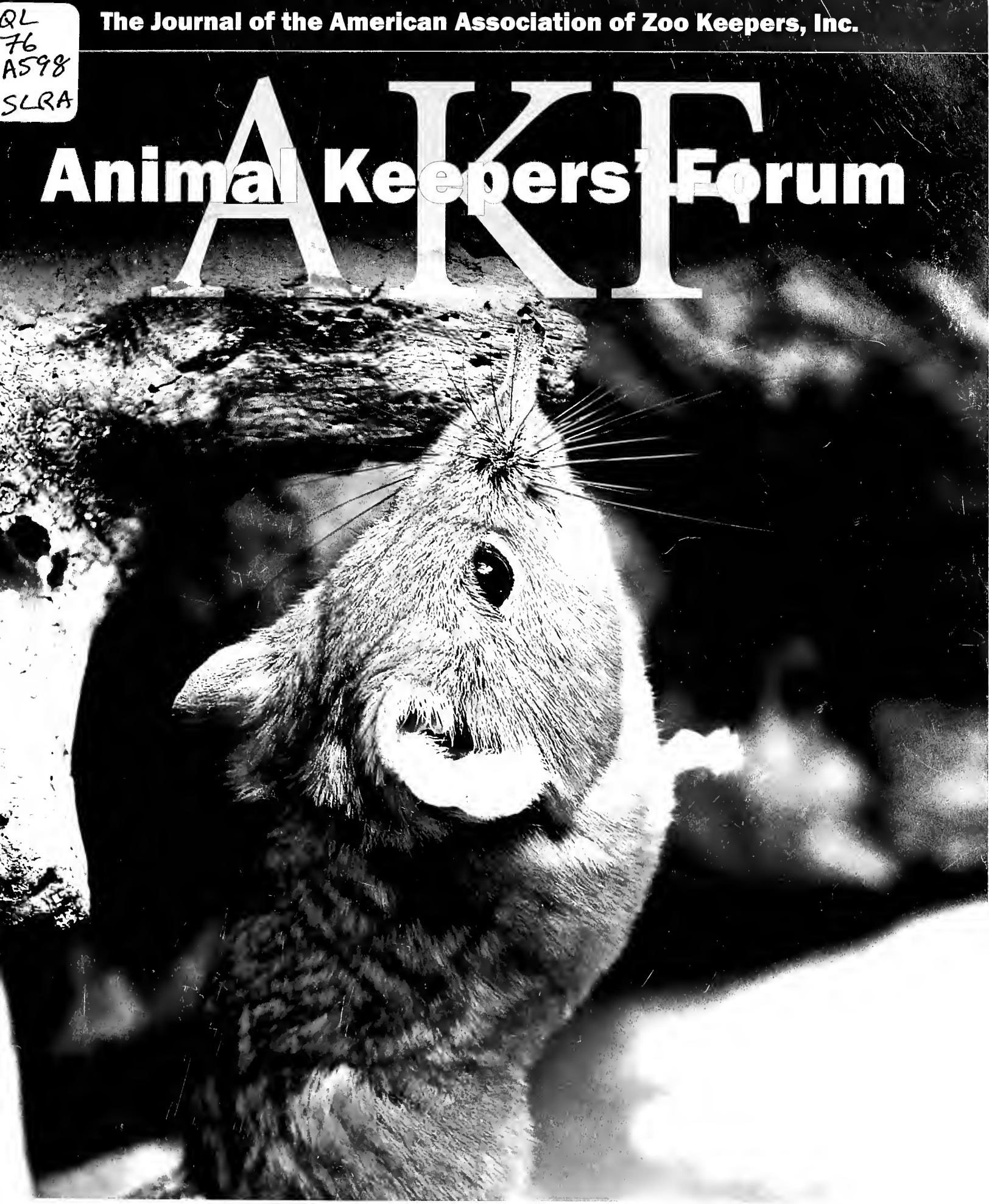
The Journal of the American Association of Zoo Keepers, Inc.

Animal Keepers' Forum



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(see P. 161 for details)

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American Association of Zoo Keepers, Inc.

The American Association of Zoo Keepers, Inc. exists to advance excellence in the animal keeping profession, foster effective communication beneficial to animal care, support deserving conservation projects, and promote the preservation of our natural resources and animal life.

About the Cover

This month's cover comes to us from Clyde Nishimura of Smithsonian's National Zoological Park, featuring a short-eared elephant shrew (*Macroscelides proboscideus*).

The short-eared elephant shrew is the smallest of the 17 living species of elephant shrew, also known as sengi. Interestingly, they are more closely related to elephants than shrews. They weigh between one and 1.5 ounces, and have a body length of about four inches. Their fur is gray brown, with a white underside. Their nostrils are at the tip of a flexible snout.

Their home range includes Namibia, southern Botswana, and the cape of south Africa. Elephant shrews burrow into sandy soil in arid semi-desert, dry grass, or shrubland. Their mostly insectivorous diet includes ants, termites, berries, and tender shoots of young plants. After a gestation of 56 days, an elephant shrew gives birth to a litter of one or two during the wet season. Young start their own hunting at two-weeks-old. At five to six-weeks-old, they are sexually mature and seek out their own home range. They keep trails clear of debris for fast escape from predators and keep their tails horizontal while they move. They clean themselves with dust baths.

Articles sent to ***Animal Keepers' Forum*** will be reviewed by the editorial staff for publication. Articles of a research or technical nature will be submitted to one or more of the zoo professionals who serve as referees for ***AKF***. No commitment is made to the author, but an effort will be made to publish articles as soon as possible. Lengthy articles may be separated into monthly installments at the discretion of the Editor. The Editor reserves the right to edit material without consultation unless approval is requested in writing by the author. Materials submitted will not be returned unless accompanied by a stamped, self-addressed, appropriately-sized envelope. Telephone, fax or e-mail contributions of late-breaking news or last-minute insertions are accepted as space allows. Phone (330) 483-1104; FAX (330) 483-1444; e-mail is shane.good@aazk.org. If you have questions about submission guidelines, please contact the Editor. Submission guidelines are also found at: aazk.org/akf-submission-guidelines/.

Deadline for each regular issue is the 3rd of the preceding month. Dedicated issues may have separate deadline dates and will be noted by the Editor.

MEMBERSHIP SERVICES

Animal Data Transfer Forms available for download at aazk.org. AAZK Publications/ Logo Products/Apparel available at AAZK Administrative Office or at aazk.org.

