pack size of only three. Interestingly, in the analysed ABQ pack audio more social, spar and mob twitters were detected than either of the other packs. The other packs barely had twitters detected and this can suggest an indication of a preference for twitters for the ABQ pack but not BOT or BRK. Spar twitters were mostly detected which, according to Robbins (2000), are associated with social interaction, such as play and emitted by adults in appeasement. This may show that the ABQ pack has a large amount of social interaction and thus may be exhibiting signs of good welfare. BOT emitted the second most vocalisations, being the biggest pack size. In the BOT audio, predominantly begging squeals, whimpers, yelps and begging cries were detected. These four vocalisation types are, according to Robbins (2000), all associated with greeting ceremonies and can be viewed as a form of social solicitation. Begging cries can also indicate distress. The BOT pack has, just like ABQ, a lot of greeting ceremonies. In the BRK pack, predominantly begging squeals and yelps were detected. Similar to BOT but in lower quantities. This could indicate a preference for greeting-related vocalization types in both the BOT and BRK packs.

The variation in detected vocalisations gives an interesting insight into the utilisation and perhaps a preference for vocalisation types by the analysed packs. The possibility of dialects within the packs increases because of the difference in utilisation of vocalisation types. When comparing the packs for dialects, a base for wild packs should be taken into consideration. In this study, neither of the packs resembles a wild pack given the reduced space of the enclosures, feeding differences and the general inability to hunt. ABQ and BOT had no significance and had a high rate of vocalisations yet show a difference in total utilisation of vocalisation types. ABQ emitted more social interaction vocalisation types and BOT greeting vocalisation types. This could indicate a dialect because of the difference in utilisation. The high number of begging cries could be explained by the different feeding regimes of the BOT pack compared to ABQ and BRK. During observations, two out of three days were around feeding and feeding was performed as group feedings of carcasses. Comparatively, the ABQ and BRK packs were fed daily individual feeds of mixed dog biscuits, meat and blood. Robbins (2000) found that begging cries are emitted during food solicitation in wild packs. Whimpers are part of the social greeting and when approached by conspecifics, it was noted by the researchers during this study that this social greeting occurred frequently in the BOT pack during feeding as well as when the pack was relaxing after feeding (Robbins, 2000; Robbins and McCreery, 2003; Bucci, Nicholson & Krausman, 2022). Further research will be necessary to prove or disprove this theory.

In North pacific killer whales, dialects are known to be a part of the communication and similar acoustic features are different between populations in the same area. Meaning this does not correlate with geographical distances and gives the possibility of social learning (Filatova, 2012; Filatova et al., 2015; Abramson et al., 2018). A similar ability to learn vocalizations has been found in bats (Boughman, 1997), hummingbirds (Wiley, 1971), and parrots (Wright, 1996). The parrots were reported to alternate calling

bouts of dialects with conspecifics (Wright, 1996). Several species show an ability to recognize individual vocalisations, these include aquatic and terrestrial mammals, and more specifically some canid species. Dialects have been found in similar species to the African wild dog like the maned wolf (*Chrysocyon* brachyurus; Balieiro & Monticelli, 2019). The experiment done by Balieiro & Monticelli (2019) showed the species was able to discriminate and recognize familiar and unfamiliar individual vocalisations (Balieiro & Monticelli, 2019). In contrast, dialects haven't been found in other similar species like the Iberian wolf (*Canis lupus signatus*). Palacios, Font & Márquez (2007) discuss even if the acoustic structure of howls is specific per individual and can be recognized, this does not imply a use for individual recognition. The influence of fundamental frequency and its way to best discriminate individuals in mammal vocalisation (Palacios, Font & Márquez, 2007). These packs studied in the current research are located in geographically distinct captive facilities, New Mexico and Chigaco in the USA and the Gauteng Province in South Africa, interestingly no significant differences were detected between the individual vocalisations of these. The total number of vocalisations did tend to differ between packs and despite non-significant results trends in vocalisation use differences were noted. Of interest in these trends was the similar use of vocalisations categories by the BOT and BRK packs. This similarity of utilisation in vocalisations could show that despite being located in different parts of the world at least some vocalisations are used more commonly by African wild dogs. However, whether these calls are used in similar contexts remains elusive.

Individual or pack-specific use of vocalisations could have ramifications on how well individuals or packs integrate during both natural and artificial pack bonding events. Artificial pack bonding events occur during human management of African wild dogs, where individuals are translocated and brought together with the intention of a pack forming within a captive facility (Potgieter et al., 2015). The creation of social bonding plays a crucial role in the formation of a breeding and stable pack. By creating a single-sex pack and joining them with the unrelated opposite sex, natural dispersal processes can be mimicked (Marneweck, 2019). Potgieter et al. (2015) showed possible repercussions of joining single-sex with opposite seks without knowledge of the pack forming and signs in behaviour. When individuals do not recognize one another, aggressive behaviour might be displayed, which could lead to fighting and in extreme cases fatalities. If indeed African wild dogs packs do have different ways of using vocalisations (such as dialects) individuals might not be recognized as part of a pack until a period of social learning occurs (Belin et al., 2004; Perrachione, Del Tufo & Gabrieli, 2011). Further research on the possibility of individual vocal recognition can be done with vocal playbacks similar to those performed in other canid species. These ensure the measurement of the response of individuals rather than other cues such as visual chemicals (Carlson, Kelly & Couzin, 2020).

The range of AWD across Africa has declined immensely in the last 50 years (IUCN/SSC, 2007; Van den Berghe et al., 2012; Woodroffe & Sillero-Zubiri, 2020; Murray et al., 2023). For conservation purposes, it is necessary to know the base natural behaviour of a wild endangered species (Bracke & Hopster, 2006). For the conservation and welfare of the AWD, it is important to increase the body of knowledge on how this complex social species uses vocal and physical behaviours to increase the success and speed of artificial pack bonding which aids to enlarge the collective gene pool (De Villiers et al., 2003). Combining dispersing single-sex packs and translocating these to suitable habitats could improve the gene pool. However, differences in dialect caused by dialectal regions or not having individual vocal recognition could be considered a substantial barrier to artificial pack formation (Reynolds, Hayes & Wiley, 2010; Wright & Dahlin, 2018; Carlson, Kelly & Couzin, 2020).

Applying artificial bonding science to captive packs and/or wild packs without a clear understanding of vocal dialects or individual recognition could end in two possible outcomes. Social interaction with social vocalisations or an aggressive interaction with unsocial vocalisation use (Robbins, 2000; Belin et al., 2004; Perrachione, Del Tufo & Gabrieli, 2011). This study did not conclusively show that African wild dogs do exhibit vocal dialects between packs, but did show trends that are suggestive that with more data vocal dialects may be observed in captive packs. Further insights into the vocalizations (and more specifically what it all means) could ultimately influence the manner African wild dogs are kept in game reserves, zoos and other organisations with captive African wild dogs. But also, inform stakeholders, such as zookeepers and reserve managers in Southern Africa involved with African wild dogs to have tools to better gauge the welfare of the individual groups. Ultimately, once more understanding of African wild dog communication is gained, this will deliver a tool that can assist in managing the health and welfare of the packs and thereby decreasing morbidity and mortality now regularly encountered.

6. Conclusion

In this section, the conclusion of this research is written. The objectives and main questions were answered using the literature, method and results in this research.

The African wild dog (*Lycaon pictus*) is a social carnivore living in large packs with a range from three to 20 mature members. An alpha pair, with their subordinates consisting mostly of offspring from previous litters, leads the pack and almost exclusively breeds once a year. This is also known as the parental family structure. The role of the subordinates is to assist in the hunt for food and help feed and raise the litter. Because of the dispersing of juvenile females, at the age of 13 months, and males, at the age of 33 to 37 months, from their natal packs, the genetic pool of the African wild dogs increases as they form single-sex groups to start their packs. In the wild, conspecifics communicate in multiple circumstances and multiple manners. Auditory signals or vocal communication have an advantage over other types of communication. The communication can reach a receiver in an instant, near or far. It is shown that discrimination can be made regardless of whether conspecific or heterospecific sends an auditory signal.

In this study, the audio of 22 mature African wild dogs in total was analyzed. The Albuquerque Biopark Zoo pack, located in Albuquerque, New Mexico United States of America, consists of three male mature pack members at the age of seven years old back in 2014. The Bothongo Rhino & Lion Nature Reserve pack, located in Krugersdorp, Gauteng South Africa, consists of ten male and five female mature pack members with an age ranging from two to ten years old in 2023. The Brookfield Zoo pack, located in Chicago Illinois United States of America, consists of four male mature pack members with an age ranging from three to nine years old back in 2014.

Vocalisations of African wild dogs are some of the most complex of the Canidae with at least 11 vocal classes, many of which (e.g. begging cries, and twitters) are unique to African wild dogs. Their vocal repertoire includes twitters, barks, begging, moans, rumbles, growls, yelps and squeals, whines, whimpers, hoo-calls, and a pack call. In this study, a total of 969 vocalisations, spread over 20 types of vocalisations, were detected in the audio files of three packs. Most vocalisations were detected in the Albuquerque Biopark Zoo audio recordings. Albuquerque Biopark Zoo predominantly used social, spar and mob twitters and begging cries. The Bothongo Rhino & Lion Nature Reserve pack predominantly used begging squeals, whimpers, yelps and begging cries. The Brookfield Zoo pack predominantly used begging squeals and yelps.

The analysis of the audio gave a great number of detected vocalisations and a difference was seen in the total per vocalisation types between packs. Despite the difference in numbers per vocalisation type, all of the vocalisation types were determined as non-significant when analysing the vocalisations individually. Per pack, a trend was seen in using different rates of specific vocalisation types. Interestingly, significance was determined in the detected vocalisations between the Albuquerque Biopark Zoo pack and the Brookfield Zoo pack.

This study was a pilot study on the utilisation of vocalisation types by African wild dogs in different packs. The null hypothesis ‘Vocalisation type and frequency are different between the three packs’, is accepted as a difference determined between the Albuquerque Biopark Zoo pack and the Brookfield Zoo pack. Different packs of African wild dogs use vocalisations with each having their preference as to which types of vocalisations are used. Even with a lower sample size with this variation in the use of vocalisations per pack, a potential dialect could be plausible. Further research will be needed to find a better difference or more similarities in the utilisation of vocalisation types in captive and wild packs and therefore pack-specific vocals dialects in African wild dogs.

7. Recommendations

The current study is a pilot study for future research on vocalisations of African wild dogs in captive and wild packs. However, the results of the study should be treated with caution due to the lower sample size. Future research could further examine the possibility of pack-specific vocal dialects in African wild dogs using larger sample sizes and a longer period of data collection.

By increasing the sample size and lengthening the period, more data will be collected and a better view will be created of the use of the vocalizations and the possibility of a dialect within the species. As this study was on three packs, adding at least double the amount could give more data to analyse and compare. When choosing the packs, the pack size, and ages of the individuals should be taken into account. It's important to have the number of pack sizes close to that in the wild to have a proper representation for the research.

Several additional research could be performed to specify the information used in the study. Firstly, more research on the behaviour shown by African wild dogs should be done to get a more detailed look at their natural behaviour. Further research can be done on wild packs of African wild dogs to make a comparison between the captive and wild packs to determine the accuracy of the findings on the behaviour of captive packs of African wild dogs. Secondly, additional research can be conducted on the correlation between behaviour and vocalisations to better understand the vocalisations used by African wild dogs in both captive and wild packs. Following this research, a comparison can be made with wild packs to determine the accuracy of the findings on the correlation between behaviour and vocalisations of captive packs of African wild dogs. This will create a base for both the behaviour and utilisation of vocalisations of African wild dogs.

A possible follow-up study for the dialects could be a play-back of vocalisations. The possibility of dialects could be tested by playing back known vocalisations of familiar and unfamiliar individuals. Individual vocal recognition can be tested by observing the reaction of the African wild dogs in the study. The outcome of that study could be used to determine whether African wild dogs have a vocal dialect. If so, this could assist in determining how quickly social cohesion is achieved during artificial bonding events as animals may need to adjust vocalisations to effectively communicate. Future artificial pack cohesion could be assessed during the process of pack formation.

References

References in text

Abramson, J. Z., Hernández-Lloreda, M. J., García, L. C., Colmenares, F., Aboitiz, F., & Call, J. (2018). Imitation of novel conspecific and human speech sounds in the killer whale (*Orcinus orca*). *Proceedings of the Royal Society B: Biological Sciences*, *285*(1871), 2017-2171.

Bachmann, C., Kummer, H. (1980). Male assessment of female choice in hamadryas baboons. *Behav Ecol Sociobiol*, 315–321

Balieiro, F. S., & Monticelli, P. F. (2019). Evidence of individual discrimination in the maned wolf long-distance extended-bark. *Behavioural Processes*, 158(219-277)

Bee, M.A. & Gerhardt, H.C. (2002). Individual voice recognition in a territorial frog (*Rana catesbeiana*). *Proc. R. Soc. B*. 269, 1443-1448.

Behr, D. M., McNutt, J. G., Ozgul, A., & Cozzi, G. (2020). When to stay and when to leave? Proximate causes of dispersal in an endangered social carnivore. Journal of Animal Ecology, 89(10), 2356–2366.

Bekoff, M., Allen, C., & Burghardt, G. M. (2002). *The Cognitive Animal: Empirical and Theoretical Perspectives on Animal Cognition*. MIT Press. 307-313

Belin, P., Fecteau, S., & Bédard, C. (2004). Thinking the voice: neural correlates of voice perception. *Trends in Cognitive Sciences*, *8*(3), 129–135.

Boughman, JW. (1997). Greater spear-nosed bats give group-distinctive calls. *Behavioral Ecology and Sociobiology.* 40, 61–70.

Bouley, P., Paulo, A., Angela, M., Du Plessis, C., & Marneweck, D. G. (2021). The successful reintroduction of African wild dogs (Lycaon pictus) to Gorongosa National Park, Mozambique. *PloS one*, *16*(4), e0249860.

Bracke, M., & Hopster, H. (2006). Assessing the Importance of Natural Behavior for Animal Welfare. *Journal of Agricultural and Environmental Ethics*, *19*(1), 77–89.

Briseño-Jaramillo, M., Estrada, A., Lemasson, A. (2014). Individual voice recognition and an auditory map of neighbours in free-ranging black howler monkeys (*Alouatta pigra*). *Behav. Ecol. Sociobiol.* 69, 13-25.

Bucci, M. E., Nicholson, K. L., & Krausman, P. R. (2022). *Lycaon pictus* (Carnivora: Canidae). *Mammalian Species*, *54*(1017).

Burrows R. 1992. Rabies in wild dogs. Nature, 359:277.

Candiotti, A., Zuberbühler, K., & Lemasson, A. (2013). Voice discrimination in four primates. *Behavioural Processes*, 99, 67–72.

Carlson, N. V., Kelly, E., & Couzin, I. D. (2020). Individual vocal recognition across taxa: a review of the literature and a look into the future. *Philosophical Transactions of the Royal Society B*, *375*(1802), 2019.0479.

Castelló, J. R., & Sillero-Zubiri, C. (2018). *Canids of the World: Wolves, Wild Dogs, Foxes, Jackals, Coyotes, and Their Relatives (Princeton Field Guides, 135)* (Illustrated). Princeton University Press.

Charrier, I., & Harcourt, R. (2006). Individual Vocal Identity in Mother and Pup Australian Sea Lions (Neophoca cinerea). *Journal of Mammalogy*, *87*(5), 929–938.

Cheetah Conservation Initiative. (2022). *African Wild Dog - Cheetah Conservation Initiative*. The (Africa Range-Wide) Cheetah Conservation Initiative. Retrieved March 13, 2023, from https://cheetahconservationinitiative.com/african-wild-dog/

Cozzi G., Behr D.M., Webster H.S., Claase M., Bryce C.M., Modise B., McNutt J.W., Ozgul A. (2020). African wild dog dispersal and implications for management. *Journal of Wildlife Management* 84, 614–621.

Creel S., Marusha Creel N., Matovelo J.A., Mtambo M.M.A., Batamuzi E.K., Cooper J.E. (1995). The effects of anthrax on endangered African wild dogs (Lycaon pictus). Journal of Zoology 236, 199–209.

Creel, S., & Creel, N. M. (1996). Limitation of African Wild Dogs by Competition with Larger Carnivores. Conservation Biology, 10(2), 526–538.

Creel S. & Creel N.M. (1996). Limitation of African wild dogs by competition with larger carnivores. Conservation Biology 10, 526–538.

Creel, S.R., & Creel, N.M. (2002). The African Wild Dog: Behavior, Ecology, and Conservation.

Darnell, A. M., Graf, J. A., Somers, M. J., Slotow, R., & Szykman Gunther, M. (2014). Space use of African wild dogs in relation to other large carnivores. *PloS one*, *9*(6), e98846.

Davis, M.S. (1987). Acoustically mediated neighbor recognition in the North American bullfrog, *Rana catesbeiana*. *Behav. Ecol. Sociobiol.* 21, 185-190

De Villiers, M., Richardson, P. L., & Van Jaarsveld, A. S. (2003). Patterns of coalition formation and spatial association in a social carnivore, the African wild dog (*Lycaon pictus*). *Journal of Zoology*, *260*(4), 377–389.

Deecke, VB., Ford, JK., Spong, P. (2000). Dialect change in resident killer whales: implications for vocal learning and cultural transmission. *Anim. Behav.* 60, 629–638.

Demartsev, V., Strandburg-Peshkin, A., Ruffner, M., & Manser, M. B. (2018). Vocal Turn-Taking in Meerkat Group Calling Sessions. Current Biology, 28(22), 3661-3666.e3.

Downs, C. T., Becker, P., Beverley, G., Davies-Mostert, H. T., Du Plessis, C., . . . Parker, D. (2019). Factors affecting the success of artificial pack formation in an endangered, social carnivore: the African wild dog. *Animal Conservation*, *22*(5), 493–502.

Durbin, L. S. (1998). Individuality in the whistle call of the Asiatic wild dog, *Cuon alpinus*. *Bioacoustics-the International Journal of Animal Sound and Its Recording*, *9*(3), 197–206.

Erwin, J., Maple, T. L. & Mitchell, T. (1979). *Captivity and behavior*. New York: Van Nostrand Reinhold.

Evermann, J. F., & Kennedy, M. A. (2011). Viral Infections. *Elsevier EBooks*, 119–129.

Filatova OA, Deecke VB, Ford JK, Matkin CO, Barrett-Lennard LG, Guzeev MA, Burdin AM, Hoyt E. (2012) Call diversity in the North Pacific killer whale populations: implications for dialect evolution and population history. *Anim. Behav.* 83, 595–603.

Filatova, OA., Samarra, FI., Deecke, VB., Ford, JK., Miller, PJ., Yurk, H. (2015). Cultural evolution of killer whale calls: background, mechanisms and consequences. *Behaviour.* 152, 2001–2038.

Ford, JK. (1991). Vocal traditions among resident killer whales (*Orcinus orca*) in coastal waters of British Columbia. *Can. J. Zool.* 69, 1454–1483.