ANIMAL KEEPERS' FORUM

TO CONTACT THE *AKF* EDITOR:
Shane Good, Media Production Editor
P.O. Box 535, Valley City, OH 44280
330-483-1104
shane.good@aazk.org

AAZK Administrative Office

American Association of Zoo Keepers
8476 E. Speedway Blvd.
Suite 204
Tucson, AZ 85710-1728
520-298-9688 (Phone/Fax)
E-mail: Ed.Hansen@aazk.org
Chief Executive/Financial Officer: Ed Hansen

EDITOR
Shane Good
GRAPHIC DESIGNER
Elizabeth Thibodeaux
ENRICHMENT OPTIONS COLUMN COORDINATORS
Julie Hartell-DeNardo, Saint Louis Zoo
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FROM THE PRESIDENT

"He knew a path that wanted walking; He knew a spring that wanted drinking; A thought that wanted further thinking"

— Robert Frost

I took an oath when I first joined the Board of Directors with AAZK. With that oath, I promised to uphold and defend the by-laws, our constitution, and the mission of our Association. As a member of the Board of Directors and your President, those documents serve as a guide in both decision making and future planning for all things AAZK. In past communications, I have referred to our mission as the rudder which helps direct the Association and as a leader, I make constant reference to these articles, insuring that my actions, real or potential, are in line with the needs of the Association.

An oath, or affirmation, is our promise of performance and can be found in several professions today. In the animal care industry, our veterinarians took an oath of office upon receiving their diploma. And while we have no such official oath as animal care professionals, I am constantly referencing the "Five Freedoms" of animal welfare in my job. I hold these freedoms as my personal oath and my pledge to assure that the minimum standards of animal welfare are being met. In the small zoo where I work, we have all embraced these as guiding principles for all that we do for the animals in our collection. We use these freedoms as the starting point for identifying animal welfare concerns, communicating these concerns and developing solutions for best practices in animal care.

For those who are not aware of the "Five Freedoms", they are as follows:

- **Freedom from Hunger and Thirst:** by ready access to fresh water and a diet to maintain full health and vigor.
- **Freedom from Discomfort:** by providing an appropriate environment including shelter and a comfortable resting area.
- **Freedom from Pain, Injury or Disease:** by prevention or rapid diagnosis and treatment
- **Freedom to Express Normal Behavior:** by providing sufficient space, proper facilities and company of the animal's own kind.
- **Freedom from Fear and Distress:** by ensuring conditions and treatment which avoid mental suffering.

The "Five Freedoms" were originally created 50 years ago as part of a report on the welfare of animals kept under intensive livestock husbandry systems. They were later adopted as the "Five Freedoms" and widely used as the basis for defining the ideal states for animal welfare.

I am responsible for the collection of animals in my institution and when I dialogue with staff about the care and management of our animals, we reference these freedoms together. It has become our common ground for animal care, communication, and problem-solving. As animal care professionals, we do three things all day: 1) we care for animals, 2) we communicate effectively, and 3) we solve problems. And when we perform these three things, we integrate the "Five Freedoms".

The "Five Freedoms" represent our common ground for communication and problem-solving; the litmus paper for animal welfare. Moreover, they have become our pledge to provide the best care for our animals. I have never had to take an oath as an animal care professional, and as simple as these freedoms may be, they have become my personal oath and pledge.

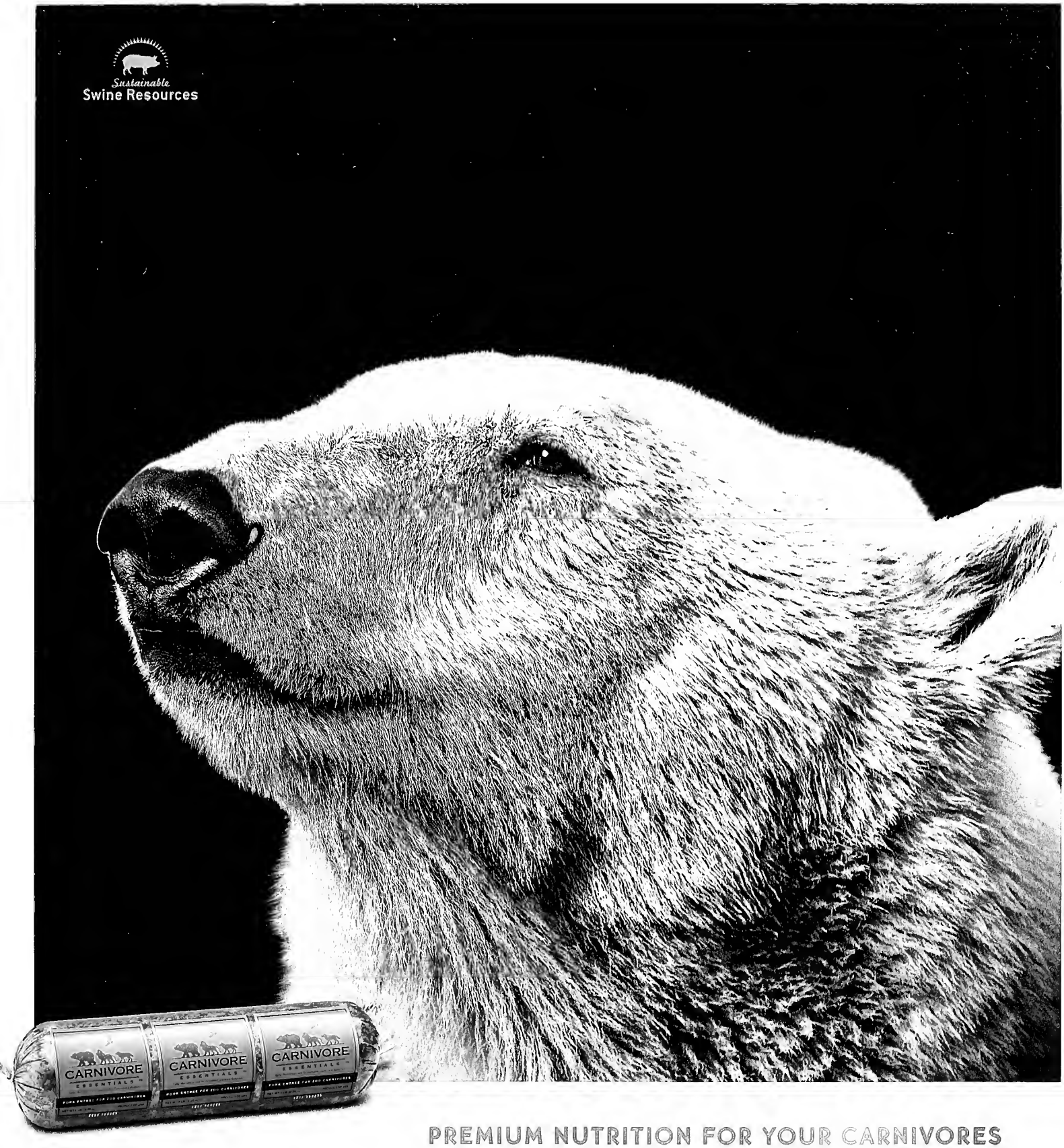
This is the thought that warrants further thinking: how often do we reference these freedoms in all that we do as animal care professionals?