Fuller, T. K., Kat, P. W., Bulger, J. B., Maddock, A. H., Ginsberg, J. R., Burrows, R., Mcnutt, J. W., & Mills, M. G. L. (1992). Population Dynamics of African Wild Dogs. *In Wildlife 2001: Populations,* 1125–1139

Gascoyne, S. C., Laurenson, M. K., Lelo, S., & Borner, M. (1993). Rabies in African wild dogs (Lycaon pictus) in the Serengeti region, Tanzania. *Journal of Wildlife Diseases*, *29*(3), 396–402.

Harrington, F. H., & Asa, C. S. (2019). 3. Wolf Communication. *Journal of Mammalogy*, *88*(3), 66–103.

Hill, D. A. & van Hooff, J. A. R. A. M. (1994). Affiliative relationships between males in groups of nonhuman primates: a summary. *Behaviour* 130: 143–149

Holekamp, K. E., Sakai, S. T., & Lundrigan, B. L. (2007). Social intelligence in the spotted hyena (*Crocuta crocuta*). *Philosophical Transactions of the Royal Society B*, *362*(1480), 523–538.

Holekamp, K. E., & Sawdy, M. (2019). The evolution of matrilineal social systems in fissiped carnivores. *Philosophical Transactions of the Royal Society B*, *374*(1780), 20180065.

Hubel, T. Y., Myatt, J. P., Jordan, N. R., Dewhirst, O. P., McNutt, J. W., & Wilson, A. M. (2016a). Additive opportunistic capture explains group hunting benefits in African wild dogs. *Nature Communications*, *7*(1), 11033.

Hubel, T. Y., Myatt, J. P., Jordan, N. R., Dewhirst, O. P., McNutt, J. W., & Wilson, A. M. (2016b). Energy cost and return for hunting in African wild dogs and cheetahs. *Nature Communications*, *7*(1), 11034.

IUCN/SSC (2007). Regional Conservation Strategy for the Cheetah and African Wild Dog in Southern Africa. IUCN Species Survival Commission: Gland. Switzerland

Jackson, C. M., Masenga, E. H., Mjingo, E. E., Davies, A., Fossøy, F., Fyumagwa, R. D., Røskaft, E., & May, R. F. (2019). No evidence of handling-induced mortality in Serengeti's African wild dog population. *Ecology and Evolution*. 1-9

Janik, VM., & Slater, PJB. (2000). The different roles of social learning in vocal communication. *Anim. Behav.* 60, 1–11

Kruuk, H., Turner, M. Comparative notes on predation by lion, leopard, cheetah and wild dog in the Serengeti area, East Africa. MAMMALIA, 31, 1-27, 1967.

Leigh, K. A. (2005). The ecology and conservation biology of the endangered African wild dog (Lycaon pictus) in the Lower Zambezi, Zambia. *The University of Sydney*, 56-90

Lindsey, P. A., Du Toit, J. T., & Mills, M. G. L. (2004). Area and prey requirements of African wild dogs under varying habitat conditions: implications for reintroductions. *South African Journal of Wildlife Research*, *34*(1), 77–86.

Lindsey, P.A & Davies-Mostert, H.T. (editors). (2009). South African Action Plan for the Conservation of Cheetahs and African Wild Dogs. Report from *a National Conservation Action Planning Workshop, Bela Bela, Limpopo Province*, South Africa, 18-19

Maddock, A. H. & Mills, M. G. L. (1994). Population characteristics of African wild dogs Lycaon pictus in the eastern Transvaal lowveld, South Africa, as revealed through photographic records. *Biol. Conserv*. 67: 57–62.

Marneweck, C., Becker, P.A., Beverley, G., Davies-Mostert, H.T., du Plessis, C., … Parker, D.M., (2019). Factors affecting the success of artificial pack formation in an endangered, social carnivore: the African wild dog. *Animal Conservation*, *22*(2019), 493–502.

Marsh, S., Woolham, M., & Forsyth, S. (2021). *Canid and Hyanid* in EAZA. (2021). *European Association of Zoos and Aquaria TAG reports 2021*. European Association of Zoos and Aquaria. Retrieved April 3, 2023, from https://www.eaza.net/assets/Uploads/Annual-report/2021-TAGAR-web-VF.pdf

McComb, K., Reby, D., Baker, L., Moss, C. F., & Sayialel, S. (2003). Long-distance communication of acoustic cues to social identity in African elephants. *Animal Behaviour*, *65*(2), 317–329.

Mills, M.G.L., Ellis, S., Woodroffe, R., Maddock, A., Stander, P., Rasmussen, G., Pole, A., Fletcher, P., & Bruford, M. (1998). Population and Habitat Viability Assessment for the African Wild Dog (Lycaon

pictus) in Southern Africa.
http://www.cbsg.org/sites/cbsg.org/files/documents/AfricanWildDogPHVA_Final%20Report.pdf

Mudumba, T., Jingo, S., Heit, D. R., & Montgomery, R. R. (2021). The landscape configuration and lethality of snare poaching of sympatric guilds of large carnivores and ungulates. *African Journal of Ecology*, *59*(1), 51–62.

Murray, M., Goesuch, C., Junker, S., Davis, B., & Woodroffe, R. (2023). *African Painted Dog | Program Plan 2022-2024*. Saving Animals From Extinction | African Painted Dog. Retrieved March 3, 2023, from https://assets.speakcdn.com/assets/2332/african_painted_dog_safe_program_plan_2022-2024_v_2.pdf

Palacios, V., Font, E., & Márquez, R. (2007). Iberian Wolf Howls: Acoustic Structure, Individual Variation, and a Comparison with North American Populations. *Journal of Mammalogy*, *88*(3), 606–613.

Perrachione, T. K., Del Tufo, S. N., & Gabrieli, J. D. (2011). Human voice recognition depends on language ability. *Science (New York, N.Y.)*, *333*(6042), 595.

Pika, S., Wilkinson, R., Kendrick, K. H., & Vernes, S. C. (2018). Taking turns: bridging the gap between human and animal communication. Proceedings of the Royal Society B: Biological Sciences, 285(1880), 20180598.

Potgieter, K. R., O'Riain, M. J., & Davies-Mostert, H. T. (2015). Behavioural Cues Can be Used to Predict the Outcome of Artificial Pack Formation in African Wild Dogs (Lycaon pictus). *South African Journal of Wildlife Research - 24-month Delayed Open Access*.

Rafferty, J. P. (2019). *Biodiversity loss | Causes, Effects, & Facts*. Britannica. Retrieved March 7, 2023, from https://www.britannica.com/science/biodiversity-loss/Ecological-effects

Ray, J., Redford, K. H., Steneck, R., & Berger, J. (2013). Large Carnivores and the Conservation of Biodiversity. Island Press.

Rendall, D., Rodman, P. S., & Emond, R. E. (1996). Vocal recognition of individuals and kin in free-ranging rhesus monkeys. *Animal Behaviour*, *51*(5), 1007–1015.

Robbins, R. L. (2000). Vocal communication in free-ranging African wild dogs (*Lycaon pictus). Behaviour, 137*(10), 1271–1298.

Robbins, R.L. & McCreery, E.K. (2000). Dominant female cannibalism in the African wild dog. Afr J Ecol, 38, 91–92.

Robbins, R., & McCreery, E. K. (2003). African wild dog pup vocalizations with special reference to Morton's model. *Behaviour*, *140*(3), 333–351.

Sadler, L. M. & Ward, S. J. (1999). Coalitions in male sugar gliders: are they natural? *J. Zool.* (Lond.) 248, 91–96.

Schel, A.M., Machanda, Z., Townsend, S.W., Zuberbühler, K., & Slocombe, K.E. (2013). Chimpanzee food calls are directed at specific individuals. *Anim. Behav.* 86, 955-965.

Seyfarth, R. M., & Cheney, D. L. (1989). Redirected Aggression and Reconciliation Among Vervet Monkeys, Cercopithecus Aethiops, *Behaviour*, *110*(1-4), 258-275.

Takahashi, D. Y., Narayanan, D. Z., & Ghazanfar, A. A. (2013). Coupled Oscillator Dynamics of Vocal Turn-Taking in Monkeys. Current Biology, 23(21), 2162–2168.

Thomas, P. R., Powell, D. M., Fergason, G., Kramer, B., Nugent, K., Vitale, C., Stehn, A. M., & Wey, T. (2006). Birth and simultaneous rearing of two litters in a pack of captive African wild dogs (Lycaon pictus). *Zoo Biology*, *25*(6), 461–477.

Reynolds MBJ, Hayes WK, Wiley JW. (2010). Geographic variation in the flight call of the Cuban parrot (*Amazona leucocephala*) and its taxonomic relevance. *Journal of Caribbean Ornithology*. 1, 4–18.

Van den Berghe, F., Paris, D. B. B. P., van Soom, A., Rijsselaere, T., van der Weyde, L., Bertschinger, H. J., & Paris, M. C. J. (2012). Reproduction in the endangered African wild dog: Basic physiology, reproductive suppression and possible benefits of artificial insemination. *Animal Reproduction Science*, *133*(1–2), 1–9.

Van Den Berghe, F., Paris, M., Sarnyai, Z., Vlamings, B. H., Millar, R. P., Ganswindt, A., Cozzi, A., Pageat, P., & Paris, D. B. (2019a). Dog appeasing pheromone prevents the androgen surge and may reduce contact dominance and active submission after stressful interventions in African wild dogs (Lycaon pictus). *PLOS ONE*, *14*(3), e0212551.

Van Den Berghe, F., Paris, M., Sarnyai, Z., Briggs, M., Millar, R. P., Ganswindt, A., & Paris, D. B. (2019b). Social rank does not affect sperm quality in male African wild dogs (Lycaon pictus). *Reproduction, Fertility and Development*, *31*(5), 875.

Wayne, R. K., & Vila, C. (2003). Molecular Genetic Studies of Wolves. *Journal of Mammalogy*, *88*(3), 606–613.

Weilgart, L., & Whitehead, H. (1997). Group-specific dialects and geographical variation in coda repertoire in South Pacific sperm whales. *Behavioral Ecology and Sociobiology*, *40*(5), 277–285.

Weyde, Van Der, L. (2013). Reproductive Biology of the Endangered African Wild Dog (Lycaon pictus) in Captive and Free-ranging Populations: an Endocrine, Behavioural and Demographic Approach. *The University of Western Australia*. https://ibream.org/wp-content/uploads/2018/04/VANDERWEYDEL-THESIS2.pdf

Wiley, RH. (1971). Song groups in a singing assembly of Little Hermits. *Condor.* 73, 28–35.

Woodroffe, R., and J. R. Ginsberg. (1997a). *Introduction.* Pages 2-6 in Woodroffe, R., Ginsberg, J., & Macdonald, G. (1997d). Status survey and conservation action plan: the African wild dog. *Gland (Switzerland): International Union for Conservation of Nature/Species Survival Commission Canid Specialist Group*.

Woodroffe, R., and J. R. Ginsberg. (1997b). *Measures for the Conservation and Management of Free-ranging Wild Dog Populations.* Pages 88- 99 in Woodroffe, R., Ginsberg, J., & Macdonald, G. (1997d). Status survey and conservation action plan: the African wild dog. *Gland (Switzerland): International Union for Conservation of Nature/Species Survival Commission Canid Specialist Group*.

Woodroffe, R., and J. R. Ginsberg. (1997c). *The role of captive breeding and reintroduction in wild dog conservation.* Pages 100-111 in Woodroffe, R., Ginsberg, J., & Macdonald, G. (1997d). Status survey and conservation action plan: the African wild dog. *Gland (Switzerland): International Union for Conservation of Nature/Species Survival Commission Canid Specialist Group*.

Woodroffe, R., Ginsberg, J., & Macdonald, G. (1997d). Status survey and conservation action plan: the African wild dog. *Gland (Switzerland): International Union for Conservation of Nature/Species Survival Commission Canid Specialist Group*.

Woodroffe R., Davies-Mostert H., Ginsberg J., Graf J., Leigh K., McCreery K., Robbins R., Mills G., Pole A., Rasmussen G., Somers M. (2007). Rates and causes of mortality in endangered African wild dogs *Lycaon pictus*: lessons for management and monitoring. *Oryx* 41:215–223.

Woodroffe, R., Prager, K. C., Munson, L., Conrad, P. A., Dubovi, E. J., & Mazet, J. A. (2012). Contact with domestic dogs increases pathogen exposure in endangered African wild dogs (Lycaon pictus). *PloS one*, 7(1), e30099.

Woodroffe, R. & Sillero-Zubiri, C. 2020. Lycaon pictus (amended version of 2012 assessment). The IUCN Red List of Threatened Species 2020: e.T12436A166502262. Accessed on 29 May 2023. https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T12436A166502262.en.

Wright, T.F. (1996). Regional dialects in the contact call of a parrot. *Proceedings of the Royal Society of London B.* 263, 867–872.

Wright, T. F., & Dahlin, C. R. (2018). Vocal dialects in parrots: patterns and processes of cultural evolution. *The Emu*, *118*(1), 50–66.

Yin, S., & McCowan, B. (2004). Barking in domestic dogs: context specificity and individual identification. *Animal Behaviour*, *68*(2), 343–355.

Reference for Images

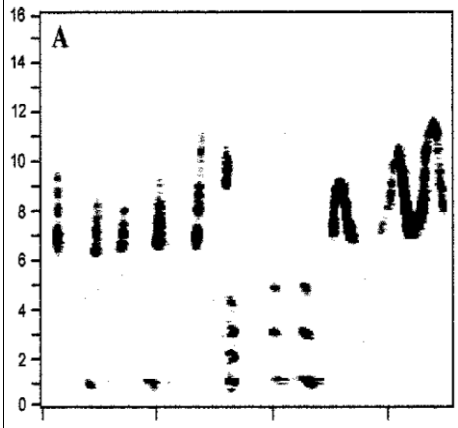
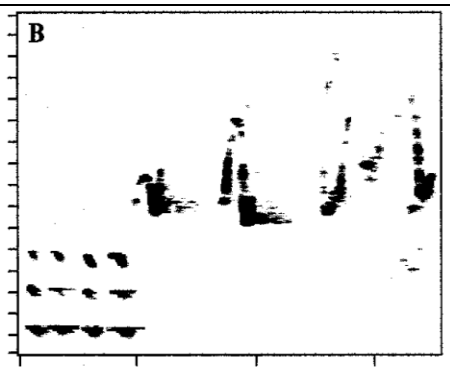
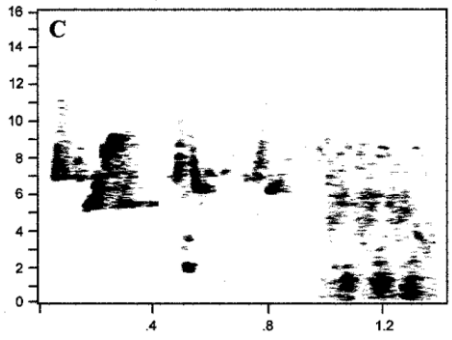
Kruger-2-Kalahari. (2022). *Photographing African Wild Dogs*. https://www.kruger-2-kalahari.com/photographing-african-wild-dogs.html

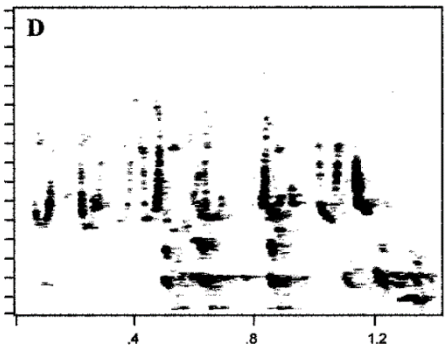
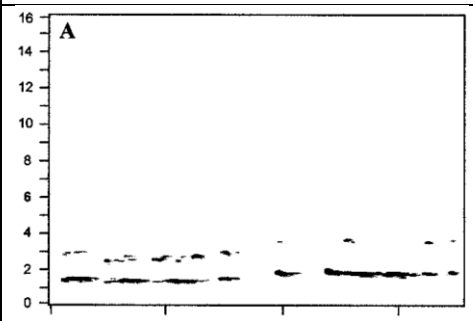
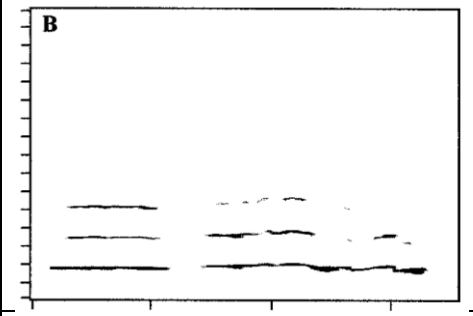
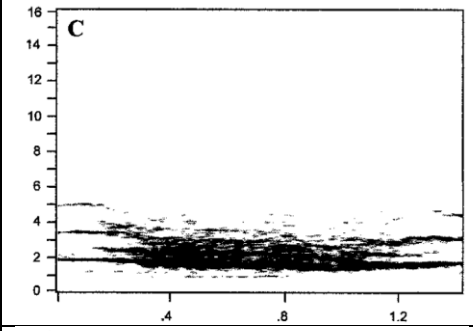
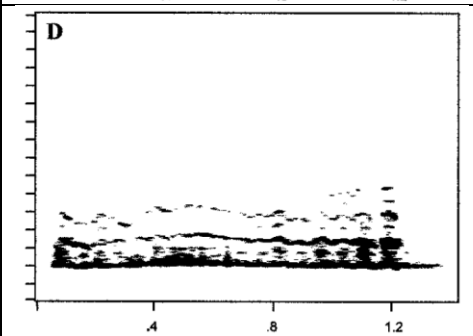
Stribbling, D. (2022). *African Wild Dogs Poster*. Fine Art America. https://fineartamerica.com/featured/african-wild-dogs-david-stribbling.html?product=poster

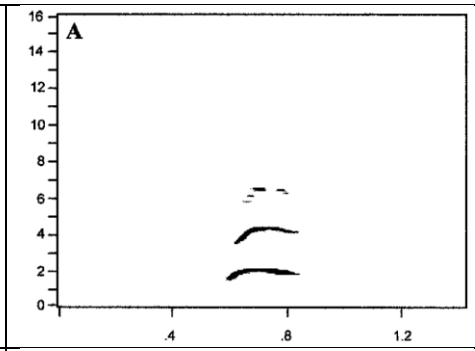
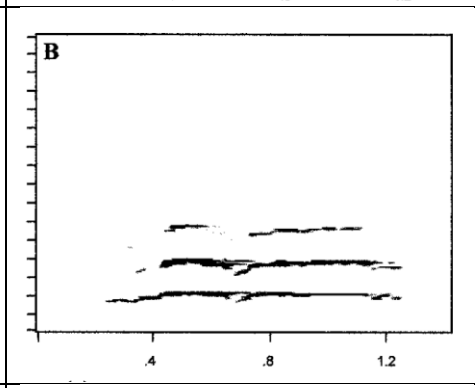
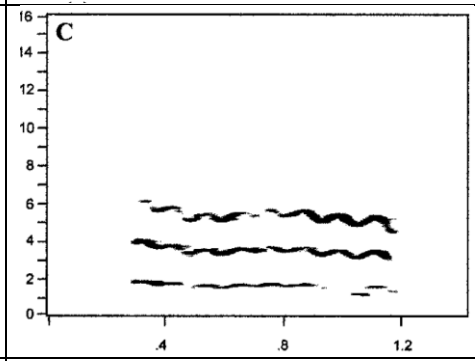
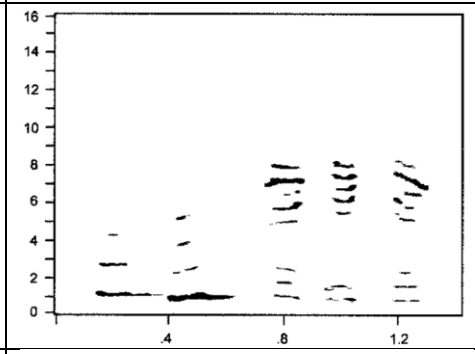
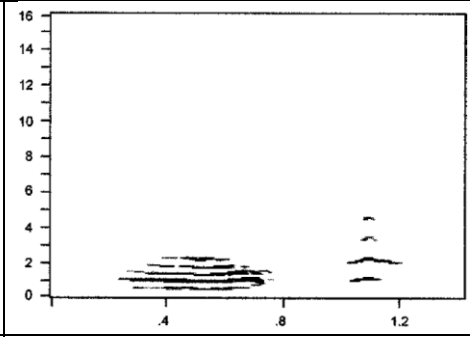
Woodroffe, R., and J. R. Ginsberg. (1997). *The role of captive breeding and reintroduction in wild dog conservation.* Pages 100-111 in R. Woodroffe, J. R. Ginsberg, and D. W. Macdonald, editors. The African Wild Dog: Status Survey and Conservation Action Plan. IUCN, Gland, Switzerland.

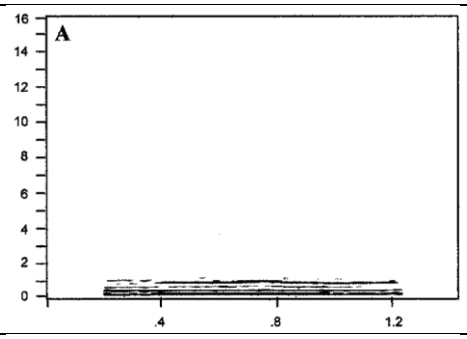
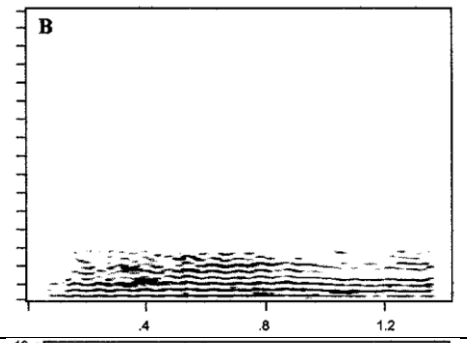
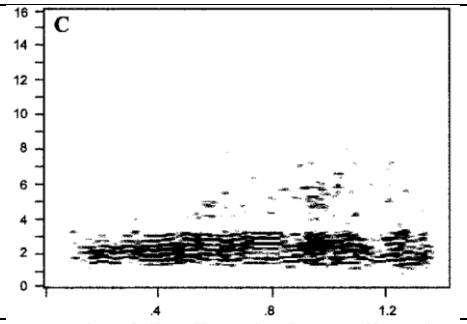
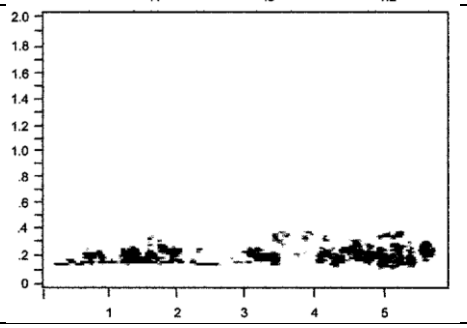
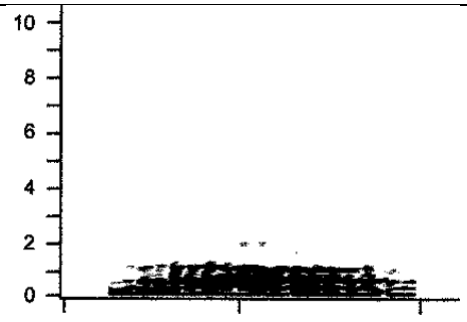
Woodroffe, R. & Sillero-Zubiri, C. (2020). *Lycaon pictus* (amended version of 2012 assessment). *The IUCN Red List of Threatened Species* 2020: e.T12436A166502262. https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T12436A166502262.en. Accessed on March 2nd, 2023.

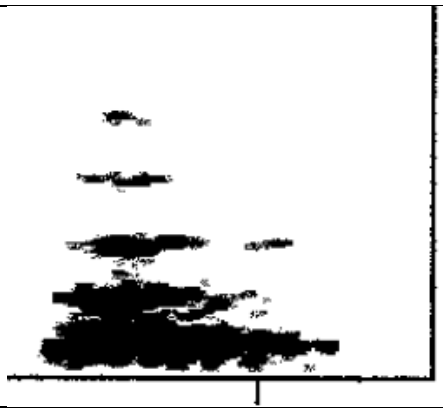
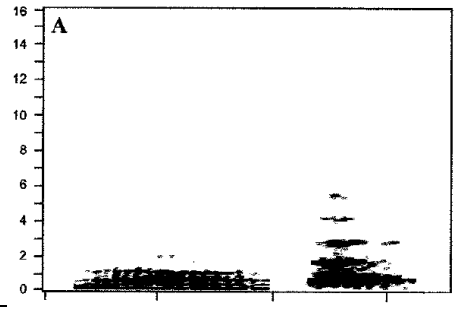
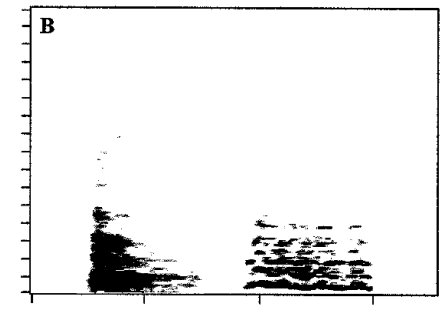
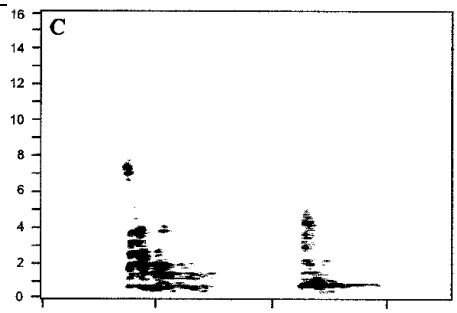
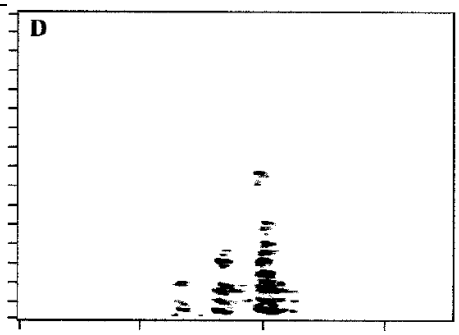
Appendix I – Ethogram of Pia Riddell

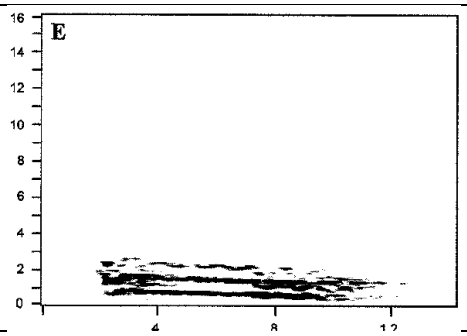
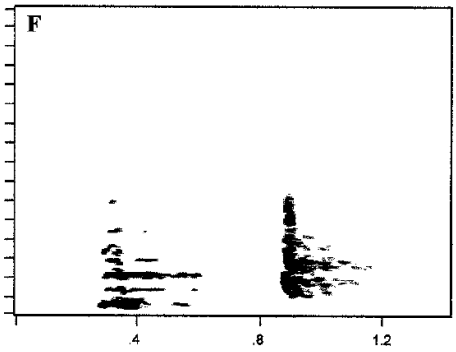
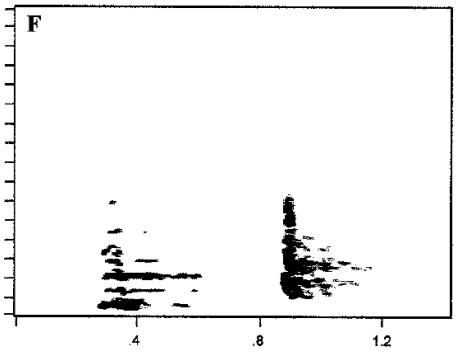
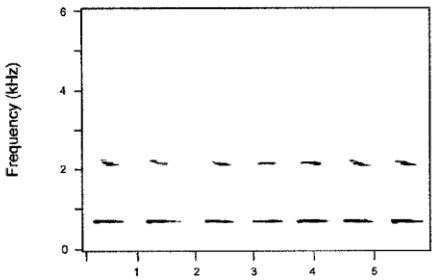
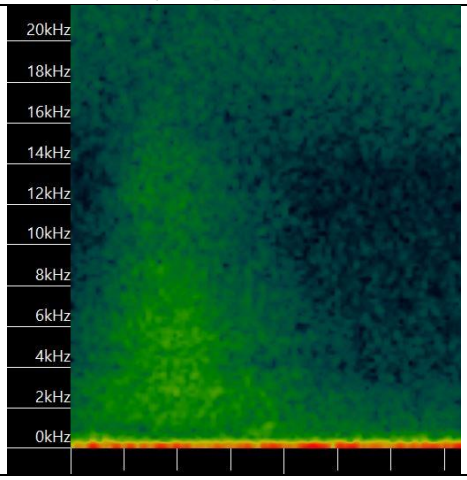
Call ID	Spectrogram	context	Acoustic burst lengths	Bouts
Twitters				
Social Twitter - Low and high freq range (high predominant) - Noisy and harmonic		Vocal accompaniments in greeting ceremonies and along with gestures, serve to reinforce social bonds. Sometimes given during resting when individuals reposition themselves or approach another animal. Typically given during high arousal	0.2-6.0 sec	Up to 83.0 sec
Spar Twitter - Low-frequency components more common - High freq components often chevron shaped and energy uneven - Harmonic intervals greater and intersyllable interval shorter		Vigorous play Appeasement Engaged in social investigation during pack formation	0.3-1.0 sec	Up to 6.3 sec
Mob Twitter - Low frequency generally suppressed - Noisey with breathy quality - Disyllabic with first syllable vertical – 0.05-0.2 sec and 0.2-0.5s between pairs		Mobbing other pack members Pursuing prey Chasing kleptoparasites from prey Resting pups when approached by adults as warning	0.9-1.8 sec	9.7 sec

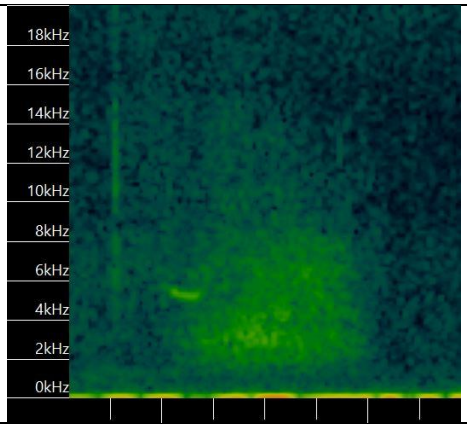
Attack twitter - Lower components more pronounced - Mostly noisy, low frequency - Nasal sound - High pitched U-shaped twitters		Packs chasing hyenas Interpack encounters Resting pups approached by adults	0.3-0.8 sec	Up to 6.8 sec
Begging cries				
Staccato		Food solicitation Greeting ceremonies (solical solicitation) Distress (spectrally noisier	0.3-11.1 sec	0.5-137.0s ec
Steady-state and modulated		Food solicitation Greeting ceremonies (solical solicitation) Distress (spectrally noisier		
Scream		Food solicitation Greeting ceremonies (solical solicitation) Distress (spectrally noisier		
Gurgle		During peak arousal, begging cries can encapsulate noisy components that range from 0.1-0.3s in length and 1.0-3.0kHz in frequency. Aside from buzz moans longest syllable lengths		
Yelps/Squeals				

Yelps - Short, sharp sounds - Diagnostically convex		Submission by subordinates' anticipation or response to pain Given in appeasement and solicitation during greeting ceremonies		
Whistle Squeals - Steady state or modulated - Syllable length 3x yelps - Single or multiple syllables - Intersyllable interval 0.04-0.06s		Similar contexts to yelps		
Begging Squeals - Diagnostically sinusoidal - Higher fundamentals and narrower freq ranges than yelps or whistle squeals		Greeting ceremonies Begging cry displays as an expression of solicitation and appeasement Also can accompany spar twitters		
Whimpers - Low frequency, low-medium amplitude		Usually repetitive Given when dogs approach one another or reposition themselves during resting When pups call from den Greeting ceremonies Can be a sign of ambivalence during mobbing		
Whines - Low to high freq and low-med amplitude - Steady state or modulated - Harmonics pronounced and syllables not repeated		Mew like during greeting ceremonies Solicitation frustration		
Moans				

Full moan - Shortest syllables and narrowest freq		Indicate frustration		
Buzz moan - Longest syllable length of any vocalisations		Context specific to the initial excitatory phase of high intensity greeting ceremonies and begging cry displays		
Buzz gurgle moan		Have greater fundamental freq. range than buzz moans alone		
Rumbles - Lowest sound - Staccato-like guttural components		Given during intial excitatory phase of greeting ceremonies		10 sec
Growls				
Social growls - Medium amplitude - Relatively uniform - Tight banded harmonics		Antagonistic interactions with other pack members		

Alarm growls - Shorter - Greater frequency spread - More amplified		Warn packs when confronted with a possible threat	0.5-6.3sec	13.5-106 sec
Barks				
Alarm barks Common alarm bark growl like in appearance and auditory quality		Same motivational intensity as alarm growls, serve similar function		
Alarm bark Tremelo alarm bark Indicates higher level of arousal than common alarm bark		More harmonic & longer than common alarm bark More uniform distribution of energy over time Given in presence of lions or humans approaching Occasionally issued repeatedly with intersyllable intervals		
Threat barks Shorter than alarm Disyllabic Each syllable same relative length, separated by intervals 0.1-0.3sec		Express motivational ambivalence Given towards pups soliciting food Appear to signal muted aggression		
Attack Bark Shortest bark and most harmonic Harmonics strong and tightly banded Low to medium amplitude Nasal quality		Pack members chasing hyenas		

Howl Bark Longest bark Least frequency spread Uttered with tremelo		Frequency:0.3-0.5kHz Individual dogs running excitedly during intrapack encounters		
Clear Bark (left) Mostly harmonic		Not often emitted Sharp barks Indicate alarm or affiliative interaction with pups		
Yelp Bark (right) Mostly noisy		Aggressively given when pack mobbing hyenas Can be affiliative		
Hoo Call Pulsed Monotonic Concatenations of single syllables		Long distance contact call Issued when dogs separated,		
Sneeze				

Huff	18kHz 16kHz 14kHz 12kHz 10kHz 8kHz 6kHz 4kHz 2kHz 0kHz			

Appendix II – Vocalisation parameters ethogram

This overview was used to determine the vocalisations in the spectrogram of the Kaleidoscope [not published].

Vocalisation	Spectral type	Frequency range (Hz)	Syllable length (s)	Intersyllable interval (ms)	Distinguishing features
Twitters					
Social twitters	Low & high frequency: noisy /harmonic	400-2500	0,03-0,07	100	At high-frequency vertical and chevron components
Spar twitters	Low & high frequency: noisy /harmonic	400-2500	0,03-0,3	50-300	At high-frequency chevron components
Mob twitters	Medium frequency: noisy /harmonic High frequency: mostly noisy	500-1400	0,02-0,05	50-800	Low frequency suppressed Noisy with breathy quality Disyllabic with first syllable vertical
Attack twitters	Low frequency: mostly noisy High frequency: noisy /harmonic	200-1200	0,02-0,06	40-400	Low-frequency components more pronounced Nasal sounding High pitched U shaped twitters present
Begging cry	harmonic	500-5500	0,03-2,2	20-600	Staccato, steady-state, modulated or screams are spectrally different
Gurgles	Noisy /harmonic	300-1800	0,3-5,5	500-7000	Can encapsulate the noisy component of begging cries ranging from 0.1-0.3 seconds in length and 1.0-3.0kHz in frequency. Second longest syllable length of any vocalisation.
Yelp/squeal					
Yelp	Harmonic	700-7000	0,1-0,3	NA	Short, sharp sound. Convex spectral shape
Whistle	Harmonic	700-7000	0,4-1,0	NA	Steady-state or modulated. Single or multiple syllables.
Begging	harmonic	1000-7000	0,5-1,0	NA	Sinusoidal shape to spectrogram.
Whimper	harmonic	300-8000	0,1-0,4	200-1500	Low-frequency components with low-medium amplitude
Whine	Harmonic/richly harmonic	400-5000	0,2-2,7	NA	Low to the high-frequency range with low to medium amplitude. Can be steady-state or modulated. Harmonics pronounced and syllables not repeated.
Moans					
Full	Richly harmonic	100-1200	0,2-1,2	NA	Short syllables and narrow frequency bands.

Buzz	Richly harmonic	200-3000	0,5-10,0	NA	Longest syllable length of any vocalisation.
Buzz Gurgle	Richly harmonic/noisy	200-3000	0,5-10,0	NA	Greater fundamental frequency than buzz moans.
Rumbles	Mostly noisy	200-500	0,1-1,3	20-200	Lowest sound. Staccato-like guttural components present.
Growls					
Social	Mostly noisy	200-1500	0,4-0,8	NA	Relatively uniform frequency. Tight harmonic banding.
Alarm	Mostly noisy	300-2000	0,2-0,4	500-6300	Greater frequency spread than social growls & greater amplification.
Barks					
Alarm (common)	Mostly noisy	200-4500	0,1-0,6	500-6300	Growl-like in appearance and auditory quality.
Alarm (Tremelo)	Noisy/harmonic	500-4500	0,6-0,7	500-6300	Tremolo bark. More harmonic and longer than common barks with more uniform distribution.
Threat	Noisy/harmonic	500-4000	0,2-0,3	100-300	Disyllabic and each syllable approximately the same length.
Howl	Mostly harmonic	500-3000	0,7-1,2	4100-9300	Longest bark call Least amount of frequency spread of any vocalisation Uttered with tremolo.
Attack	Mostly harmonic	300-4000	0,04-0,1	30-50	Shortest & most harmonic bark. Harmonics strong & tightly banded. Low to medium amplitude Nasal quality.
Clear	Mostly harmonic	300-4000	0,1-0,4	NA	
Yelp	Mostly noisy harmonic	600-6500	0,1-0,2	NA	
Hoo calls	harmonic	600-800	0,1-0,8	100-1400	Pulsatile, monotonic concatenations of single syllables.

Appendix III – Research model

The research model of the graduation research for year 4 is presented and described below (Fig. 8).