As always, I welcome your thoughts and input. E-mail me at bob.cisneros@aazk.org; I would love to hear from you. Drop me a line and I promise to write back.

Respectfully,

Bob Cisneros

The National Archives. "Farm Animal Welfare Council: The Five Freedoms" http://webarchive.nationalarchives.gov.uk/20121007104210/http:/www.fawc.org.uk/freedoms.htm



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COMING EVENTS

Post upcoming events here!
e-mail shane.good@aazk.org

June 1-5, 2015
Prosimian TAG Meeting and Workshop
Myakka City, FL
Hosted by The Lemur Conservation Foundation.
For more information contact Alison Grand at: agrand@lemurreserve.org.

June 1-5, 2015
Conservation Breeding Centers for Wildlife Sustainability
Smithsonian Conservation Biology Institute (National Zoo), Front Royal, VA
For more information go to: SMConservation.gmu.edu

June 2-4, 2015
Chimpanzee Husbandry Workshop
Detroit, MI
Hosted by Detroit Zoological Society
For more information go to: detroitzoo.org/animals/chimpanzeeworkshop

June 14-18, 2015
International Rhino Keepers' Workshop
Chester, England
Hosted by Chester Zoo
For more information and Call for Papers, go to: rhinokeeperassociation.org/rhino-keeper-workshop/

July 10-16, 2015
Felid TAG Conference and Husbandry Course
Pittsburgh, PA
Hosted by Pittsburgh Zoo and PPG Aquarium
For more information go to: http://pittsburghzoo.org/felidtagconference

August 6-9, 2015
13th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles
Tucson, AZ
For more information go to: turtlesurvival.org/conference

September 9-13, 2015
International Congress on Zookeeping
Leipzig, Germany
Hosted by Leipzig Zoo and the International Congress of Zookeepers (ICZ).
For more information visit: iczoo.org.

September 17-21, 2015
AZA National Conference
Salt Lake City, UT
Hosted by Utah's Hogle Zoo
For more information visit: aza.org.

October 5-9, 2015
Giraffe Care Workshop
Colorado Springs, CO
Hosted by Cheyenne Mountain Zoo
For more information visit: cmzoo.org/index.php/giraffe-care-workshop/

AMERICAN ASSOCIATION of ZOO KEEPERS

September 27 - Oct. 1, 2015
AAZK National Conference
St. Louis, MO
Hosted by Saint Louis Zoo and St. Louis Chapter of AAZK
More details can be found at: www.stlzoo.org/animals/soyouwanttobeazookeeper/americanassociationofzooke/

October 12-16
Zoos and Aquariums Committing to Conservation Conference (ZACC)
Denver, CO
Hosted by Denver Zoo
For more information go to: http://www.denverzoo.org/ZACC

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trees
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Thanks for competing for polar bears and the Arctic; we raised $11,838.07 in this year's Chapter Challenge!

Brookfield Chapter is the recipient of the grand prize— a living, breathing tree!

What do you plan to do with your Chapter's funds?

1. Use the funds in your own community—by planting on the grounds of your own zoo or aquarium or by supporting a local tree-planting project.
2. Donate the funds to SaveNature.Org, an international tree-planting organization that works to protect tropical rainforests. With this option, the Chapter should talk about the importance of rainforests in combating climate change as part of the fundraising process.
3. Donate the funds to Polar Bears International in support of Acres for the Atmosphere projects.

Let us know what you are doing at
aac@polarbearsinternational.org.

Plant a tree. Help a polar bear. It's as simple as that!

Final standings:

Brookfield	$3,355.45
Greater Philadelphia	$1,663.00
Lincoln Park	$1,350.00
Columbus	$1,094.00
Greater Cleveland	$1,000.00
Greater Houston	$792.62
Milwaukee	$757.00
Tulsa	$580.00
Fresno Chaffee	$500.00
Toronto Zoo	$273.00
San Antonio	$200.00
Rocky Mountain	$155.00
Portland	$100.00

CHAPTER NEWS

The Portland Chapter of AAZK had a very busy year in 2014! For BFR last year we raised $47,284.46! This makes for a grand total of $292,842.50 since AAZK began raising funds for this important project.

Our very own Carolyn Leonard was second place overall in raising funds and right now she is at Lewa enjoying an amazing trip with fellow Chapter member Kim Voyle. Congratulations Carolyn, we cannot wait to hear all about it!

Another big project for us this year was our second Conservation Comedy Night and Auction raising $28,000 which we split between two wonderful non-profit organizations: Ruaha Carnivore Project in Tanzania and the Portland Chapter of the Audubon Society. We also held many smaller fund raisers bringing in over $1200 which benefitted Trees for You and Me, Orang Outreach, and The Amur Leopard Project.

We also supported continuing education for our members and helped to send two to the 2014 National AAZK Conference in Orlando, FL.

In January, we voted in new Chapter Officers for 2015: President Becca Van Beek, VP Anne Lauerman, Tres. Michael Illig, Interim Sec. Chris Wright and Liaison Michelle Schireman. Many thanks to Philip Fensterer (Past President) for his exemplary service!

The new year has begun with our Chapter finalizing our Chapter Mission Statement and updating our Chapter By-Laws. Plus our Bowling For Rhinos date is already set for June 13th! And as always we have some other amazing fund raisers in the works!

A special congrats goes to Chapter member Philip Fensterer who was recently accepted as a member of the National AAZK Conservation Committee!

Please 'Like' us on our Facebook page to keep up to date on all of our activities!