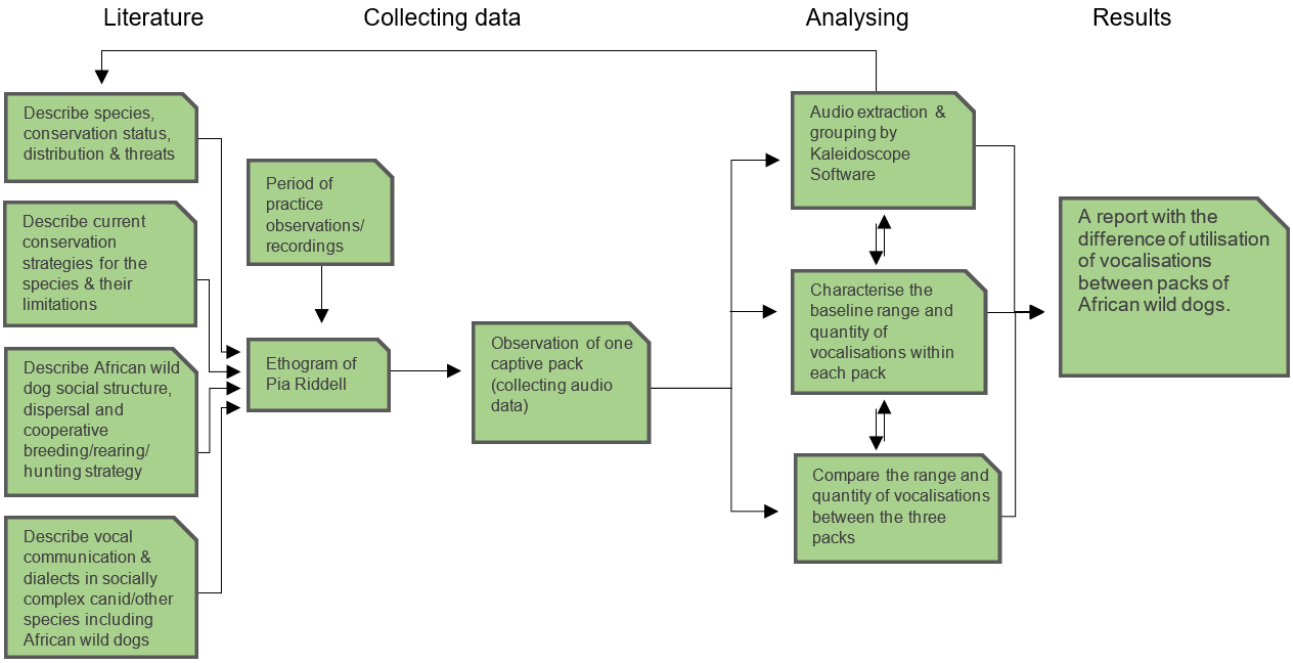


Figure 8. Research model of the graduate research of the influence of genetic relatedness on vocalizations of African wild dogs. The models consists of four parts: literature, collecting data, analysing and results.

Appendix IV – Overview of the days of the vocalisations

The names of the files are directly copied from the audio files. This table contains all files from the five days to keep an overview.

Institute	Date of videos (D/M/Y)	Nr. of the day	Number of audio files this day	File names (with vocals given a *)	Comments
Bothongo Rhino and Lion Nature Reserve	11/04/2023	(1)	9	110423 Day 1 Audio 1 File 003* 110423 Day 1 Audio 2 File 015 110423 Day 1 Audio 2 File 015 mic 2 110423 Day 1 Audio 3 File 017 110423 Day 1 Audio 4 File 018* 110423 Day 1 Audio 5 File 023 110423 Day 1 Audio 6 File 026* 110423 Day 1 Audio 7 File 028* 110423 Day 1 Audio 8 File 029	
	12/04/2023	(2)	23	120423 Day 2 Audio 1 File 030* 120423 Day 2 Audio 2 File 034 mic 2 120423 Day 2 Audio 2 File 034 120423 Day 2 Audio 2 File 035 120423 Day 2 Audio 2 File 036 120423 Day 2 Audio 6 File 040 120423 Day 2 Audio 7 File 041* 120423 Day 2 Audio 8 File 045* 120423 Day 2 Audio 9 File 046* 120423 Day 2 Audio 10 File 048* 120423 Day 2 Audio 11 File 049 120423 Day 2 Audio 12 File 050* 120423 Day 2 Audio 13 File 051* 120423 Day 2 Audio 14 File 052* 120423 Day 2 Audio 15 File 053 120423 Day 2 Audio 16 File 054* 120423 Day 2 Audio 17 File 055* 120423 Day 2 Audio 18 File 057* 120423 Day 2 Audio 19 File 058* 120423 Day 2 Audio 20 File 059* 120423 Day 2 Audio 21 File 061* 120423 Day 2 Audio 22 File 065 120423 Day 2 Audio 23 File 066*	Feeding around 13h
	13/04/2023	(3)	28	130423 Day3 audio 1 file 1* 130423 Day3 audio 2 file 2* 130423 Day3 audio 3 file 3 130423 Day3 audio 3.1 file 4 130423 Day3 audio 4 file 5* 130423 Day3 audio 5 file 6 130423 Day3 audio 6 file 7 130423 Day3 audio 7 file 8 130423 Day3 audio 8 file 9* 130423 Day3 audio 9 file 10* 130423 Day3 audio 10 file 11 130423 Day3 audio 11 file 12 130423 Day3 audio 12 file 13* 130423 Day3 audio 13 file 14* 130423 Day3 audio 14 file 15* 130423 Day3 audio 15 file 16 130423 Day3 audio 16 file 17 130423 Day3 audio 17 file 18* 130423 Day3 audio 18 file 19*	Feeding in the morning

				130423 Day3 audio 19 file 20 130423 Day3 audio 20 file 21 130423 Day3 audio 21 file 22* 130423 Day3 audio 22 file 23 130423 Day3 audio 23 file 24 130423 Day3 audio 24 file 25 130423 Day3 audio 25 file 26 130423 Day3 audio 26 file 27* 130423 Day3 audio 27 file 28	
Albuquerque Biopark Zoo	12/05/2014	(1)	4	File ABQ-12052014-0938am* File ABQ-12052014-1051am* File ABQ-12052014-1114am* File ABQ-12052014-1130am*	
	13/05/2014	(2)	3	File ABQ-13052014-1000am* File ABQ-13052014-1025am* File ABQ-13052014-1042am*	
	14/05/2014	(3)	5	File ABQ-14052014-0959am* File ABQ-14052014-1003am* File ABQ-14052014-1007am* File ABQ-14052014-1041am* File ABQ-14052014-1053am*	
Brookfield Zoo	23/06/2014	(-3)	4	BRK-23062014-0947am* BRK-23062014-1032am* BRK-23062014-1220am* BRK-23062014-1438am*	
	24/06/2014	(-2)	3	BRK-23062014-CAM2-0923am* BRK-23062014-CAM2-1428am* BRK-24062014-CAM2-1440am*	
	25/06/2014	(-1)	3	BRK-25062014-CAM1-1443* BRK-25062014-CAM2-1432* BRK-25062014-CAM2-1544*	

Appendix V – Overview of the analysis

The overview of the analysed audio files is shown. Additionally, the cumulative numbers per vocal found in the raw and normalised data analysis are shown.

Institute and day	Nr. of audio files	Nr. full audio files in seconds	Nr. full audio files in minutes	Nr. full audio files in hours	Nr. of seconds of vocals in audio files	Nr. of vocals in audio files
Albuquerque Biopark Zoo (ABQ)						
day 1	4	3214,1	53,57	0,89	17,31	96
day 2	3	1977,38	32,96	0,55	14,94	179
day 3	5	2404,43	40,07	0,67	48,43	398
Total of 3 days	12	7595,91	126,60	2,11	80,68	673
Bothongo Rhino and Lion Nature Reserve (BOT)						
day 1	9	2016,65	33,61	0,56	10,39	13
day 2	22	3846,5	64,11	1,07	54,9	145
day 3	28	9597,93	159,97	2,67	42,16	230
Total of 3 days	59	15461,08	257,68	4,29	107,45	388
Brookfield Zoo (BRK)						
day -3	4	1516,1	25,27	0,42	13,61	32
day -2	3	2649,2	44,15	0,74	11,72	27
day -1	3	1735,29	28,92	0,48	9,62	37
Total of 3 days	10	5900,59	98,34	1,64	34,95	96
Cumulative total	81	28957,58	482,63	8,04	223,08	1157

Cumulative number per vocal found in raw data analysis

	ABQ	BOT	BRK	Total	Perc
Social twitter	219	4	0	223	23,01%
Spar twitter	260	5	2	267	27,55%
Mob twitter	31	0	0	31	3,20%
Begging cry	14	13	4	31	3,20%
Yelp	1	18	14	33	3,41%
Whistle squeal	0	8	12	20	2,06%
Begging squeal	7	110	20	137	14,14%
Whimper	1	157	3	161	16,62%
Whine	7	9	0	16	1,65%
Buzz gurgle moan	0	3	0	3	0,31%
Rumble	4	5	0	9	0,93%
Social growl	7	0	0	7	0,72%
Alarm growl	4	0	0	4	0,41%
Common alarm bark	5	0	0	5	0,52%
Threat bark	4	0	0	4	0,41%
Howl bark	3	0	0	3	0,31%
Clear bark	5	0	0	5	0,52%
Yelp bark	1	1	1	3	0,31%
Sneeze	0	2	0	2	0,21%
Huff	5	0	0	5	0,52%
Total	573	333	56	969	100%

Cumulative number per vocal found in normalised data analysis

	ABQ	BOT	BRK	Total	Perc
Social twitter	103,79	0,93	0,00	104,72	27,13%
Spar twitter	123,22	1,16	1,22	125,61	32,54%
Mob twitter	14,69	0,00	0,00	14,69	3,81%
Begging cry	6,64	3,03	2,44	12,10	3,14%
Yelp	0,47	4,19	8,54	13,21	3,42%
Whistle squeal	0,00	1,86	7,32	9,18	2,38%
Begging squeal	3,32	25,61	12,20	41,13	10,66%
Whimper	3,32	25,61	12,20	41,13	10,66%
Whine	3,32	2,10	0,00	5,41	1,40%
Buzz gurgle moan	0,00	0,70	0,00	0,70	0,18%
Rumble	0,00	0,70	0,00	0,70	0,18%
Social growl	3,32	0,00	0,00	3,32	0,86%
Alarm growl	1,90	0,00	0,00	1,90	0,49%
Common alarm bark	2,37	0,00	0,00	2,37	0,61%
Threat bark	1,90	0,00	0,00	1,90	0,49%
Howl bark	1,42	0,00	0,00	1,42	0,37%
Clear bark	2,37	0,00	0,00	2,37	0,61%
Yelp bark	0,47	0,23	0,61	1,32	0,34%
Sneeze	0,00	0,47	0,00	0,47	0,12%
Huff	2,37	0,00	0,00	2,37	0,61%
Total	272,52	66,13	44,54	386,02	100%

Appendix VI – Tables per vocalisations

These tables contain the accumulated data per vocalisations per pack per day and added is the normalised data per vocalisation per pack per day. Additionally, the mean per day and mean per hour are shown.

Social twitter

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	0	0	219	73,00	0,00	0,00	103,79	34,6
BOT	0	3	1	1,33	0,00	0,70	0,23	0,3
BRK	0	0	0	0,00	0,00	0,00	0,00	0,0

Spar twitter

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	80	93	87	86,67	37,92	44,08	41,23	41,1
BOT	1	3	1	1,67	0,23	0,70	0,23	0,4
BRK	0	0	2	0,67	0,00	0,00	1,22	0,4

Mob twitter

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	0	0	31	10,33	0,00	0,00	14,69	4,9
BOT	0	0	0	0,00	0,00	0,00	0,00	0,0
BRK	0	0	0	0,00	0,00	0,00	0,00	0,0

Begging cry

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	0	0	14	4,67	0,00	0,00	6,64	2,2
BOT	1	8	4	4,33	0,23	1,86	0,93	1,0
BRK	0	0	4	1,33	0,00	0,00	2,44	0,8

Yelp

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	1	0	0	0,33	0,47	0,00	0,00	0,2
BOT	0	1	17	6,00	0,00	0,23	3,96	1,4
BRK	4	1	9	4,67	2,44	0,61	5,49	2,8

Whistle squeal

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	0	0	0	0,00	0,00	0,00	0,00	0,0
BOT	0	6	2	2,67	0,00	1,40	0,47	0,6
BRK	9	0	3	4,00	5,49	0,00	1,83	2,4

Begging squeal

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	0	0	7	2,33	0,00	0,00	3,32	1,1
BOT	0	51	59	36,67	0,00	11,87	13,74	8,5
BRK	4	9	7	6,67	2,44	5,49	4,27	4,1

Whimper

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	0	0	1	0,33	0,00	0,00	0,47	0,2
BOT	0	69	88	52,33	0,00	16,07	20,49	12,2
BRK	0	0	3	1,00	0,00	0,00	1,83	0,6

Whine

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	0	7	0	2,33	0,00	3,32	0,00	1,1
BOT	5	1	3	3,00	1,16	0,23	0,70	0,7
BRK	0	0	0	0,00	0,00	0,00	0,00	0,0

Buzz gurgle moan

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	0	0	0	0,00	0,00	0,00	0,00	0,0
BOT	0	3	0	1,00	0,00	0,70	0,00	0,2
BRK	0	0	0	0,00	0,00	0,00	0,00	0,0

Rumble

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	0	0	4	1,33	0,00	0,00	1,90	0,6
BOT	1	0	4	1,67	0,23	0,00	0,93	0,4
BRK	0	0	0	0,00	0,00	0,00	0,00	0,0

Social growl

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	2	0	5	2,33	0,95	0,00	2,37	1,1
BOT	0	0	0	0,00	0,00	0,00	0,00	0,0
BRK	0	0	0	0,00	0,00	0,00	0,00	0,0

Alarm growl

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	1	0	3	1,33	0,47	0,00	1,42	0,6
BOT	0	0	0	0,00	0,00	0,00	0,00	0,0
BRK	0	0	0	0,00	0,00	0,00	0,00	0,0

Common alarm growl

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	0	0	5	1,67	0,00	0,00	2,37	0,8
BOT	0	0	0	0,00	0,00	0,00	0,00	0,0
BRK	0	0	0	0,00	0,00	0,00	0,00	0,0

Threat bark

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	0	0	4	1,33	0,00	0,00	1,90	0,6
BOT	0	0	0	0,00	0,00	0,00	0,00	0,00
BRK	0	0	0	0,00	0,00	0,00	0,00	0,00

Howl bark

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	0	0	3	1,00	0,00	0,00	1,42	0,5
BOT	0	0	0	0,00	0,00	0,00	0,00	0,0
BRK	0	0	0	0,00	0,00	0,00	0,00	0,0

Clear bark

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	1	0	4	1,67	0,47	0,00	1,90	0,8
BOT	0	0	0	0,00	0,00	0,00	0,00	0,0
BRK	0	0	0	0,00	0,00	0,00	0,00	0,0

Yelp bark

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	0	0	1	0,33	0,00	0,00	0,47	0,2
BOT	0	1	0	0,33	0,00	0,23	0,00	0,1
BRK	1	0	0	0,33	0,61	0,00	0,00	0,2

Sneeze

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	0	0	0	0,00	0,00	0,00	0,00	0,0
BOT	0	2	0	0,67	0,00	0,47	0,00	0,2
BRK	0	0	0	0,00	0,00	0,00	0,00	0,0

Huff

Pack	day 1	day 2	day 3	Mean per day	day 1 per hour	day 2 per hour	day 3 per hour	Mean per hour
ABQ	0	0	5	1,67	0,00	0,00	2,37	0,8
BOT	0	0	0	0,00	0,00	0,00	0,00	0,00
BRK	0	0	0	0,00	0,00	0,00	0,00	0,00

Appendix VII – SPSS tables

Descriptive statistics data

This table shows a statistical overview with the raw results of the descriptive statistics and the Shapiro-Wilk test per vocalisation per pack. The table beneath it shows the direct results per vocal per pack including the results after applying the $\log_{10}$ to transform not normally distribute data.

Overview of descriptive statistics test raw data

Statistics overview		Descriptives (normal)			Shapiro Wilk
		Mean (statistic)	Skewness (St.)	Standard Error	Significance
ABQ	Social twitter	73,00	1,732	73,0	0,000
BOT	Social twitter	1,33	0,935	0,9	0,637
BRK	Social twitter	0,00	0,000	0,0	.
ABQ	Spar twitter	86,67	-0,230	3,8	0,915
BOT	Spar twitter	1,67	1,732	0,7	0,000
BRK	Spar twitter	0,67	1,732	0,7	0,000
ABQ	Mob twitter	10,33	1,732	10,3	0,000
BOT	Mob twitter	0,00	0,000	0,0	.
BRK	Mob twitter	0,00	0,000	0,0	.
ABQ	Begging cry	4,67	1,732	4,7	0,000
BOT	Begging cry	4,33	0,423	2,0	0,843
BRK	Begging cry	1,33	1,732	1,3	0,000
ABQ	Yelp	0,33	1,732	0,3	0,000
BOT	Yelp	6,00	1,711	5,5	0,100
BRK	Yelp	4,67	0,722	2,3	0,726
ABQ	Whistle squeal	0,00	0,000	0,0	.
BOT	Whistle squeal	2,67	0,935	1,8	0,637
BRK	Whistle squeal	4,00	0,935	2,6	0,637
ABQ	Begging squeal	2,33	1,732	2,3	0,000
BOT	Begging squeal	36,67	-1,611	18,5	0,239
BRK	Begging squeal	6,67	-0,586	1,5	0,780
ABQ	Whimper	0,33	1,732	0,3	0,000
BOT	Whimper	52,33	-1,410	26,7	0,395
BRK	Whimper	1,00	1,732	1,0	0,000
ABQ	Whine	2,33	1,732	2,3	0,000
BOT	Whine	3,00	0,000	1,2	1,000
BRK	Whine	0,00	0,000	0,0	.
ABQ	Buzz gurgle moan	0,00	0,000	0,0	.
BOT	Buzz gurgle moan	1,00	1,732	1,0	0,000
BRK	Buzz gurgle moan	0,00	0,000	0,0	.
ABQ	Rumble	1,330	1,732	1,3	0,000
BOT	Rumble	1,670	1,293	1,2	0,463
BRK	Rumble	0,000	0,000	0,0	0,000
ABQ	Social growl	2,33	0,586	1,5	0,780
BOT	Social growl	0,00	0,000	0,0	.
BRK	Social growl	0,00	0,000	0,0	.
ABQ	Alarm growl	1,33	0,935	0,9	0,637
BOT	Alarm growl	0,00	0,000	0,0	.
BRK	Alarm growl	0,00	0,000	0,0	.

ABQ	Common alarm bark	1,67	1,732	1,7	0,000
BOT	Common alarm bark	0,00	0,000	0,0	.
BRK	Common alarm bark	0,00	0,000	0,0	.
ABQ	Threat bark	1,33	1,732	1,3	0,000
BOT	Threat bark	0,00	0,000	0,0	.
BRK	Threat bark	0,00	0,000	0,0	.
ABQ	Howl bark	1,00	1,732	1,0	0,000
BOT	Howl bark	0,00	0,000	0,0	.
BRK	Howl bark	0,00	0,000	0,0	.
ABQ	Clear bark	1,67	1,293	1,2	0,463
BOT	Clear bark	0,00	0,000	0,0	.
BRK	Clear bark	0,00	0,000	0,0	.
ABQ	Yelp bark	0,33	1,732	0,3	0,000
BOT	Yelp bark	0,33	1,732	0,3	0,000
BRK	Yelp bark	0,33	1,732	0,3	0,000
ABQ	Sneeze	0,00	0,000	0,0	.
BOT	Sneeze	0,67	1,732	0,7	0,000
BRK	Sneeze	0,00	0,000	0,0	.
ABQ	Huff	0,00	0,000	0,0	.
BOT	Huff	1,67	1,732	1,7	0,000
BRK	Huff	0,00	0,000	0,0	.

Overview of descriptive statistics test raw data transformed with log_{10}

Statistics overview		**Descriptives (in log10)**			**Shapiro Wilk**
		Mean (statistic)	Skewness (St.)	Standard Error	Significance
ABQ	Social twitter	0,781	1,732	0,8	0,000
BOT	Social twitter	0,301	0,000	0,2	1,000
BRK	Social twitter	0,000	0,000	0,0	.
ABQ	Spar twitter	19,942	-0,339	0,0	0,875
BOT	Spar twitter	0,401	1,732	0,1	0,000
BRK	Spar twitter	0,159	1,732	0,2	0,000
ABQ	Mob twitter	0,502	1,732	0,5	0,000
BOT	Mob twitter	0,000	0,000	0,0	.
BRK	Mob twitter	0,000	0,000	0,0	.
ABQ	Begging cry	0,392	1,732	0,4	0,000
BOT	Begging cry	0,651	-0,637	0,2	0,760
BRK	Begging cry	0,223	1,732	0,2	0,000
ABQ	Yelp	0,100	1,732	0,1	0,000
BOT	Yelp	0,519	1,330	0,4	0,443
BRK	Yelp	0,667	-0,411	0,2	0,847
ABQ	Whistle squeal	0,000	0,000	0,0	.
BOT	Whistle squeal	0,441	-0,384	0,2	0,858
BRK	Whistle squeal	0,534	-0,597	0,3	0,776
ABQ	Begging squeal	0,301	1,732	0,3	0,000
BOT	Begging squeal	1,165	-1,725	0,6	0,059
BRK	Begging squeal	0,867	-0,990	0,1	0,613
ABQ	Whimper	0,100	1,732	0,1	0,000

BOT	Whimper	1,265	-1,714	0,6	0,091
BRK	Whimper	0,201	1,732	0,2	0,000
ABQ	Whine	0,301	1,732	0,3	0,000
BOT	Whine	0,560	-0,754	0,1	0,713
BRK	Whine	0,000	0,000	0,0	.
ABQ	Buzz gurgle moan	0,000	0,000	0,0	.
BOT	Buzz gurgle moan	0,201	1,732	0,2	0,000
BRK	Buzz gurgle moan	0,000	0,000	0,0	.
ABQ	Rumble	0,223	1,732	0,2	0,000
BOT	Rumble	0,333	0,411	0,2	0,847
BRK	Rumble	0,000	0,000	0,0	.
ABQ	Social growl	0,418	-0,658	0,2	0,752
BOT	Social growl	0,000	0,000	0,0	.
BRK	Social growl	0,000	0,000	0,0	.
ABQ	Alarm growl	0,301	0,000	0,2	1,000
BOT	Alarm growl	0,000	0,000	0,0	.
BRK	Alarm growl	0,000	0,000	0,0	.
ABQ	Common alarm bark	0,259	1,732	0,3	0,000
BOT	Common alarm bark	0,000	0,000	0,0	.
BRK	Common alarm bark	0,000	0,000	0,0	.
ABQ	Threat bark	0,233	1,732	0,2	0,000
BOT	Threat bark	0,000	0,000	0,0	.
BRK	Threat bark	0,000	0,000	0,0	.
ABQ	Howl bark	0,201	1,732	0,2	0,000
BOT	Howl bark	0,000	0,000	0,0	.
BRK	Howl bark	0,000	0,000	0,0	.
ABQ	Clear bark	0,333	0,411	0,2	0,847
BOT	Clear bark	0,000	0,000	0,0	.
BRK	Clear bark	0,000	0,000	0,0	.
ABQ	Yelp bark	0,100	1,732	0,1	0,000
BOT	Yelp bark	0,100	1,732	0,1	0,000
BRK	Yelp bark	0,100	1,732	0,1	0,000
ABQ	Sneeze	0,000	0,000	0,0	.
BOT	Sneeze	0,159	1,732	0,2	0,000
BRK	Sneeze	0,000	0,000	0,0	.
ABQ	Huff	0,000	0,000	0,0	.
BOT	Huff	0,259	1,732	0,3	0,000
BRK	Huff	0,000	0,000	0,0	.

Overview of descriptive statistics test normalised data

Statistics overview		**Descriptives (normal)**			**Shapiro Wilk**
		Mean (statistic)	Skewness (St.)	Standard Error	Significance
ABQ	Social twitter	34,60	1,732	34,6	0,000
BOT	Social twitter	0,31	0,958	0,2	0,627
BRK	Social twitter	0,00	0,000	0,0	.
ABQ	Spar twitter	41,08	-0,223	1,8	0,918
BOT	Spar twitter	0,39	1,732	0,2	0,000

BRK	Spar twitter	0,41	1,732	0,4	0,000
ABQ	Mob twitter	4,90	1,732	4,9	0,000
BOT	Mob twitter	0,00	0,000	0,0	.
BRK	Mob twitter	0,00	0,000	0,0	.
ABQ	Begging cry	2,21	1,732	2,2	0,000
BOT	Begging cry	1,01	0,418	0,5	0,845
BRK	Begging cry	0,81	1,732	0,8	0,000
ABQ	Yelp	0,16	1,732	0,2	0,000
BOT	Yelp	1,40	1,711	1,3	0,099
BRK	Yelp	2,85	0,722	1,4	0,726
ABQ	Whistle squeal	0,00	0,000	0,0	.
BOT	Whistle squeal	0,62	0,924	0,4	0,624
BRK	Whistle squeal	2,44	0,935	1,6	0,637
ABQ	Begging squeal	1,11	1,732	1,1	0,000
BOT	Begging squeal	8,54	-1,610	4,3	0,240
BRK	Begging squeal	4,07	-0,586	0,9	0,780
ABQ	Whimper	0,16	1,732	0,2	0,000
BOT	Whimper	12,19	-1,410	6,2	0,394
BRK	Whimper	0,61	1,732	0,6	0,000
ABQ	Whine	1,11	1,732	1,1	0,000
BOT	Whine	0,70	-0,032	0,3	0,988
BRK	Whine	0,00	0,000	0,0	.
ABQ	Buzz gurgle moan	0,00	0,000	0,0	.
BOT	Buzz gurgle moan	0,23	1,732	0,2	0,000
BRK	Buzz gurgle moan	0,00	0,000	0,0	.
ABQ	Rumble	0,63	1,732	0,6	0,000
BOT	Rumble	0,62	-0,958	0,3	0,627
BRK	Rumble	0,00	0,000	0,0	.
ABQ	Social growl	1,11	0,581	0,7	0,782
BOT	Social growl	0,00	0,000	0,0	.
BRK	Social growl	0,00	0,000	0,0	.
ABQ	Alarm growl	0,63	0,947	0,4	0,632
BOT	Alarm growl	0,00	0,000	0,0	.
BRK	Alarm growl	0,00	0,000	0,0	.
ABQ	Common alarm bark	0,79	1,732	0,8	0,000
BOT	Common alarm bark	0,00	0,000	0,0	.
BRK	Common alarm bark	0,00	0,000	0,0	.
ABQ	Threat bark	0,63	1,732	0,6	0,000
BOT	Threat bark	0,00	0,000	0,0	.
BRK	Threat bark	0,00	0,000	0,0	.
ABQ	Howl bark	0,47	1,732	0,5	0,000
BOT	Howl bark	0,00	0,000	0,0	.
BRK	Howl bark	0,00	0,000	0,0	.
ABQ	Clear bark	0,79	1,303	0,6	0,458
BOT	Clear bark	0,00	0,000	0,0	.
BRK	Clear bark	0,00	0,000	0,0	.
ABQ	Yelp bark	0,16	1,732	0,2	0,000
BOT	Yelp bark	0,08	1,732	0,1	0,000

BRK	Yelp bark	0,20	1,732	0,2	0,000
ABQ	Sneeze	0,00	0,000	0,0	.
BOT	Sneeze	0,16	1,732	0,2	0,000
BRK	Sneeze	0,00	0,000	0,0	.
ABQ	Huff	0,79	1,732	0,8	0,000
BOT	Huff	0,00	0,000	0,0	.
BRK	Huff	0,00	0,000	0,0	.

Overview of descriptive statistics test normalised data transformed with log_{10}

Statistics overview		Descriptives (in log10)			Shapiro Wilk
		Mean (statistic)	Skewness (St.)	Standard Error	Significance
ABQ	Social twitter	0,67	1,732	0,7	0,000
BOT	Social twitter	0,11	0,640	0,1	0,759
BRK	Social twitter	0,00	0,000	0,0	0,000
ABQ	Spar twitter	1,623	-0,331	0,0	0,878
BOT	Spar twitter	0,137	1,732	0,0	0,000
BRK	Spar twitter	0,116	1,732	0,1	0,000
ABQ	Mob twitter	0,399	1,732	0,4	0,000
BOT	Mob twitter	0,000	0,000	0,0	.
BRK	Mob twitter	0,000	0,000	0,0	.
ABQ	Begging cry	0,294	1,732	0,3	0,000
BOT	Begging cry	0,277	-0,203	0,1	0,925
BRK	Begging cry	0,179	1,732	0,2	0,000
ABQ	Yelp	0,056	1,732	0,1	0,000
BOT	Yelp	0,262	1,623	0,2	0,228
BRK	Yelp	0,519	-0,267	0,2	0,902
ABQ	Whistle squeal	0,000	0,000	0,0	.
BOT	Whistle squeal	0,183	0,356	0,1	0,868
BRK	Whistle squeal	0,421	-0,335	0,2	0,876
ABQ	Begging squeal	0,212	1,732	0,2	0,000
BOT	Begging squeal	0,759	-1,716	0,4	0,085
BRK	Begging squeal	0,690	-0,961	0,1	0,626
ABQ	Whimper	0,056	1,732	0,1	0,000
BOT	Whimper	0,855	-1,697	0,4	0,129
BRK	Whimper	0,151	1,732	0,2	0,000
ABQ	Whine	2118,000	1,732	0,2	0,000
BOT	Whine	0,218	-0,442	0,1	0,836
BRK	Whine	0,000	0,000	0,0	.
ABQ	Buzz gurgle moan	0,000	0,000	0,0	.
BOT	Buzz gurgle moan	0,077	1,732	0,1	0,000
BRK	Buzz gurgle moan	0,000	0,000	0,0	.
ABQ	Rumble	0,154	1,732	0,2	0,000
BOT	Rumble	0,202	-1,169	0,2	0,528
BRK	Rumble	0,000	0,000	0,0	.
ABQ	Social growl	0,273	-0,296	0,2	0,981
BOT	Social growl	0,000	0,000	0,0	.
BRK	Social growl	0,000	0,000	0,0	.

ABQ	Alarm growl	0,184	0,381	0,1	0,859
BOT	Alarm growl	0,000	0,000	0,0	.
BRK	Alarm growl	0,000	0,000	0,0	.
ABQ	Common alarm bark	0,176	1,732	0,2	0,000
BOT	Common alarm bark	0,000	0,000	0,0	.
BRK	Common alarm bark	0,000	0,000	0,0	.
ABQ	Threat bark	0,154	1,732	0,2	0,000
BOT	Threat bark	0,000	0,000	0,0	.
BRK	Threat bark	0,000	0,000	0,0	.
ABQ	Howl bark	0,128	1,732	0,1	0,000
BOT	Howl bark	0,000	0,000	0,0	.
BRK	Howl bark	0,000	0,000	0,0	.
ABQ	Clear bark	0,210	0,791	0,1	0,698
BOT	Clear bark	0,000	0,000	0,0	.
BRK	Clear bark	0,000	0,000	0,0	.
ABQ	Yelp bark	0,558	1,732	0,1	0,000
BOT	Yelp bark	0,030	1,732	0,1	0,000
BRK	Yelp bark	0,069	1,732	0,1	0,000
ABQ	Sneeze	0,000	0,000	0,0	.
BOT	Sneeze	0,056	1,732	0,1	0,000
BRK	Sneeze	0,000	0,000	0,0	.
ABQ	Huff	0,176	1,732	0,2	0,000
BOT	Huff	0,000	0,000	0,0	.
BRK	Huff	0,000	0,000	0,0	.

Appendix VIII – SPSS results raw and normalised data

Beneath is the overview of the descriptive statistics results of the raw and normalised data, added are transformations with $\log_{10}$ for the raw and normalised data.

Table of descriptive statistics results from raw data and data transformed with $\log_{10}$

Social twitter

Descriptives

Packs			Statistic	Std. Error
Vocals ABQ	Mean		73,00	73,000
	95% Confidence Interval for Mean	Lower Bound	-241,09	
		Upper Bound	387,09	
	5% Trimmed Mean		.	
	Median		,00	
	Variance		15987,000	
	Std. Deviation		126,440	
	Minimum		0	
	Maximum		219	
	Range		219	
	Interquartile Range		.	
	Skewness		1,732	1,225
	Kurtosis		.	
BOT	Mean		1,33	,882
	95% Confidence Interval for Mean	Lower Bound	-2,46	
		Upper Bound	5,13	
	5% Trimmed Mean		.	
	Median		1,00	
	Variance		2,333	
	Std. Deviation		1,528	
	Minimum		0	
	Maximum		3	
	Range		3	
	Interquartile Range		.	
	Skewness		,935	1,225
	Kurtosis		.	.
BRK	Mean		,00	,000
	95% Confidence Interval for Mean	Lower Bound	,00	
		Upper Bound	,00	
	5% Trimmed Mean		,00	
	Median		,00	
	Variance		,000	
	Std. Deviation		,000	
	Minimum		0	
	Maximum		0	
	Range		0	
	Interquartile Range		0	
	Skewness		.	.
	Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,253	3	.	,964	3	,637
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

In log10

Descriptives

Packs			Statistic	Std. Error
LgVocals ABQ	Mean		,7808	,78081
	95% Confidence Interval for Mean	Lower Bound	-2,5787	
		Upper Bound	4,1404	
	5% Trimmed Mean		.	
	Median		,0000	
	Variance		1,829	
	Std. Deviation		1,35240	
	Minimum		,00	
	Maximum		2,34	
	Range		2,34	
	Interquartile Range		.	
	Skewness		1,732	1,225
	Kurtosis		.	
BOT	Mean		,3010	,17380
	95% Confidence Interval for Mean	Lower Bound	-,4468	
		Upper Bound	1,0488	
	5% Trimmed Mean		.	
	Median		,3010	
	Variance		,091	
	Std. Deviation		,30103	
	Minimum		,00	
	Maximum		,60	
	Range		,60	
	Interquartile Range		.	
	Skewness		,000	1,225
	Kurtosis		.	.
BRK	Mean		,0000	,00000
	95% Confidence Interval for Mean	Lower Bound	,0000	
		Upper Bound	,0000	
	5% Trimmed Mean		,0000	
	Median		,0000	
	Variance		,000	
	Std. Deviation		,00000	
	Minimum		,00	
	Maximum		,00	
	Range		,00	
	Interquartile Range		,00	
	Skewness		.	.
	Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,175	3	.	1,000	3	1,000
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Spar twitter

Descriptives

Packs			Statistic	Std. Error
Vocals ABQ	Mean		86,67	3,756
	95% Confidence Interval for Mean	Lower Bound	70,50	
		Upper Bound	102,83	
	5% Trimmed Mean		.	
	Median		87,00	
	Variance		42,333	
	Std. Deviation		6,506	
	Minimum		80	
	Maximum		93	
	Range		13	
	Interquartile Range		.	
	Skewness		-,230	1,225
	Kurtosis		.	
BOT	Mean		1,67	,667
	95% Confidence Interval for Mean	Lower Bound	-1,20	
		Upper Bound	4,54	
	5% Trimmed Mean		.	
	Median		1,00	
	Variance		1,333	
	Std. Deviation		1,155	
	Minimum		1	
	Maximum		3	
	Range		2	
	Interquartile Range		.	
	Skewness		1,732	1,225
	Kurtosis		.	
BRK	Mean		,67	,667
	95% Confidence Interval for Mean	Lower Bound	-2,20	
		Upper Bound	3,54	
	5% Trimmed Mean		.	
	Median		,00	
	Variance		1,333	
	Std. Deviation		1,155	
	Minimum		0	
	Maximum		2	
	Range		2	
	Interquartile Range		.	
	Skewness		1,732	1,225
	Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,187	3	.	,998	3	,915
	BOT	,385	3	.	,750	3	,000
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

In log10

Descriptives

Packs			Statistic	Std. Error
LgVocals ABQ	Mean		1,9420	,01870
	95% Confidence Interval for Mean	Lower Bound	1,8616	
		Upper Bound	2,0225	
	5% Trimmed Mean		.	
	Median		1,9445	
	Variance		,001	
	Std. Deviation		,03239	
	Minimum		1,91	
	Maximum		1,97	
	Range		,06	
	Interquartile Range		.	
	Skewness		-,339	1,225
	Kurtosis		.	
BOT	Mean		,4014	,10034
	95% Confidence Interval for Mean	Lower Bound	-,0304	
		Upper Bound	,8331	
	5% Trimmed Mean		.	
	Median		,3010	
	Variance		,030	
	Std. Deviation		,17380	
	Minimum		,30	
	Maximum		,60	
	Range		,30	
	Interquartile Range		.	
	Skewness		1,732	1,225
	Kurtosis		.	
BRK	Mean		,1590	,15904
	95% Confidence Interval for Mean	Lower Bound	-,5253	
		Upper Bound	,8433	
	5% Trimmed Mean		.	
	Median		,0000	
	Variance		,076	
	Std. Deviation		,27547	
	Minimum		,00	
	Maximum		,48	
	Range		,48	
	Interquartile Range		.	
	Skewness		1,732	1,225
	Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,197	3	.	,996	3	,875
	BOT	,385	3	.	,750	3	,000
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

Mob twitter

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		10,33	10,333
		95% Confidence Interval for Mean	Lower Bound	-34,13	
			Upper Bound	54,79	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		320,333	
		Std. Deviation		17,898	
		Minimum		0	
		Maximum		31	
		Range		31	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

In log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,5017	,50172
		95% Confidence Interval for Mean	Lower Bound	-1,6570	
			Upper Bound	2,6604	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,755	
		Std. Deviation		,86900	
		Minimum		,00	
		Maximum		1,51	
		Range		1,51	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Begging cry

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		4,67	4,667
		95% Confidence Interval for Mean	Lower Bound	-15,41	
			Upper Bound	24,75	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		65,333	
		Std. Deviation		8,083	
		Minimum		0	
		Maximum		14	
		Range		14	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		4,33	2,028
		95% Confidence Interval for Mean	Lower Bound	-4,39	
			Upper Bound	13,06	
		5% Trimmed Mean		.	
		Median		4,00	
		Variance		12,333	
		Std. Deviation		3,512	
		Minimum		1	
		Maximum		8	
		Range		7	
		Interquartile Range		.	
		Skewness		,423	1,225
		Kurtosis		.	.
	BRK	Mean		1,33	1,333
		95% Confidence Interval for Mean	Lower Bound	-4,40	
			Upper Bound	7,07	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		5,333	
		Std. Deviation		2,309	
		Minimum		0	
		Maximum		4	
		Range		4	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,204	3	.	,993	3	,843
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