Guests enjoying the Portland Chapter of AAZK's Comedy Night Fundraiser

A Comparative Study on the White-handed Gibbon *(Hylobates lar)* Vocalization

Kristilee Kodis

Abstract

White-handed gibbons *(Hylobates lar)* have been studied for their vocalizations which are unlike other species. In the wild and in captivity they are found to be very vocal and active. Zoos try to provide their animals with adequate habitats mimicking their natural environments in order to preserve their natural behaviors and vocalizations. This study followed a male and female pair-bond of gibbons who have lived together for 10 years at Wildlife Safari in Winston, OR. The study looked at the frequency and duration of female vs. male vocalizations during the morning and evening. The data were then compared to wild gibbons to look at the difference between captive and wild vocalizations. This study showed that the time between vocalizations and duration of vocalizations between captive and wild gibbons is different and that the male and female vocalizations do not completely follow past studies.

Introduction

In the last decade animal communication has become a topic that is in the process of being understood, so scientists can fully comprehend how animals interact with each other. Understanding communication between different and the same species can be used to help save these species by allowing humans to better understand movement patterns and habits. Animals use advanced language techniques to communicate with one another, they have developed mechanisms for vocalizations based on their different habitats, proximity, and senses. Animal vocalizations need to overcome habitat challenges such as the distance in the desert, the trees in the forest, and the density of water. They are also used for sensory differences, such as color vision differences and olfactory senses, and proximity differences, such as the distance between one animal and the next.

In animal communication, natural selection favors species which vocalize to affect the behavior of listeners and listeners who acquire information from vocalizations, using this information to represent their environment (Seyfarth and Dorothy, 2003). Animals rely on verbal and nonverbal signs to fully communicate a meaning or action.

Gibbons *(Hylobates)* are apes from the old world monkey families. Gibbon vocalizations are well heard and known of but still not understood. There are many different studies taking place to understand their many vocalizations and why they make them.

White-handed gibbons *(Hylobates lar)* produce their loud vocalizations using a throat sac located beneath the chin to help enhance and project sound. The sac allows them to collect air for a louder, longer, more projected vocalization (Palombit, 1996). White-handed gibbons make family pairs with a primary couple and their offspring. They have a very in-depth social system, and have been known to howl as a means for communication. Couples perform "duets," which are interactive vocalizations between the breeding pair in a family unit (Palombit, 1996). Each morning as a believed means to advertise their territory and reinforce their pair-bonds, the breeding pair of white-handed gibbons will take part in a "duet." Females lead the "duet" of morning vocalizations with louder, more dominant vocalizations, while males give a following vocalization (Palombit, 1996). Their loud resonant songs can be heard up to a half-mile away (Chivers and Reicharcf, 1980). Songs by far exceed those of all other species due to the sound-amplifying throat sac.

White-handed gibbons have been found in Indochina and Thailand, west of Mekong River, Tenasserim; Malay Peninsula and Sumatra (Heissmann, 1991). They live in tropical rain forests from sea level to about 6,500 feet in elevation, but much of their habitat has been destroyed due to deforestation (Heissmann, 1991). Tropical rainforests are thick with trees and vocalizations need to be louder and longer with a higher resonance to be heard through all of the foliage.

Because gibbons are found in many different zoos and their calls are commonly heard by guests, many studies have been done on their vocalizations. Studies have focused on vocalizations in the pair bond, immature female vocalizations, and the effect of predators on vocalizations.

In past studies of measuring vocalizations, results indicate there were no obvious acoustic differences between the vocalizations gibbons make during breeding pairs and song duets as when they see predators until they looked at the data under closer scrutiny (Clarke et al., 2006). It has been found that male gibbons would start vocalizations if a predator was around which is uncommon for regular "duets" (Clarke et al., 2006).

Other studies have found that males with increased vocalization have a higher probability of forming pair-mating and "duets" (Barelli et al., 1998). Vocalizations also have a large role in the decision-making process (Barelli et al., 1998). Gibbons are known to participate in their duets around sunrise and sunset (Palombit,

1996). Their vocalizations can be heard up to a half-mile, take approximately half an hour and are started by the adult female (Palombit, 1996). The duets start with an introductory sequence that leads to an organizing sequence for the great-vocalization sequence of the female which is often then followed by a male vocalization (Chivers and Reicharcf, 1980). The combination of these vocalizations alternate for about three-minute intervals for about fifteen minutes (Palombit, 1996).

Many other experiments have been performed to see if vocal cues could be used to train female gibbons using operant conditioning. The use of males has not been explored due to the fact females are the dominant leaders of vocalizations. In a study by Koda, Oyakawa, Kato and Masataka (2007), which was done on the vocalization of an immature female primate, the study found that when taking vocalization training step by step, the study could use operant conditioning to pair a reward with a v-card and vocalization (Koda et al., 2007). Those immature female gibbons remembered and were cognizant of what they were learning (Koda et al., 2007).

Both of these studies have shown that vocalizations can be learned and analyzed based on environment and circumstances. The aim of my comparative study was to test whether vocalizations differ between female and male white-handed gibbons to see if there is a difference in duration and frequency. This study compared the frequency and duration between the white-handed gibbons found at Wildlife Safari and vocalizations between wild and captive white-handed gibbons. The null hypothesis is that there is no difference in vocalization duration or frequencies between males and female vocalizations and that there is no difference in the vocalizations found between captive and wild white-handed gibbons.

Methods

Two white-handed gibbons were observed at Wildlife Safari in Winston, Oregon in the lower area of the Zoo called the Village. The gibbons are a male and a female; the male is a pale buff gibbon named Santos and is 22-years-old while the female is a black gibbon named Rerun and is 23-years-old. Both gibbons were born and raised in zoos, never having experienced their native habitats.

The gibbons live by themselves on an island in the middle of the lower part of the Village, surrounded by water. Every morning the gibbons were given their diet and enrichment between 9:00 am and 9:30 am. Every evening the gibbons were given their diets and put into their houses for the night between 6:00 pm and 6:30 pm.

During the day the gibbons could freely roam their island and only had interactions with keepers for morning feedings, morning enrichment, afternoon training, evening diets and being put up for the night into their houses. The only interactions the gibbons have with the public were when the public watched the gibbons and made vocalizations towards the gibbons.