In log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,3920	,39203
		95% Confidence Interval for Mean	Lower Bound	-1,2947	
			Upper Bound	2,0788	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,461	
		Std. Deviation		,67902	
		Minimum		,00	
		Maximum		1,18	
		Range		1,18	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,6514	,19006
		95% Confidence Interval for Mean	Lower Bound	-,1663	
			Upper Bound	1,4692	
		5% Trimmed Mean		.	
		Median		,6990	
		Variance		,108	
		Std. Deviation		,32919	
		Minimum		,30	
		Maximum		,95	
		Range		,65	
		Interquartile Range		.	
		Skewness		-,637	1,225
		Kurtosis		.	.
	BRK	Mean		,2330	,23299
		95% Confidence Interval for Mean	Lower Bound	-,7695	
			Upper Bound	1,2355	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,163	
		Std. Deviation		,40355	
		Minimum		,00	
		Maximum		,70	
		Range		,70	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,224	3	.	,984	3	,760
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

Yelp

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,33	,333
		95% Confidence Interval for Mean	Lower Bound	-1,10	
			Upper Bound	1,77	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		,333	
		Std. Deviation		,577	
		Minimum		0	
		Maximum		1	
		Range		1	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		6,00	5,508
		95% Confidence Interval for Mean	Lower Bound	-17,70	
			Upper Bound	29,70	
		5% Trimmed Mean		.	
		Median		1,00	
		Variance		91,000	
		Std. Deviation		9,539	
		Minimum		0	
		Maximum		17	
		Range		17	
		Interquartile Range		.	
		Skewness		1,711	1,225
		Kurtosis		.	.
	BRK	Mean		4,67	2,333
		95% Confidence Interval for Mean	Lower Bound	-5,37	
			Upper Bound	14,71	
		5% Trimmed Mean		.	
		Median		4,00	
		Variance		16,333	
		Std. Deviation		4,041	
		Minimum		1	
		Maximum		9	
		Range		8	
		Interquartile Range		.	
		Skewness		,722	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,367	3	.	,794	3	,100
	BRK	,232	3	.	,980	3	,726

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,1003	,10034
		95% Confidence Interval for Mean	Lower Bound	-,3314	
			Upper Bound	,5321	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,030	
		Std. Deviation		,17380	
		Minimum		,00	
		Maximum		,30	
		Range		,30	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,5188	,37837
		95% Confidence Interval for Mean	Lower Bound	-1,1092	
			Upper Bound	2,1467	
		5% Trimmed Mean		.	
		Median		,3010	
		Variance		,429	
		Std. Deviation		,65535	
		Minimum		,00	
		Maximum		1,26	
		Range		1,26	
		Interquartile Range		.	
		Skewness		1,330	1,225
		Kurtosis		.	.
	BRK	Mean		,6667	,20242
		95% Confidence Interval for Mean	Lower Bound	-,2043	
			Upper Bound	1,5376	
		5% Trimmed Mean		.	
		Median		,6990	
		Variance		,123	
		Std. Deviation		,35060	
		Minimum		,30	
		Maximum		1,00	
		Range		,70	
		Interquartile Range		.	
		Skewness		-,411	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,297	3	.	,917	3	,443
	BRK	,203	3	.	,994	3	,847

a. Lilliefors Significance Correction

Whistle squeal

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.
	BOT	Mean		2,67	1,764
		95% Confidence Interval for Mean	Lower Bound	-4,92	
			Upper Bound	10,26	
		5% Trimmed Mean		.	
		Median		2,00	
		Variance		9,333	
		Std. Deviation		3,055	
		Minimum		0	
		Maximum		6	
		Range		6	
		Interquartile Range		.	
		Skewness		,935	1,225
		Kurtosis		.	.
	BRK	Mean		4,00	2,646
		95% Confidence Interval for Mean	Lower Bound	-7,38	
			Upper Bound	15,38	
		5% Trimmed Mean		.	
		Median		3,00	
		Variance		21,000	
		Std. Deviation		4,583	
		Minimum		0	
		Maximum		9	
		Range		9	
		Interquartile Range		.	
		Skewness		,935	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	.	3	.	.	3	.
	BOT	,253	3	.	,964	3	,637
	BRK	,253	3	.	,964	3	,637

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BOT	Mean		,4407	,24464
		95% Confidence Interval for Mean	Lower Bound	-,6118	
			Upper Bound	1,4933	
		5% Trimmed Mean		.	
		Median		,4771	
		Variance		,180	
		Std. Deviation		,42372	
		Minimum		,00	
		Maximum		,85	
		Range		,85	
		Interquartile Range		.	
		Skewness		-,384	1,225
		Kurtosis		.	.
	BRK	Mean		,5340	,29067
		95% Confidence Interval for Mean	Lower Bound	-,7166	
			Upper Bound	1,7847	
		5% Trimmed Mean		.	
		Median		,6021	
		Variance		,253	
		Std. Deviation		,50346	
		Minimum		,00	
		Maximum		1,00	
		Range		1,00	
		Interquartile Range		.	
		Skewness		-,597	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	.	3	.	.	3	.
	BOT	,201	3	.	,994	3	,858
	BRK	,220	3	.	,986	3	,776

a. Lilliefors Significance Correction

Begging squeal

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		2,33	2,333
		95% Confidence Interval for Mean	Lower Bound	-7,71	
			Upper Bound	12,37	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		16,333	
		Std. Deviation		4,041	
		Minimum		0	
		Maximum		7	
		Range		7	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		36,67	18,478
		95% Confidence Interval for Mean	Lower Bound	-42,84	
			Upper Bound	116,17	
		5% Trimmed Mean		.	
		Median		51,00	
		Variance		1024,333	
		Std. Deviation		32,005	
		Minimum		0	
		Maximum		59	
		Range		59	
		Interquartile Range		.	
		Skewness		-1,611	1,225
		Kurtosis		.	.
	BRK	Mean		6,67	1,453
		95% Confidence Interval for Mean	Lower Bound	,42	
			Upper Bound	12,92	
		5% Trimmed Mean		.	
		Median		7,00	
		Variance		6,333	
		Std. Deviation		2,517	
		Minimum		4	
		Maximum		9	
		Range		5	
		Interquartile Range		.	
		Skewness		-,586	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,340	3	.	,850	3	,239
	BRK	,219	3	.	,987	3	,780

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,3010	,30103
		95% Confidence Interval for Mean	Lower Bound	-,9942	
			Upper Bound	1,5963	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,272	
		Std. Deviation		,52140	
		Minimum		,00	
		Maximum		,90	
		Range		,90	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		1,1647	,58264
		95% Confidence Interval for Mean	Lower Bound	-1,3422	
			Upper Bound	3,6716	
		5% Trimmed Mean		.	
		Median		1,7160	
		Variance		1,018	
		Std. Deviation		1,00915	
		Minimum		,00	
		Maximum		1,78	
		Range		1,78	
		Interquartile Range		.	
		Skewness		-1,725	1,225
		Kurtosis		.	.
	BRK	Mean		,8674	,08872
		95% Confidence Interval for Mean	Lower Bound	,4856	
			Upper Bound	1,2491	
		5% Trimmed Mean		.	
		Median		,9031	
		Variance		,024	
		Std. Deviation		,15366	
		Minimum		,70	
		Maximum		1,00	
		Range		,30	
		Interquartile Range		.	
		Skewness		-,990	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,374	3	.	,776	3	,059
	BRK	,259	3	.	,959	3	,613

a. Lilliefors Significance Correction

Whimper

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,33	,333
		95% Confidence Interval for Mean	Lower Bound	-1,10	
			Upper Bound	1,77	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		,333	
		Std. Deviation		,577	
		Minimum		0	
		Maximum		1	
		Range		1	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		52,33	26,735
		95% Confidence Interval for Mean	Lower Bound	-62,70	
			Upper Bound	167,37	
		5% Trimmed Mean		.	
		Median		69,00	
		Variance		2144,333	
		Std. Deviation		46,307	
		Minimum		0	
		Maximum		88	
		Range		88	
		Interquartile Range		.	
		Skewness		-1,410	1,225
		Kurtosis		.	.
	BRK	Mean		1,00	1,000
		95% Confidence Interval for Mean	Lower Bound	-3,30	
			Upper Bound	5,30	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		3,000	
		Std. Deviation		1,732	
		Minimum		0	
		Maximum		3	
		Range		3	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,307	3	.	,903	3	,395
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,1003	,10034
		95% Confidence Interval for Mean	Lower Bound	-,3314	
			Upper Bound	,5321	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,030	
		Std. Deviation		,17380	
		Minimum		,00	
		Maximum		,30	
		Range		,30	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		1,2648	,63313
		95% Confidence Interval for Mean	Lower Bound	-1,4593	
			Upper Bound	3,9890	
		5% Trimmed Mean		.	
		Median		1,8451	
		Variance		1,203	
		Std. Deviation		1,09661	
		Minimum		,00	
		Maximum		1,95	
		Range		1,95	
		Interquartile Range		.	
		Skewness		-1,714	1,225
		Kurtosis		.	.
	BRK	Mean		,2007	,20069
		95% Confidence Interval for Mean	Lower Bound	-,6628	
			Upper Bound	1,0642	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,121	
		Std. Deviation		,34760	
		Minimum		,00	
		Maximum		,60	
		Range		,60	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,368	3	.	,790	3	,091
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

Whine

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		2,33	2,333
		95% Confidence Interval for Mean	Lower Bound	-7,71	
			Upper Bound	12,37	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		16,333	
		Std. Deviation		4,041	
		Minimum		0	
		Maximum		7	
		Range		7	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		3,00	1,155
		95% Confidence Interval for Mean	Lower Bound	-1,97	
			Upper Bound	7,97	
		5% Trimmed Mean		.	
		Median		3,00	
		Variance		4,000	
		Std. Deviation		2,000	
		Minimum		1	
		Maximum		5	
		Range		4	
		Interquartile Range		.	
		Skewness		,000	1,225
		Kurtosis		.	.
	BRK	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,175	3	.	1,000	3	1,000
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,3010	,30103
		95% Confidence Interval for Mean	Lower Bound	-,9942	
			Upper Bound	1,5963	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,272	
		Std. Deviation		,52140	
		Minimum		,00	
		Maximum		,90	
		Range		,90	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,5604	,13930
		95% Confidence Interval for Mean	Lower Bound	-,0389	
			Upper Bound	1,1598	
		5% Trimmed Mean		.	
		Median		,6021	
		Variance		,058	
		Std. Deviation		,24127	
		Minimum		,30	
		Maximum		,78	
		Range		,48	
		Interquartile Range		.	
		Skewness		-,754	1,225
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,235	3	.	,978	3	,713
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Buzz gurgle moan

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.
	BOT	Mean		1,00	1,000
		95% Confidence Interval for Mean	Lower Bound	-3,30	
			Upper Bound	5,30	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		3,000	
		Std. Deviation		1,732	
		Minimum		0	
		Maximum		3	
		Range		3	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	.	3	.	.	3	.
	BOT	,385	3	.	,750	3	,000
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BOT	Mean		,2007	,20069
		95% Confidence Interval for Mean	Lower Bound	-,6628	
			Upper Bound	1,0642	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,121	
		Std. Deviation		,34760	
		Minimum		,00	
		Maximum		,60	
		Range		,60	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	.	3	.	.	3	.
	BOT	,385	3	.	,750	3	,000
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Rumble

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		1,33	1,333
		95% Confidence Interval for Mean	Lower Bound	-4,40	
			Upper Bound	7,07	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		5,333	
		Std. Deviation		2,309	
		Minimum		0	
		Maximum		4	
		Range		4	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		1,67	1,202
		95% Confidence Interval for Mean	Lower Bound	-3,50	
			Upper Bound	6,84	
		5% Trimmed Mean		.	
		Median		1,00	
		Variance		4,333	
		Std. Deviation		2,082	
		Minimum		0	
		Maximum		4	
		Range		4	
		Interquartile Range		.	
		Skewness		1,293	1,225
		Kurtosis		.	.
	BRK	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,292	3	.	,923	3	,463
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,2330	,23299
		95% Confidence Interval for Mean	Lower Bound	-,7695	
			Upper Bound	1,2355	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,163	
		Std. Deviation		,40355	
		Minimum		,00	
		Maximum		,70	
		Range		,70	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,3333	,20242
		95% Confidence Interval for Mean	Lower Bound	-,5376	
			Upper Bound	1,2043	
		5% Trimmed Mean		.	
		Median		,3010	
		Variance		,123	
		Std. Deviation		,35060	
		Minimum		,00	
		Maximum		,70	
		Range		,70	
		Interquartile Range		.	
		Skewness		,411	1,225
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,203	3	.	,994	3	,847
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Social growl

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		2,33	1,453
		95% Confidence Interval for Mean	Lower Bound	-3,92	
			Upper Bound	8,58	
		5% Trimmed Mean		.	
		Median		2,00	
		Variance		6,333	
		Std. Deviation		2,517	
		Minimum		0	
		Maximum		5	
		Range		5	
		Interquartile Range		.	
		Skewness		,586	1,225
		Kurtosis		.	.
	BOT	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,219	3	.	,987	3	,780
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,4184	,22654
		95% Confidence Interval for Mean	Lower Bound	-,5563	
			Upper Bound	1,3932	
		5% Trimmed Mean		.	
		Median		,4771	
		Variance		,154	
		Std. Deviation		,39238	
		Minimum		,00	
		Maximum		,78	
		Range		,78	
		Interquartile Range		.	
		Skewness		-,658	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,226	3	.	,983	3	,752
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Alarm growl

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		1,33	,882
		95% Confidence Interval for Mean	Lower Bound	-2,46	
			Upper Bound	5,13	
		5% Trimmed Mean		.	
		Median		1,00	
		Variance		2,333	
		Std. Deviation		1,528	
		Minimum		0	
		Maximum		3	
		Range		3	
		Interquartile Range		.	
		Skewness		,935	1,225
		Kurtosis		.	.
	BOT	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,253	3	.	,964	3	,637
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,3010	,17380
		95% Confidence Interval for Mean	Lower Bound	-,4468	
			Upper Bound	1,0488	
		5% Trimmed Mean		.	
		Median		,3010	
		Variance		,091	
		Std. Deviation		,30103	
		Minimum		,00	
		Maximum		,60	
		Range		,60	
		Interquartile Range		.	
		Skewness		,000	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,175	3	.	1,000	3	1,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Common alarm bark

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		1,67	1,667
		95% Confidence Interval for Mean	Lower Bound	-5,50	
			Upper Bound	8,84	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		8,333	
		Std. Deviation		2,887	
		Minimum		0	
		Maximum		5	
		Range		5	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,2594	,25938
		95% Confidence Interval for Mean	Lower Bound	-,8567	
			Upper Bound	1,3754	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,202	
		Std. Deviation		,44927	
		Minimum		,00	
		Maximum		,78	
		Range		,78	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Threat bark

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		1,33	1,333
		95% Confidence Interval for Mean	Lower Bound	-4,40	
			Upper Bound	7,07	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		5,333	
		Std. Deviation		2,309	
		Minimum		0	
		Maximum		4	
		Range		4	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,2330	,23299
		95% Confidence Interval for Mean	Lower Bound	-,7695	
			Upper Bound	1,2355	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,163	
		Std. Deviation		,40355	
		Minimum		,00	
		Maximum		,70	
		Range		,70	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Howl bark

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		1,00	1,000
		95% Confidence Interval for Mean	Lower Bound	-3,30	
			Upper Bound	5,30	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		3,000	
		Std. Deviation		1,732	
		Minimum		0	
		Maximum		3	
		Range		3	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,2007	,20069
		95% Confidence Interval for Mean	Lower Bound	-,6628	
			Upper Bound	1,0642	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,121	
		Std. Deviation		,34760	
		Minimum		,00	
		Maximum		,60	
		Range		,60	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Pack-specific vocal dialects in African wild dogs

Clear bark

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		1,67	1,202
		95% Confidence Interval for Mean	Lower Bound	-3,50	
			Upper Bound	6,84	
		5% Trimmed Mean		.	
		Median		1,00	
		Variance		4,333	
		Std. Deviation		2,082	
		Minimum		0	
		Maximum		4	
		Range		4	
		Interquartile Range		.	
		Skewness		1,293	1,225
		Kurtosis		.	.
	BOT	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,292	3	.	,923	3	,463
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,3333	,20242
		95% Confidence Interval for Mean	Lower Bound	-,5376	
			Upper Bound	1,2043	
		5% Trimmed Mean		.	
		Median		,3010	
		Variance		,123	
		Std. Deviation		,35060	
		Minimum		,00	
		Maximum		,70	
		Range		,70	
		Interquartile Range		.	
		Skewness		,411	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,203	3	.	,994	3	,847
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Yelp bark

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,33	,333
		95% Confidence Interval for Mean	Lower Bound	-1,10	
			Upper Bound	1,77	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		,333	
		Std. Deviation		,577	
		Minimum		0	
		Maximum		1	
		Range		1	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,33	,333
		95% Confidence Interval for Mean	Lower Bound	-1,10	
			Upper Bound	1,77	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		,333	
		Std. Deviation		,577	
		Minimum		0	
		Maximum		1	
		Range		1	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,33	,333
		95% Confidence Interval for Mean	Lower Bound	-1,10	
			Upper Bound	1,77	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		,333	
		Std. Deviation		,577	
		Minimum		0	
		Maximum		1	
		Range		1	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,385	3	.	,750	3	,000
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,1003	,10034
		95% Confidence Interval for Mean	Lower Bound	-,3314	
			Upper Bound	,5321	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,030	
		Std. Deviation		,17380	
		Minimum		,00	
		Maximum		,30	
		Range		,30	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,1003	,10034
		95% Confidence Interval for Mean	Lower Bound	-,3314	
			Upper Bound	,5321	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,030	
		Std. Deviation		,17380	
		Minimum		,00	
		Maximum		,30	
		Range		,30	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,1003	,10034
		95% Confidence Interval for Mean	Lower Bound	-,3314	
			Upper Bound	,5321	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,030	
		Std. Deviation		,17380	
		Minimum		,00	
		Maximum		,30	
		Range		,30	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,385	3	.	,750	3	,000
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

Sneeze

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.
	BOT	Mean		,67	,667
		95% Confidence Interval for Mean	Lower Bound	-2,20	
			Upper Bound	3,54	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		1,333	
		Std. Deviation		1,155	
		Minimum		0	
		Maximum		2	
		Range		2	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	.	3	.	.	3	.
	BOT	,385	3	.	,750	3	,000
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BOT	Mean		,1590	,15904
		95% Confidence Interval for Mean	Lower Bound	-,5253	
			Upper Bound	,8433	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,076	
		Std. Deviation		,27547	
		Minimum		,00	
		Maximum		,48	
		Range		,48	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	.	3	.	.	3	.
	BOT	,385	3	.	,750	3	,000
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Huff