To determine when to base the hours of the study, data were collected for three days by the study observer from 4:00 am

to 12:00 pm and 2:00 pm to 7:00 pm to record when gibbon vocalizations were prominent. Keepers were also questioned about and asked to record when the keepers heard the gibbons' vocalizations for a week to determine the vocalization activity hours. After being determined, the parameters of the research study were set.

Every other day for four weeks the gibbons were watched from 9:00 am to 11:30 am in the mornings and 4:30 pm to 6:30 pm in the evenings to collect and record the frequency/pitch and duration of the gibbon vocalizations. Vocalizations were categorized as vocalization 1 being a short "woop", vocalization 2 being a "woop", vocalization 3 being a long "woooop" and vocalization 4 being a "Whooooooop". During the original preliminary week of gathering data to find a call, the calls were timed and set so during the data collection time the calls would be easily recorded with a ranking of 1-4.

In the experiment a frequency recorder, voice recorder, multiple stopwatches, a clock, pen, and paper were used to make measurements and recordings. The frequency recorder was a Sony Walkman® WM-D6 because it works well in rough field conditions. The voice recorder, Sony - Digital Voice Recorder Model number ICDPX312, records up to 536 hours. The frequency recorder and voice recorder were set on a bench side by side, started at the beginning of the research time, either 9:00 am or 4:30 pm, and turned off at the end of the designated research time, either 11:30 am or 6:30 pm.

The voice recorder and frequency recorder were left on the entire time of the experiment and timed with a regular clock so they could be accurately recorded. Multiple stopwatches were turned on and off and the time data were recorded based on when

Categories	Vocalization	Length of vocalization
1	Short "woop"	0 - 0.4 seconds
2	"Woop"	0.4 - 2.3 seconds
3	Long "woooop"	2.3 - 5.6 seconds
4	"Whooooooop"	5.6+ seconds

Figure 1: A categorized version of the gibbon vocalizations explained above. During the original preliminary week of gathering data to find a call, the calls were timed and set so during the data collection time the calls would be easily recorded with a ranking of 1-4.

the gibbon vocalization started, when the gibbon vocalization stopped, and if the male or female gibbon was vocalizing. Each time a stop watch was stopped, the data were recorded on a data sheet for the day. Male and female vocalizations were recorded on a data sheet, when the female would start to vocalize a stopwatch was started and a data sheet was filled out with the 1-4 point schema according to what vocalizations the female was making. When the female would stop the vocalization the stopwatch was stopped. When the male would vocalize a stopwatch was started and a data sheet was filled out with the 1-4 point schema according to what vocalizations the male was making. If both the male and female were vocalizing, a stopwatch would be started for both, along with a data sheet being filled out for both of the gibbons. When the male stopped vocalizing, his stopwatch and data sheet were stopped and done being filled out. When the female stopped vocalizing, her stopwatch and data sheet were stopped and done being filled out. Males and female vocalizations were recorded as separate entities, not as a combined vocalization. If the gibbons were in the middle of a vocalization when the designated time was over, the rest of their vocalization would be recorded and used in the data collection.

Results

After the data were collected it was then analyzed in two ways. First, the vocalizations made by the male and the vocalizations made by the female gibbon in captivity were compared using Microsoft® Excel. Secondly, the types of observed vocalizations recorded in captivity through the research at Wildlife Safari were listed (Figures 1 and 2) and compared to the wild vocalizations (Figure 2) in Clarke, Reichard and Zuberbühler's (2006) paper.

When looking at vocalizations between the male and female gibbons, both the female and the male initiated vocalizations. Females initiated vocalizations 92.8% of the time while males only initiated vocalizations 7.2% of the time. After a time span of 30 minutes or more, males were most likely to start vocalizations. Vocalizations never started before the gibbons received their diets; they started 10 to 30 minutes after diets were received. The female gibbon was the only gibbon to use a number 4 vocalization; it had the highest frequencies and were the loudest, longest vocalization witnessed during the study. The entire length and amount of the vocalizations differed during each of the different days of study. On seven of the observation days the male vocalizations were a minimum, between 10-20, while the female amount of vocalizations did not really vary. Female vocalizations reached up to 2500Hz while male vocalizations reached 1700Hz. No afternoon vocalizations were witnessed.

The captive gibbon research was compared to the wild gibbon study performed by Clarke, Reichard and Zuberbühler (2006). Clarke et al. (2006) found that female great vocalizations lasted on average 17.43±1.32 s and they were rapidly produced within the first two minutes of the vocalization. The female gibbon in captivity had a great vocalization that lasted 14.62±2.32 seconds and took on average 10±5 minutes to be produced after the vocalizations started. Clarke et al. (2006) found great vocalizations during the first two minutes of a duet were connected to the song duet complexities and after that time period female great vocalizations were related to the presence of predators.

These data could not be compared to the gibbons in captivity because predators were not present. Clarke et al. (2006) found males usually replied to female great vocalizations within 1.0±3.4 seconds. While in captivity, the female gibbon's great vocalization was later in the duet and only answered by a male vocalization 86.2% of the time. Clarke et al. (2006) found female great vocalizations to be a loud and penetrating two-humped vocalization; the vocalization lasted on average 17.4 ±1.32 seconds with a swift male reply within 1.0±3.4 seconds. In captivity, the great vocalization of the female reached the highest pitch, which was never reached by the male. The female vocalization lasted 22.4 ±2.82 seconds while the male replied either within 0.5±2.2 seconds or 10.3±2.1 seconds or did not occur at all and was followed up by another female vocalization.

Discussion

When looking at the comparison of the captive male and female vocalizations, it was found that females have the dominant vocalizations. Females, the majority of the time, start the first vocalization of the morning, known as the initiation vocalization. Then a duet between a male and female takes place using vocalizations 1 thru 3. Then the female would give a vocalization 4, which may or may not be followed by a male vocalization. When there is a break, stop or lull in the vocalizations, a male or female will start the vocalization again.

Females are more likely to start morning vocalizations and reach frequencies not found in male vocalizations. The female used all vocalization categories while males used vocalizations 1-3 (Figure 1). The female used vocalization 2 and 3 the most and 4 only two to four times in a morning's vocalization. The male used vocalization 1 and 3 the most and never made a vocalization number 4. The vocalizations did not go in a synchronized order, 1

Categories	Vocalization	Length of vocalization	Clarke, Reichard and Zuberbühler (2006) Vocalization (Figure 3)
1	Short "woop"	0 - 0.4 seconds	'Wa'&'hoo'
2	"Woop"	0.4 - 2.3 seconds	'Leaning wa'
3	Long "woooop"	2.3 - 5.6 seconds	'oo'
4	"Whooooooop"	5.6+ seconds	'Sharp wow'& 'waoo'

Figure 2: A categorized version of the gibbon vocalizations explained above. During the original preliminary week of gathering data to find a call, the calls were timed and set so during the data collection time, the calls would be easily recorded with a ranking of 1-4. The data from the comparative study were then added in, showing the calls they classified and the sounds they classified them to the data collected. This gave the data a common comparative value.