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.
	BOT	Mean		1,67	1,667
		95% Confidence Interval for Mean	Lower Bound	-5,50	
			Upper Bound	8,84	
		5% Trimmed Mean		.	
		Median		,00	
		Variance		8,333	
		Std. Deviation		2,887	
		Minimum		0	
		Maximum		5	
		Range		5	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,00	,000
		95% Confidence Interval for Mean	Lower Bound	,00	
			Upper Bound	,00	
		5% Trimmed Mean		,00	
		Median		,00	
		Variance		,000	
		Std. Deviation		,000	
		Minimum		0	
		Maximum		0	
		Range		0	
		Interquartile Range		0	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	.	3	.	.	3	.
	BOT	,385	3	.	,750	3	,000
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BOT	Mean		,2594	,25938
		95% Confidence Interval for Mean	Lower Bound	-,8567	
			Upper Bound	1,3754	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,202	
		Std. Deviation		,44927	
		Minimum		,00	
		Maximum		,78	
		Range		,78	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	.	3	.	.	3	.
	BOT	,385	3	.	,750	3	,000
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Table of descriptive statistics results normalised data and data transformed with log_{10}

Social twitter

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		34,5967	34,59667
		95% Confidence Interval for Mean	Lower Bound	-114,2608	
			Upper Bound	183,4541	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		3590,788	
		Std. Deviation		59,92318	
		Minimum		,00	
		Maximum		103,79	
		Range		103,79	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,3100	,20599
		95% Confidence Interval for Mean	Lower Bound	-,5763	
			Upper Bound	1,1963	
		5% Trimmed Mean		.	
		Median		,2300	
		Variance		,127	
		Std. Deviation		,35679	
		Minimum		,00	
		Maximum		,70	
		Range		,70	
		Interquartile Range		.	
		Skewness		,958	1,225
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,255	3	.	,962	3	,627
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

In log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,6734	,67344
		95% Confidence Interval for Mean	Lower Bound	-2,2241	
			Upper Bound	3,5710	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		1,361	
		Std. Deviation		1,16643	
		Minimum		,00	
		Maximum		2,02	
		Range		2,02	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,1068	,06706
		95% Confidence Interval for Mean	Lower Bound	-,1817	
			Upper Bound	,3953	
		5% Trimmed Mean		.	
		Median		,0899	
		Variance		,013	
		Std. Deviation		,11615	
		Minimum		,00	
		Maximum		,23	
		Range		,23	
		Interquartile Range		.	
		Skewness		,640	1,225
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,224	3	.	,984	3	,759
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Spar twitter

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		41,0767	1,77989
		95% Confidence Interval for Mean	Lower Bound	33,4184	
			Upper Bound	48,7349	
		5% Trimmed Mean		.	
		Median		41,2300	
		Variance		9,504	
		Std. Deviation		3,08286	
		Minimum		37,92	
		Maximum		44,08	
		Range		6,16	
		Interquartile Range		.	
		Skewness		-,223	1,225
		Kurtosis		.	.
	BOT	Mean		,3867	,15667
		95% Confidence Interval for Mean	Lower Bound	-,2874	
			Upper Bound	1,0607	
		5% Trimmed Mean		.	
		Median		,2300	
		Variance		,074	
		Std. Deviation		,27135	
		Minimum		,23	
		Maximum		,70	
		Range		,47	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,4067	,40667
		95% Confidence Interval for Mean	Lower Bound	-1,3431	
			Upper Bound	2,1564	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,496	
		Std. Deviation		,70437	
		Minimum		,00	
		Maximum		1,22	
		Range		1,22	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,187	3	.	,998	3	,918
	BOT	,385	3	.	,750	3	,000
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

In log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		1,6233	,01846
		95% Confidence Interval for Mean	Lower Bound	1,5438	
			Upper Bound	1,7027	
		5% Trimmed Mean		.	
		Median		1,6256	
		Variance		,001	
		Std. Deviation		,03197	
		Minimum		1,59	
		Maximum		1,65	
		Range		,06	
		Interquartile Range		.	
		Skewness		-,331	1,225
		Kurtosis		.	.
	BOT	Mean		,1368	,04685
		95% Confidence Interval for Mean	Lower Bound	-,0648	
			Upper Bound	,3383	
		5% Trimmed Mean		.	
		Median		,0899	
		Variance		,007	
		Std. Deviation		,08114	
		Minimum		,09	
		Maximum		,23	
		Range		,14	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,1155	,11545
		95% Confidence Interval for Mean	Lower Bound	-,3813	
			Upper Bound	,6122	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,040	
		Std. Deviation		,19997	
		Minimum		,00	
		Maximum		,35	
		Range		,35	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,196	3	.	,996	3	,878
	BOT	,385	3	.	,750	3	,000
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

Mob twitter

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		4,8967	4,89667
		95% Confidence Interval for Mean	Lower Bound	-16,1720	
			Upper Bound	25,9653	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		71,932	
		Std. Deviation		8,48128	
		Minimum		,00	
		Maximum		14,69	
		Range		14,69	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

In log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,3985	,39854
		95% Confidence Interval for Mean	Lower Bound	-1,3162	
			Upper Bound	2,1133	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,477	
		Std. Deviation		,69029	
		Minimum		,00	
		Maximum		1,20	
		Range		1,20	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Begging cry

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		2,2133	2,21333
		95% Confidence Interval for Mean	Lower Bound	-7,3099	
			Upper Bound	11,7365	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		14,697	
		Std. Deviation		3,83361	
		Minimum		,00	
		Maximum		6,64	
		Range		6,64	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		1,0067	,47210
		95% Confidence Interval for Mean	Lower Bound	-1,0246	
			Upper Bound	3,0379	
		5% Trimmed Mean		.	
		Median		,9300	
		Variance		,669	
		Std. Deviation		,81770	
		Minimum		,23	
		Maximum		1,86	
		Range		1,63	
		Interquartile Range		.	
		Skewness		,418	1,225
		Kurtosis		.	.
	BRK	Mean		,8133	,81333
		95% Confidence Interval for Mean	Lower Bound	-2,6862	
			Upper Bound	4,3128	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		1,985	
		Std. Deviation		1,40873	
		Minimum		,00	
		Maximum		2,44	
		Range		2,44	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,204	3	.	,993	3	,845
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

In log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,2944	,29436
		95% Confidence Interval for Mean	Lower Bound	-,9722	
			Upper Bound	1,5609	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,260	
		Std. Deviation		,50985	
		Minimum		,00	
		Maximum		,88	
		Range		,88	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,2773	,10587
		95% Confidence Interval for Mean	Lower Bound	-,1782	
			Upper Bound	,7328	
		5% Trimmed Mean		.	
		Median		,2856	
		Variance		,034	
		Std. Deviation		,18337	
		Minimum		,09	
		Maximum		,46	
		Range		,37	
		Interquartile Range		.	
		Skewness		-,203	1,225
		Kurtosis		.	.
	BRK	Mean		,1789	,17885
		95% Confidence Interval for Mean	Lower Bound	-,5907	
			Upper Bound	,9484	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,096	
		Std. Deviation		,30978	
		Minimum		,00	
		Maximum		,54	
		Range		,54	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,185	3	.	,998	3	,925
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

Yelp

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,1567	,15667
		95% Confidence Interval for Mean	Lower Bound	-,5174	
			Upper Bound	,8307	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,074	
		Std. Deviation		,27135	
		Minimum		,00	
		Maximum		,47	
		Range		,47	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		1,3967	1,28339
		95% Confidence Interval for Mean	Lower Bound	-4,1253	
			Upper Bound	6,9186	
		5% Trimmed Mean		.	
		Median		,2300	
		Variance		4,941	
		Std. Deviation		2,22289	
		Minimum		,00	
		Maximum		3,96	
		Range		3,96	
		Interquartile Range		.	
		Skewness		1,711	1,225
		Kurtosis		.	.
	BRK	Mean		2,8467	1,42333
		95% Confidence Interval for Mean	Lower Bound	-3,2774	
			Upper Bound	8,9708	
		5% Trimmed Mean		.	
		Median		2,4400	
		Variance		6,078	
		Std. Deviation		2,46529	
		Minimum		,61	
		Maximum		5,49	
		Range		4,88	
		Interquartile Range		.	
		Skewness		,722	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,367	3	.	,793	3	,099
	BRK	,232	3	.	,980	3	,726

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,0558	,05577
		95% Confidence Interval for Mean	Lower Bound	-,1842	
			Upper Bound	,2957	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,009	
		Std. Deviation		,09660	
		Minimum		,00	
		Maximum		,17	
		Range		,17	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,2618	,21839
		95% Confidence Interval for Mean	Lower Bound	-,6779	
			Upper Bound	1,2015	
		5% Trimmed Mean		.	
		Median		,0899	
		Variance		,143	
		Std. Deviation		,37826	
		Minimum		,00	
		Maximum		,70	
		Range		,70	
		Interquartile Range		.	
		Skewness		1,623	1,225
		Kurtosis		.	.
	BRK	Mean		,5185	,17500
		95% Confidence Interval for Mean	Lower Bound	-,2344	
			Upper Bound	1,2715	
		5% Trimmed Mean		.	
		Median		,5366	
		Variance		,092	
		Std. Deviation		,30311	
		Minimum		,21	
		Maximum		,81	
		Range		,61	
		Interquartile Range		.	
		Skewness		-,267	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,342	3	.	,845	3	,228
	BRK	,190	3	.	,997	3	,902

a. Lilliefors Significance Correction

Whistle squeal

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BOT	Mean		,6233	,41135
		95% Confidence Interval for Mean	Lower Bound	-1,1466	
			Upper Bound	2,3932	
		5% Trimmed Mean		.	
		Median		,4700	
		Variance		,508	
		Std. Deviation		,71248	
		Minimum		,00	
		Maximum		1,40	
		Range		1,40	
		Interquartile Range		.	
		Skewness		,924	1,225
		Kurtosis		.	.
	BRK	Mean		2,4400	1,61391
		95% Confidence Interval for Mean	Lower Bound	-4,5041	
			Upper Bound	9,3841	
		5% Trimmed Mean		.	
		Median		1,8300	
		Variance		7,814	
		Std. Deviation		2,79537	
		Minimum		,00	
		Maximum		5,49	
		Range		5,49	
		Interquartile Range		.	
		Skewness		,935	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	.	3	.	.	3	.
	BOT	,252	3	.	,965	3	,642
	BRK	,253	3	.	,964	3	,637

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BOT	Mean		,1825	,11002
		95% Confidence Interval for Mean	Lower Bound	-,2909	
			Upper Bound	,6559	
		5% Trimmed Mean		.	
		Median		,1673	
		Variance		,036	
		Std. Deviation		,19056	
		Minimum		,00	
		Maximum		,38	
		Range		,38	
		Interquartile Range		.	
		Skewness		,356	1,225
		Kurtosis		.	.
	BRK	Mean		,4213	,23497
		95% Confidence Interval for Mean	Lower Bound	-,5896	
			Upper Bound	1,4323	
		5% Trimmed Mean		.	
		Median		,4518	
		Variance		,166	
		Std. Deviation		,40698	
		Minimum		,00	
		Maximum		,81	
		Range		,81	
		Interquartile Range		.	
		Skewness		-,335	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	.	3	.	.	3	.
	BOT	,198	3	.	,995	3	,868
	BRK	,196	3	.	,996	3	,876

a. Lilliefors Significance Correction

Begging squeal

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		1,1067	1,10667
		95% Confidence Interval for Mean	Lower Bound	-3,6549	
			Upper Bound	5,8683	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		3,674	
		Std. Deviation		1,91680	
		Minimum		,00	
		Maximum		3,32	
		Range		3,32	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		8,5367	4,30233
		95% Confidence Interval for Mean	Lower Bound	-9,9748	
			Upper Bound	27,0481	
		5% Trimmed Mean		.	
		Median		11,8700	
		Variance		55,530	
		Std. Deviation		7,45186	
		Minimum		,00	
		Maximum		13,74	
		Range		13,74	
		Interquartile Range		.	
		Skewness		-1,610	1,225
		Kurtosis		.	.
	BRK	Mean		4,0667	,88631
		95% Confidence Interval for Mean	Lower Bound	,2532	
			Upper Bound	7,8801	
		5% Trimmed Mean		.	
		Median		4,2700	
		Variance		2,357	
		Std. Deviation		1,53513	
		Minimum		2,44	
		Maximum		5,49	
		Range		3,05	
		Interquartile Range		.	
		Skewness		-,586	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,339	3	.	,850	3	,240
	BRK	,219	3	.	,987	3	,780

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,2118	,21183
		95% Confidence Interval for Mean	Lower Bound	-,6996	
			Upper Bound	1,1232	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,135	
		Std. Deviation		,36690	
		Minimum		,00	
		Maximum		,64	
		Range		,64	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,7594	,38006
		95% Confidence Interval for Mean	Lower Bound	-,8759	
			Upper Bound	2,3946	
		5% Trimmed Mean		.	
		Median		1,1096	
		Variance		,433	
		Std. Deviation		,65828	
		Minimum		,00	
		Maximum		1,17	
		Range		1,17	
		Interquartile Range		.	
		Skewness		-1,716	1,225
		Kurtosis		.	.
	BRK	Mean		,6902	,08114
		95% Confidence Interval for Mean	Lower Bound	,3411	
			Upper Bound	1,0393	
		5% Trimmed Mean		.	
		Median		,7218	
		Variance		,020	
		Std. Deviation		,14053	
		Minimum		,54	
		Maximum		,81	
		Range		,28	
		Interquartile Range		.	
		Skewness		-,961	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,369	3	.	,788	3	,085
	BRK	,256	3	.	,962	3	,626

a. Lilliefors Significance Correction

Whimper

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,1567	,15667
		95% Confidence Interval for Mean	Lower Bound	-,5174	
			Upper Bound	,8307	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,074	
		Std. Deviation		,27135	
		Minimum		,00	
		Maximum		,47	
		Range		,47	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		12,1867	6,22549
		95% Confidence Interval for Mean	Lower Bound	-14,5995	
			Upper Bound	38,9728	
		5% Trimmed Mean		.	
		Median		16,0700	
		Variance		116,270	
		Std. Deviation		10,78287	
		Minimum		,00	
		Maximum		20,49	
		Range		20,49	
		Interquartile Range		.	
		Skewness		-1,410	1,225
		Kurtosis		.	.
	BRK	Mean		,6100	,61000
		95% Confidence Interval for Mean	Lower Bound	-2,0146	
			Upper Bound	3,2346	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		1,116	
		Std. Deviation		1,05655	
		Minimum		,00	
		Maximum		1,83	
		Range		1,83	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,307	3	.	,903	3	,394
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,0558	,05577
		95% Confidence Interval for Mean	Lower Bound	-,1842	
			Upper Bound	,2957	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,009	
		Std. Deviation		,09660	
		Minimum		,00	
		Maximum		,17	
		Range		,17	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,8548	,42839
		95% Confidence Interval for Mean	Lower Bound	-,9884	
			Upper Bound	2,6980	
		5% Trimmed Mean		.	
		Median		1,2322	
		Variance		,551	
		Std. Deviation		,74199	
		Minimum		,00	
		Maximum		1,33	
		Range		1,33	
		Interquartile Range		.	
		Skewness		-1,697	1,225
		Kurtosis		.	.
	BRK	Mean		,1506	,15060
		95% Confidence Interval for Mean	Lower Bound	-,4974	
			Upper Bound	,7986	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,068	
		Std. Deviation		,26084	
		Minimum		,00	
		Maximum		,45	
		Range		,45	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,361	3	.	,806	3	,129
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

Whine

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		1,1067	1,10667
		95% Confidence Interval for Mean	Lower Bound	-3,6549	
			Upper Bound	5,8683	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		3,674	
		Std. Deviation		1,91680	
		Minimum		,00	
		Maximum		3,32	
		Range		3,32	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,6967	,26847
		95% Confidence Interval for Mean	Lower Bound	-,4585	
			Upper Bound	1,8518	
		5% Trimmed Mean		.	
		Median		,7000	
		Variance		,216	
		Std. Deviation		,46501	
		Minimum		,23	
		Maximum		1,16	
		Range		,93	
		Interquartile Range		.	
		Skewness		-,032	1,225
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,176	3	.	1,000	3	,988
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,2118	,21183
		95% Confidence Interval for Mean	Lower Bound	-,6996	
			Upper Bound	1,1232	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,135	
		Std. Deviation		,36690	
		Minimum		,00	
		Maximum		,64	
		Range		,64	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,2183	,07086
		95% Confidence Interval for Mean	Lower Bound	-,0866	
			Upper Bound	,5231	
		5% Trimmed Mean		.	
		Median		,2304	
		Variance		,015	
		Std. Deviation		,12273	
		Minimum		,09	
		Maximum		,33	
		Range		,24	
		Interquartile Range		.	
		Skewness		-,442	1,225
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,206	3	.	,993	3	,836
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Buzz gurgle moan

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BOT	Mean		,2333	,23333
		95% Confidence Interval for Mean	Lower Bound	-,7706	
			Upper Bound	1,2373	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,163	
		Std. Deviation		,40415	
		Minimum		,00	
		Maximum		,70	
		Range		,70	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	.	3	.	.	3	.
	BOT	,385	3	.	,750	3	,000
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BOT	Mean		,0768	,07682
		95% Confidence Interval for Mean	Lower Bound	-,2537	
			Upper Bound	,4073	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,018	
		Std. Deviation		,13305	
		Minimum		,00	
		Maximum		,23	
		Range		,23	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	.	3	.	.	3	.
	BOT	,385	3	.	,750	3	,000
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Rumble

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,6333	,63333
		95% Confidence Interval for Mean	Lower Bound	-2,0917	
			Upper Bound	3,3583	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		1,203	
		Std. Deviation		1,09697	
		Minimum		,00	
		Maximum		1,90	
		Range		1,90	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,6200	,20599
		95% Confidence Interval for Mean	Lower Bound	-,2663	
			Upper Bound	1,5063	
		5% Trimmed Mean		.	
		Median		,7000	
		Variance		,127	
		Std. Deviation		,35679	
		Minimum		,23	
		Maximum		,93	
		Range		,70	
		Interquartile Range		.	
		Skewness		-,958	1,225
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,255	3	.	,962	3	,627
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,2330	,23299
		95% Confidence Interval for Mean	Lower Bound	-,7695	
			Upper Bound	1,2355	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,163	
		Std. Deviation		,40355	
		Minimum		,00	
		Maximum		,70	
		Range		,70	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,3333	,20242
		95% Confidence Interval for Mean	Lower Bound	-,5376	
			Upper Bound	1,2043	
		5% Trimmed Mean		.	
		Median		,3010	
		Variance		,123	
		Std. Deviation		,35060	
		Minimum		,00	
		Maximum		,70	
		Range		,70	
		Interquartile Range		.	
		Skewness		,411	1,225
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,203	3	.	,994	3	,847
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Social growl

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		1,1067	,68863
		95% Confidence Interval for Mean	Lower Bound	-1,8563	
			Upper Bound	4,0696	
		5% Trimmed Mean		.	
		Median		,9500	
		Variance		1,423	
		Std. Deviation		1,19274	
		Minimum		,00	
		Maximum		2,37	
		Range		2,37	
		Interquartile Range		.	
		Skewness		,581	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,219	3	.	,987	3	,782
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,2726	,15256
		95% Confidence Interval for Mean	Lower Bound	-,3839	
			Upper Bound	,9290	
		5% Trimmed Mean		.	
		Median		,2900	
		Variance		,070	
		Std. Deviation		,26425	
		Minimum		,00	
		Maximum		,53	
		Range		,53	
		Interquartile Range		.	
		Skewness		-,296	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,193	3	.	,997	3	,891
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Alarm growl