Number of the call and a description of what the call sounds like	Other information adding insight into the call
(1) The 'wa' note is a short and steeply rising note, appearing as a more or less straight line on the spectrogram; sometimes appearing slightly concave.	It consistently spans over 100 Hz in the frequency domain, which sets it aside from the 'hoo' note.
(2) The 'hoo' is a low frequency, quiet note consistently spanning a much narrower frequency range than 'wa' notes.	
(3) The 'leaning wa' notes may be more or less straight like the 'wa' notes, but longer in duration, and therefore lean more to the right; sometimes they have a slight bump in the middle.	
(4) The 'oo' note is of a relatively even pitch and therefore produces a flat note, as seen on the spectrogram, of varying duration.	Sometimes it may rise slightly at the start.
(5) The 'sharp wow' note is a loud and penetrating note. It rises steeply at first then falls steeply to produce a concave curve.	It invariably spans more than 700 Hz in the frequency domain. The end of the note may be prolonged horizontally.
(6) The 'waoo' note is highly variable. It always rises steeply at first, but then may hold pitch at an even level or fall in pitch to create a convex curve.	It spans a much lower frequency range than the 'sharp wow'.

Figure 3: The description of calls in the paper by Clarke, Reichard and Zuberbühler (2006), The Vocal Behavior of Free-Ranging White-handed Gibbons (HYLOBATES LAR) In Khao Yai National Park, Thailand. The calls were combined to fit the 4 range calls predetermined (Figure 2).

to 2 to 3 to 4; they did not go in any apparent order. A vocalization 1 could be followed by a 2 or 3, the only reoccurring order was the female made a vocalization 3 after a 4. There was no consistency on what vocalizations happened where or when that could be observed by the researcher.

Males were found to take part in solo vocalizations. There would be a five to seven minute break between the duet vocalizations and then the male would have a three to ten minute solo vocalization with no answer from the female. After a short break of two to four minutes the male's duet vocalizations would start again.

The female reached up to 2500Hz in her vocalizations while the male reached up to 1700Hz. The difference in the frequencies is due to the vocalization 4. Each of the vocalizations does not have a frequency number that can be directly categorized with a number but there is a frequency range for each of the vocalizations. The female projecting vocalization 4 gives her a louder vocalization and higher frequency than that of the male.

When comparing wild and captive gibbons there were many differences observed. A major difference was in the time of vocalizations. The gibbons in the wild vocalized at dawn and dusk, while the gibbons in captivity vocalized between 9:30 and 11:30 in the morning, with no night vocalizations. The captive gibbons made morning vocalizations that appeared to be dependent on their diets, while vocalizations at night were not heard.

The female great vocalizations, vocalization 4, in wild gibbons were found in the beginning of the duet while in captive gibbons it was always towards the end of the duet. Female great vocalizations in the wild took a shorter amount to start and lasted longer than the great vocalization from the female in captivity. The male reply to a female great vocalization was very different between captive and wild gibbons. The male answer to the female vocalization in captivity was either sooner or later than wild animals.

The biggest difference found in vocalizations was when looking at males in captivity vs. wild. The responses to vocalizations, start of vocalizations, and stop of vocalizations were the most different. Studying male gibbon vocalizations has future research potential.

Factors that could not be measured in the captive study were measured in the wild study; for example, the complexities of the vocalizations and the effect of predators in the environment. Environmental complexities could have the biggest effect on gibbon vocalizations but were not looked at. The gibbons found at Wildlife Safari do not face environmental factors, problems or issues that gibbons in the wild do. All of the factors and issues that can have an effect on gibbon vocalizations or vocalizations those gibbons would learn from family members, as a learned behavior. Because the gibbons in captivity have never been in a native habitat with different gibbons, there might be learned vocalizations which are not present. The captive gibbons have a manufactured environment to increase their happiness though stimulation, the gibbons do not have natural predators, they do not have to try to survive and the gibbons do not have to worry about their diets because it is brought to them daily. There are many factors that were not approached in this study that could account for differences in vocalizations. There are similarities between captive and wild gibbons, but more importantly there are many differences. Future research on differences in captive gibbons' vocalizations will help to clear up any questions not covered in this study because captive gibbons at only one zoo will not necessarily behave or vocalize the same.

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Substrate Preference for Escape Trails in Short-eared Elephant Shrews

Madeleine Parsell, Behavioral Enrichment Intern
Kenton Kerns, Biologist
Ashton Shaffer, Keeper
Smithsonian's National Zoological Park,
Small Mammal House
Washington, DC

Adult Short-eared Elephant Shrew.
Picture courtesy of Clyde Nishimura

Introduction

Macroscelides proboscideus (short-eared elephant shrew) hails from desert and semi-desert habitats in Namibia, southern Botswana, and South Africa, thus S.E. elephant shrews are adapted to dry, sandy terrain (Dohring, 2002; Rathbun, 2009; Smit, et al., 2010; Smithers, 1971; Stuart, 2013). Although this species' fossil records date back to the Eocene (Macrini, 2004), there is a deficit in data concerning behavioral ecology (Rathbun and Rathbun, 2006). Information regarding elephant shrews date back as far as the early 19th century, but has since gone under many revisions. For instance, the assessment that S.E. elephant shrews are diurnal (Smithers, 1971) has been dismissed in more recent years. S.E. elephant shrews are now thought to be crepuscular, though reports concerning activity are likely to be biased given this species' keen sight, auditory and olfactory senses and their naturally skittish behavior (Rathbun, 2009; Unger, 1999).

Despite the limited information available concerning S.E. elephant shrew behavior, it is well established that they construct what is essentially a highway system of trails. These trail systems aid the shrews in avoiding predation by allowing them to travel more quickly between foraging locations and shelter (Rathbun, 2009; Unger, 1999). According to Unger (1999), these paths are developed passively by traveling along the same route repeatedly, which creates shallow burrows in the substrate. Shrews actively maintain these highway systems by removing any debris and barriers using their mouths and forefoot sweeping and forehead pushing motions (Rathbun, 2009; Unger, 1999).