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,6300	,41765
		95% Confidence Interval for Mean	Lower Bound	-1,1670	
			Upper Bound	2,4270	
		5% Trimmed Mean		.	
		Median		,4700	
		Variance		,523	
		Std. Deviation		,72339	
		Minimum		,00	
		Maximum		1,42	
		Range		1,42	
		Interquartile Range		.	
		Skewness		,947	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,254	3	.	,963	3	,632
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,1837	,11110
		95% Confidence Interval for Mean	Lower Bound	-,2943	
			Upper Bound	,6617	
		5% Trimmed Mean		.	
		Median		,1673	
		Variance		,037	
		Std. Deviation		,19243	
		Minimum		,00	
		Maximum		,38	
		Range		,38	
		Interquartile Range		.	
		Skewness		,381	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,201	3	.	,995	3	,859
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Common alarm bark

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,7900	,79000
		95% Confidence Interval for Mean	Lower Bound	-2,6091	
			Upper Bound	4,1891	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		1,872	
		Std. Deviation		1,36832	
		Minimum		,00	
		Maximum		2,37	
		Range		2,37	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,1759	,17588
		95% Confidence Interval for Mean	Lower Bound	-,5809	
			Upper Bound	,9326	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,093	
		Std. Deviation		,30463	
		Minimum		,00	
		Maximum		,53	
		Range		,53	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Threat bark

Descriptives

	Packs			Statistic	Std. Error
Day	ABQ	Mean		2,00	,577
		95% Confidence Interval for Mean	Lower Bound	-,48	
			Upper Bound	4,48	
		5% Trimmed Mean		.	
		Median		2,00	
		Variance		1,000	
		Std. Deviation		1,000	
		Minimum		1	
		Maximum		3	
		Range		2	
		Interquartile Range		.	
		Skewness		,000	1,225
		Kurtosis		.	.
	BOT	Mean		2,00	,577
		95% Confidence Interval for Mean	Lower Bound	-,48	
			Upper Bound	4,48	
		5% Trimmed Mean		.	
		Median		2,00	
		Variance		1,000	
		Std. Deviation		1,000	
		Minimum		1	
		Maximum		3	
		Range		2	
		Interquartile Range		.	
		Skewness		,000	1,225
		Kurtosis		.	.
	BRK	Mean		2,00	,577
		95% Confidence Interval for Mean	Lower Bound	-,48	
			Upper Bound	4,48	
		5% Trimmed Mean		.	
		Median		2,00	
		Variance		1,000	
		Std. Deviation		1,000	
		Minimum		1	
		Maximum		3	
		Range		2	
		Interquartile Range		.	
		Skewness		,000	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Day	ABQ	,175	3	.	1,000	3	1,000
	BOT	,175	3	.	1,000	3	1,000
	BRK	,175	3	.	1,000	3	1,000

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,1541	,15413
		95% Confidence Interval for Mean	Lower Bound	-,5090	
			Upper Bound	,8173	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,071	
		Std. Deviation		,26697	
		Minimum		,00	
		Maximum		,46	
		Range		,46	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Howl bark

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,4733	,47333
		95% Confidence Interval for Mean	Lower Bound	-1,5633	
			Upper Bound	2,5099	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,672	
		Std. Deviation		,81984	
		Minimum		,00	
		Maximum		1,42	
		Range		1,42	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

ln log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,1279	,12794
		95% Confidence Interval for Mean	Lower Bound	-,4225	
			Upper Bound	,6784	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,049	
		Std. Deviation		,22160	
		Minimum		,00	
		Maximum		,38	
		Range		,38	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Clear bark

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,7900	,57134
		95% Confidence Interval for Mean	Lower Bound	-1,6683	
			Upper Bound	3,2483	
		5% Trimmed Mean		.	
		Median		,4700	
		Variance		,979	
		Std. Deviation		,98960	
		Minimum		,00	
		Maximum		1,90	
		Range		1,90	
		Interquartile Range		.	
		Skewness		1,303	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,293	3	.	,922	3	,458
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

In log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,2099	,13517
		95% Confidence Interval for Mean	Lower Bound	-,3717	
			Upper Bound	,7915	
		5% Trimmed Mean		.	
		Median		,1673	
		Variance		,055	
		Std. Deviation		,23412	
		Minimum		,00	
		Maximum		,46	
		Range		,46	
		Interquartile Range		.	
		Skewness		,791	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,239	3	.	,975	3	,698
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Yelp bark

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,1567	,15667
		95% Confidence Interval for Mean	Lower Bound	-,5174	
			Upper Bound	,8307	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,074	
		Std. Deviation		,27135	
		Minimum		,00	
		Maximum		,47	
		Range		,47	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,0767	,07667
		95% Confidence Interval for Mean	Lower Bound	-,2532	
			Upper Bound	,4065	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,018	
		Std. Deviation		,13279	
		Minimum		,00	
		Maximum		,23	
		Range		,23	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,2033	,20333
		95% Confidence Interval for Mean	Lower Bound	-,6715	
			Upper Bound	1,0782	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,124	
		Std. Deviation		,35218	
		Minimum		,00	
		Maximum		,61	
		Range		,61	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	,385	3	.	,750	3	,000
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

In log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,0558	,05577
		95% Confidence Interval for Mean	Lower Bound	-,1842	
			Upper Bound	,2957	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,009	
		Std. Deviation		,09660	
		Minimum		,00	
		Maximum		,17	
		Range		,17	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,0300	,02997
		95% Confidence Interval for Mean	Lower Bound	-,0990	
			Upper Bound	,1589	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,003	
		Std. Deviation		,05191	
		Minimum		,00	
		Maximum		,09	
		Range		,09	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,0689	,06894
		95% Confidence Interval for Mean	Lower Bound	-,2277	
			Upper Bound	,3656	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,014	
		Std. Deviation		,11941	
		Minimum		,00	
		Maximum		,21	
		Range		,21	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	,385	3	.	,750	3	,000
	BRK	,385	3	.	,750	3	,000

a. Lilliefors Significance Correction

Sneeze

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BOT	Mean		,1567	,15667
		95% Confidence Interval for Mean	Lower Bound	-,5174	
			Upper Bound	,8307	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,074	
		Std. Deviation		,27135	
		Minimum		,00	
		Maximum		,47	
		Range		,47	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	.	3	.	.	3	.
	BOT	,385	3	.	,750	3	,000
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

In log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BOT	Mean		,0558	,05577
		95% Confidence Interval for Mean	Lower Bound	-,1842	
			Upper Bound	,2957	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,009	
		Std. Deviation		,09660	
		Minimum		,00	
		Maximum		,17	
		Range		,17	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	.	3	.	.	3	.
	BOT	,385	3	.	,750	3	,000
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Huff

Descriptives

	Packs			Statistic	Std. Error
Vocals	ABQ	Mean		,7900	,79000
		95% Confidence Interval for Mean	Lower Bound	-2,6091	
			Upper Bound	4,1891	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		1,872	
		Std. Deviation		1,36832	
		Minimum		,00	
		Maximum		2,37	
		Range		2,37	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
Vocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

In log10

Descriptives

	Packs			Statistic	Std. Error
LgVocals	ABQ	Mean		,1759	,17588
		95% Confidence Interval for Mean	Lower Bound	-,5809	
			Upper Bound	,9326	
		5% Trimmed Mean		.	
		Median		,0000	
		Variance		,093	
		Std. Deviation		,30463	
		Minimum		,00	
		Maximum		,53	
		Range		,53	
		Interquartile Range		.	
		Skewness		1,732	1,225
		Kurtosis		.	.
	BOT	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.
	BRK	Mean		,0000	,00000
		95% Confidence Interval for Mean	Lower Bound	,0000	
			Upper Bound	,0000	
		5% Trimmed Mean		,0000	
		Median		,0000	
		Variance		,000	
		Std. Deviation		,00000	
		Minimum		,00	
		Maximum		,00	
		Range		,00	
		Interquartile Range		,00	
		Skewness		.	.
		Kurtosis		.	.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Packs	Statistic	df	Sig.	Statistic	df	Sig.
LgVocals	ABQ	,385	3	.	,750	3	,000
	BOT	.	3	.	.	3	.
	BRK	.	3	.	.	3	.

a. Lilliefors Significance Correction

Appendix IX – Overview ANOVA repeated measures and Friedman tests results

Social twitter (Friedman)

Ranks

	Mean Rank
ABQ	2,17
BOT	2,33
BRK	1,50

Test Statistics[a]

N	3
Chi-Square	2,000
df	2
Asymp. Sig.	,368

a. Friedman Test

Spar twitter (Friedman)

Ranks

	Mean Rank
ABQ	3,00
BOT	1,67
BRK	1,33

Test Statistics[a]

N	3
Chi-Square	4,667
df	2
Asymp. Sig.	,097

a. Friedman Test

Mob twitter (ANOVA repeated measures)

Pairwise Comparisons

Measure: Vocal

(I) packs	(J) packs	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	Upper Bound
1	2	4,897	4,897	1,000	-32,557	42,350
	3	4,897	4,897	1,000	-32,557	42,350
2	1	-4,897	4,897	1,000	-42,350	32,557
	3	,000	,000	.	,000	,000
3	1	-4,897	4,897	1,000	-42,350	32,557
	2	,000	,000	.	,000	,000

Based on estimated marginal means

a. Adjustment for multiple comparisons: Bonferroni.

Tests of Within-Subjects Effects

Measure: Vocal

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
packs	Sphericity Assumed	47,955	2	23,977	1,000	,444	,333
	Greenhouse-Geisser	47,955	1,000	47,955	1,000	,423	,333
	Huynh-Feldt	47,955	1,000	47,955	1,000	,423	,333
	Lower-bound	47,955	1,000	47,955	1,000	,423	,333
Error(packs)	Sphericity Assumed	95,909	4	23,977			
	Greenhouse-Geisser	95,909	2,000	47,955			
	Huynh-Feldt	95,909	2,000	47,955			
	Lower-bound	95,909	2,000	47,955			

Begging cry (Friedman)

Ranks

	Mean Rank
ABQ	1,83
BOT	2,33
BRK	1,83

Test Statistics[a]

N	3
Chi-Square	,545
df	2
Asymp. Sig.	,761

a. Friedman Test

Yelp (Friedman)

Ranks

	Mean Rank
ABQ	1,33
BOT	1,67
BRK	3,00

Test Statistics[a]

N	3
Chi-Square	4,667
df	2
Asymp. Sig.	,097

a. Friedman Test

Whistle squeal (ANOVA repeated measures)

Pairwise Comparisons

Measure: Vocals

(I) Packs	(J) Packs	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	Upper Bound
1	2	-,623	,411	,807	-3,770	2,523
	3	-2,440	1,614	,809	-14,784	9,904
2	1	,623	,411	,807	-2,523	3,770
	3	-1,817	2,002	1,000	-17,130	13,497
3	1	2,440	1,614	,809	-9,904	14,784
	2	1,817	2,002	1,000	-13,497	17,130

Based on estimated marginal means

a. Adjustment for multiple comparisons: Bonferroni.

Tests of Within-Subjects Effects

Measure: Vocals

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Packs	Sphericity Assumed	9,642	2	4,821	1,422	,342	,416
	Greenhouse-Geisser	9,642	1,008	9,567	1,422	,355	,416
	Huynh-Feldt	9,642	1,032	9,346	1,422	,355	,416
	Lower-bound	9,642	1,000	9,642	1,422	,355	,416
Error(Packs)	Sphericity Assumed	13,564	4	3,391			
	Greenhouse-Geisser	13,564	2,016	6,729			
	Huynh-Feldt	13,564	2,064	6,573			
	Lower-bound	13,564	2,000	6,782			

Begging squeal (ANOVA repeated measures)

Pairwise Comparisons

Measure: Vocals

(I) Packs	(J) Packs	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	Upper Bound
1	2	-7,430	3,739	,556	-36,025	21,165
	3	-2,960	1,336	,471	-13,180	7,260
2	1	7,430	3,739	,556	-21,165	36,025
	3	4,470	3,568	1,000	-22,823	31,763
3	1	2,960	1,336	,471	-7,260	13,180
	2	-4,470	3,568	1,000	-31,763	22,823

Based on estimated marginal means

a. Adjustment for multiple comparisons: Bonferroni.

Tests of Within-Subjects Effects

Measure: Vocals

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Packs	Sphericity Assumed	83,947	2	41,974	2,946	,164	,596
	Greenhouse-Geisser	83,947	1,201	69,892	2,946	,213	,596
	Huynh-Feldt	83,947	2,000	41,974	2,946	,164	,596
	Lower-bound	83,947	1,000	83,947	2,946	,228	,596
Error(Packs)	Sphericity Assumed	56,989	4	14,247			
	Greenhouse-Geisser	56,989	2,402	23,723			
	Huynh-Feldt	56,989	4,000	14,247			
	Lower-bound	56,989	2,000	28,494			

Whimper (Friedman)

Ranks

	Mean Rank
ABQ	1,50
BOT	2,67
BRK	1,83

Test Statistics[a]

N	3
Chi-Square	3,714
df	2
Asymp. Sig.	,156

a. Friedman Test

Whine (Friedman)

Ranks

	Mean Rank
ABQ	2,00
BOT	2,67
BRK	1,33

Test Statistics[a]

N	3
Chi-Square	3,200
df	2
Asymp. Sig.	,202

a. Friedman Test

Buzz gurgle moan (Friedman)

Ranks

	Mean Rank
ABQ	1,83
BOT	2,33
BRK	1,83

Test Statistics[a]

N	3
Chi-Square	2,000
df	2
Asymp. Sig.	,368

a. Friedman Test

Rumble (Friedman)

Ranks

	Mean Rank
ABQ	2,17
BOT	2,33
BRK	1,50

Test Statistics[a]

N	3
Chi-Square	2,000
df	2
Asymp. Sig.	,368

a. Friedman Test

Social growl (ANOVA repeated measures)

Pairwise Comparisons

Measure: Vocals

(I) Packs	(J) Packs	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	Upper Bound
1	2	1,107	,689	,748	-4,161	6,374
	3	1,107	,689	,748	-4,161	6,374
2	1	-1,107	,689	,748	-6,374	4,161
	3	,000	,000	.	,000	,000
3	1	-1,107	,689	,748	-6,374	4,161
	2	,000	,000	.	,000	,000

Based on estimated marginal means

a. Adjustment for multiple comparisons: Bonferroni.

Tests of Within-Subjects Effects

Measure: Vocals

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Packs	Sphericity Assumed	2,449	2	1,225	2,583	,190	,564
	Greenhouse-Geisser	2,449	1,000	2,449	2,583	,249	,564
	Huynh-Feldt	2,449	1,000	2,449	2,583	,249	,564
	Lower-bound	2,449	1,000	2,449	2,583	,249	,564
Error(Packs)	Sphericity Assumed	1,897	4	,474			
	Greenhouse-Geisser	1,897	2,000	,948			
	Huynh-Feldt	1,897	2,000	,948			
	Lower-bound	1,897	2,000	,948			

Alarm growl (ANOVA repeated measures)

Pairwise Comparisons

Measure: Vocals

(I) Packs	(J) Packs	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	Upper Bound
1	2	,630	,418	,811	-2,565	3,825
	3	,630	,418	,811	-2,565	3,825
2	1	-,630	,418	,811	-3,825	2,565
	3	,000	,000	.	,000	,000
3	1	-,630	,418	,811	-3,825	2,565
	2	,000	,000	.	,000	,000

Based on estimated marginal means

a. Adjustment for multiple comparisons: Bonferroni.

Tests of Within-Subjects Effects

Measure: Vocals

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Packs	Sphericity Assumed	,794	2	,397	2,275	,219	,532
	Greenhouse-Geisser	,794	1,000	,794	2,275	,270	,532
	Huynh-Feldt	,794	1,000	,794	2,275	,270	,532
	Lower-bound	,794	1,000	,794	2,275	,270	,532
Error(Packs)	Sphericity Assumed	,698	4	,174			
	Greenhouse-Geisser	,698	2,000	,349			
	Huynh-Feldt	,698	2,000	,349			
	Lower-bound	,698	2,000	,349			

Common alarm bark (Friedman)

Ranks

	Mean Rank
ABQ	2,33
BOT	1,83
BRK	1,83

Test Statistics[a]

N	3
Chi-Square	2,000
df	2
Asymp. Sig.	,368

a. Friedman Test

Threat bark (Friedman)

Ranks

	Mean Rank
ABQ	2,33
BOT	1,83
BRK	1,83

Test Statistics[a]

N	3
Chi-Square	2,000
df	2
Asymp. Sig.	,368

a. Friedman Test

Howl bark (Friedman)

Ranks

	Mean Rank
ABQ	2,33
BOT	1,83
BRK	1,83

Test Statistics[a]

N	3
Chi-Square	2,000
df	2
Asymp. Sig.	,368

a. Friedman Test

Clear bark (ANOVA repeated measures)

Pairwise Comparisons

Measure: Vocals

(I) Packs	(J) Packs	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	Upper Bound
1	2	,790	,571	,903	-3,580	5,160
	3	,790	,571	,903	-3,580	5,160
2	1	-,790	,571	,903	-5,160	3,580
	3	,000	,000	.	,000	,000
3	1	-,790	,571	,903	-5,160	3,580
	2	,000	,000	.	,000	,000

Based on estimated marginal means

a. Adjustment for multiple comparisons: Bonferroni.

Tests of Within-Subjects Effects

Measure: Vocals

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Packs	Sphericity Assumed	1,248	2	,624	1,912	,261	,489
	Greenhouse-Geisser	1,248	1,000	1,248	1,912	,301	,489
	Huynh-Feldt	1,248	1,000	1,248	1,912	,301	,489
	Lower-bound	1,248	1,000	1,248	1,912	,301	,489
Error(Packs)	Sphericity Assumed	1,306	4	,326			
	Greenhouse-Geisser	1,306	2,000	,653			
	Huynh-Feldt	1,306	2,000	,653			
	Lower-bound	1,306	2,000	,653			

Yelp bark (Friedman)

Ranks

	Mean Rank
ABQ	2,00
BOT	2,00
BRK	2,00

Test Statistics[a]

N	3
Chi-Square	,000
df	2
Asymp. Sig.	1,000

a. Friedman Test

Sneeze (Friedman)

Ranks

	Mean Rank
ABQ	1,83
BOT	2,33
BRK	1,83

Test Statistics[a]

N	3
Chi-Square	2,000
df	2
Asymp. Sig.	,368

a. Friedman Test

Huff (Friedman)

Ranks

	Mean Rank
ABQ	2,33
BOT	1,83
BRK	1,83

Test Statistics[a]

N	3
Chi-Square	2,000
df	2
Asymp. Sig.	,368

a. Friedman Test

Appendix X – Table of the Kruskall-Wallis test results

Pairwise Comparisons of PackID C

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
3-2	9.050	5.338	1.695	.090	.270
3-1	15.175	5.338	2.843	.004	.013
2-1	6.125	5.338	1.147	.251	.754

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is ,050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.