To discover new means of enrichment for captive S.E. elephant shrews in a zoo setting, animal staff at the Smithsonian National Zoo's Small Mammal house developed an experiment utilizing the animal's natural behavior of trail building. This experiment explores preference for finer and coarser substrates in relation to trail use using a singly-housed adult female S.E. elephant shrew. The shrew was alternately presented with three different substrates (chinchilla dust bath, mulch, and small river rocks) other than her "normal" substrate, a semi-fine sand. Two assumptions were made that guided the design of this study: (1) coarser substrates are more difficult to manipulate than finer substrates, such that it takes more time and/or costs more energy to manipulate coarser substrates, and (2) preference for a particular substrate indicates reduced fitness cost (less energy output and/or reduced risk of predation). Based on these

assumptions, it was hypothesized that fine substrates would be preferred over coarse substrates.

Materials & Methods

This study was conducted from 10 October through 12 November 2013 with a singly-housed adult (two-years-old) female short-eared elephant shrew in her habitat at the Smithsonian's National Zoological Park's Small Mammal House. The habitat provided a variety of substrates similar to those found in the shrew's natural habitat. Sand, approximately 8cm deep, coated the floor of the exhibit. The exhibit itself is shaped like a pentagon, with two glass walls for visitors to view the habitat. The remaining three walls have shallow, plaster outcroppings that provide built-in trails that zigzag up the walls approximately 1.22m. Two long, thin tree branches protrude out of a collection of rocks on either side of the entrance to the exhibit. A number of large rocks and a small, hollow log form a half-circle facing the entrance. In approximately the center of the half-circle there is a sturdy root-like structure. The exhibit is 1.52-meter square with a 2.44-meter ceiling (Figure 1).

Figure 1. Short-eared elephant shrew exhibit with escape trails A through E and experimental substrate zone (shaded circle).

S.E. elephant shrews are most active in the evening and early morning when the Small Mammal House is closed, thus behavior was recorded using a nocturnal video camera. Recordings of the baseline and subsequent experiments (chinchilla dust bath, mulch, and small river rocks) began before substrates were added to the exhibit in the afternoon and ended the following morning when the exhibit was cleaned. Start times ranged from roughly 1330 to 1630 hrs, while end times ranged from 0820 to 0930 hrs. To be as consistent as possible in the analysis, only data from the first five hours of video capture and from midnight until 0820 hrs was used. This was considered one day's worth of data.

Three different substrates of varying coarseness were used to test the S.E. elephant shrew's affinity: Kaytee© Chinchilla Dust Bath (fine; 521 Clay Street, P.O. Box 230 Chilton, WI 53014; http://www.kaytee.com), Riverside Mulch™ Shredded Hardwood (coarse; RR 8 South Branch River Road, Romney, WV 26757; http://www.riversidemulch.com), and river rocks (very coarse) with approximately a 2cm diameter. The "normal" substrate lining the floor of the habitat was a sand best described as semi-fine with grains of varying sizes. The coarsest grains were up to approximately 3mm in diameter and the finest were too fine to measure.

The shrew's affinity to each substrate was tested by adding a patch of the experimental substrate (dust bath, mulch, or rocks) to the middle of trail A (Figure 1). Trail A was chosen as the experimental trail because it was visible to the naked eye and was most traversed by the shrew according to observations by keeper staff. All paths, (A, B, C, D and E), were preexisting and developed by the shrew prior to the start of the study (Figure 1).

Before the study commenced, baseline behavior watches were conducted by adding a patch of new, normal substrate (semi-fine sand) to the middle of path A and observing the shrew's movements among paths A, B, C, D and E. The normal sand was added to create a disturbance similar to that caused by adding the experimental substrates to the enclosure. This was important for comparing responses to substrates because it ensured that the variations in the shrew's behavior were due to the particular substrate added, rather than the disturbance created by adding a substrate. The baseline substrate was left in the exhibit for four days before the first experiment began. Response to the baseline and all subsequent experiments were measured by recording the number of times each trail was used and the time spent traversing each path in seconds.

In the afternoon of day five, the patch of new sand was scooped out and replaced with dust bath on trail A. The substrate was left in the enclosure for four days. When the dust bath was removed, the resulting hole was filled by shifting existing exhibit sand. To avoid a bleed-over of response from each experiment into the next, a minimum of a three-day buffer was used where no substrates were added to the enclosure. Mulch and rocks were added using the same procedures.

Data were analyzed from the first day only, because that was when response to the substrate was strongest. Subsequent days provided valuable qualitative data, providing insight into how behavior changed with extended exposure to the substrate. Because behavioral change, such as acclimation, was not pertinent to the study, subsequent days were not statistically analyzed.

Data Analysis

Time spent on trails data were analyzed using R software via a hypothesis test in which the proportion of time (seconds) spent on trail A was compared to the amount of time spent on all trails. Data were included in the analysis if at least half of the trail was used by the shrew. Three comparisons were analyzed: (1) baseline versus dust bath, (2) baseline versus mulch, and (3) baseline versus rocks. Statistical significance was established at the 0.05 level ($p \leq 0.05$).

Results

Dust Bath

When dust bath was present, the shrew spent more time in seconds on trail A than on all other trails combined. Under dust bath conditions, the shrew spent approximately 80% of her time on trail A versus all other trails (Figure 2). This was statistically greater than the proportion of time spent on trail A under baseline conditions (approximately 63%). The shrew spent less than half as much time on trail A under baseline conditions at 357 seconds compared to dust bath conditions at 805 seconds. Conversely, there was very little difference in combined time spent on all other trails (B-E), with 212 seconds under baseline conditions and 208 seconds under dust bath conditions. The shrew also tended to use all trails more when dust bath was present versus the baseline (table 1); this was especially true for trail A, which saw an increase from 17 uses under baseline to 72 uses when dust bath was present.

Mulch

When mulch was present, the shrew spent less time on trail A than on all other trails combined. The shrew spent only 18% of her time on trail A during the mulch experiment versus 63% under baseline conditions (Figure 3). The shrew spent almost nine times more seconds on trail A under baseline conditions (357 seconds) than dust bath condition (41 seconds). She also spent slightly less time on all other trails when mulch (187 seconds) was present compared to the baseline experiment (212 seconds). In general, the shrew was less active when mulch was present by spending less time on all trails and using all trails less (table 1), with the exception of trail B. Out of all experiments, trail B was used most frequently when mulch was present.

Rocks

The proportion of time spent on trail A under rocks conditions versus the baseline was not significantly different (Figure 4). She spent approximately 58% of her time on trail A when rocks were present, which is only 5% less than the baseline at 63%. The shrew spent much less time on all trails in general, with only 61 seconds on trail A and 44 seconds on all other trails combined. She also used all trails far less during the rocks experiment compared to all other experiments (table 1).

Substrate	Trail A	Trail B	Trail C	Trail D	Trail E
Baseline	17	0	10	6	16
Dust	72	6	11	6	24
Mulch	9	15	0	0	13
Rocks	4	1	0	1	1

Table 1. Number of times all trails were used during study. Generally all trails were used more during the dust bath experiment when compared to the baseline, especially trail A with 72 uses when dust bath was present compared to 17 uses during the baseline. Conversely, all trails were used far less when rocks were present, which may be due to the shrew being ill. The shrew also tended to use all trails less when mulch was present except for trail B, which was used most when mulch was present.

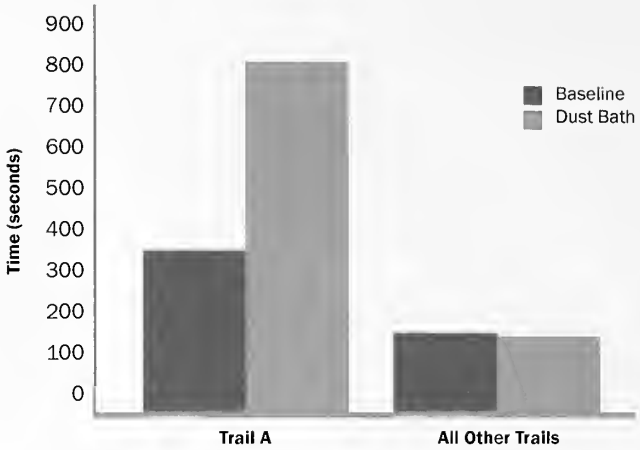

Figure 2. Time spent on trail A and trails B through E combined during baseline and dust bath experiments. The short-eared elephant shrew spent approximately 80% of her time on trail A when dust bath was present versus 63% of her time on trail A during the baseline, which was a statistically significant difference. The shrew spent more than twice as much time on the dust bath trail A than the baseline trail A at 805 and 357 seconds, respectively.

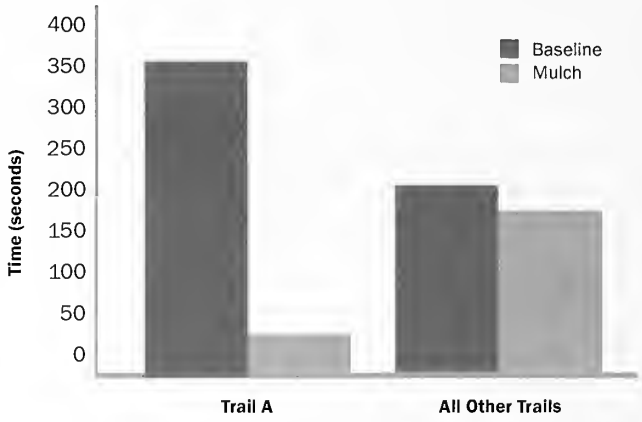

Figure 3. Time spent on trail A and trails B through E during baseline and mulch experiments. The shrew spent significantly less time on trail A than on all other trails combined when mulch was present than during the baseline, with 18% and 63% of her time on trail A, respectively. The shrew spent almost nine times more seconds on trail A under baseline conditions than dust bath conditions, with 357 and 41 seconds on trail A respectively.

Figure 4. Time spent on trail A and trails B through E during baseline and rocks experiments. The shrew spent drastically less time on all trails when rocks were present versus the baseline, yet there was not a statistical difference between the baseline and the rocks experiment in the proportion of time spent on trail A versus all other trails combined. Due to illness detected in the shrew shortly after the commencement of this experiment, results were inconclusive.

Discussion

There were a couple of inconsistencies in data collection, such as the first half of trail A not being visible during the mulch trial. While this may have somewhat influenced the values used for the analysis, the findings are still valid. Because the mulch patch itself was still visible, the shrew's interaction and avoidance of the substrate were still observable. The shrew actively avoided the mulch more than in any other experiment with 15 instances of avoidance, versus zero for the baseline and six for dust bath (table 1). The shrew avoided the substrate more than she crossed it (table 1). When crossing the substrate the shrew often seemed to show trepidation by pausing before crossing. Furthermore, the camera was fixed the second day and all of path A was visible for the remainder of the study. Rather than seeing similar or higher activity levels on subsequent days, drastically less activity was noted. When mulch was present the shrew was less active on all trails (table 1). These observations suggest that the statistical findings are an accurate assessment of the shrew's affinity to mulch. It is exceedingly clear the shrew strongly disliked mulch.

During the rocks experiment, the shrew was drastically less active across all trails compared to the other experiments (table 1). Given that the rock data does not follow any pattern reflected in the other experiments, it is likely that the extent of her inactivity was caused by an illness that was discovered the following day. Furthermore, the resulting small sample sizes made analyzing the data difficult. As such, the rock trial was inconclusive and should be repeated in future experiments.

The greatest activity by far was observed during the dust bath experiment with 72 uses of trail A and greater activity across most trails in general when compared to the baseline (table 1). While the shrew seemed to show trepidation when crossing the mulch, this was very rarely, if ever, the case for the dust bath. The shrew rarely slowed down or paused before crossing the dust bath, and in some cases she would retrace her steps over the dust bath a number of times before continuing to her destination along the path. Although there were six instances of substrate avoidance, it is still abundantly clear that the shrew had a very strong affinity to the dust bath.

Due to her affinity towards the dust bath and her seeming distaste for the mulch, it is very possible the shrew preferred finer substrates to coarser substrates. Yet, without proficient rocks data it is difficult to conclude this with complete confidence. The shrew may have disliked the mulch for a number of reasons other than coarseness, such as water content or odor. This being said, the shrew did seem to show distaste and discomfort in crossing mulch and rocks, respectively, which in light of the shrew's strong affinity to the dust bath suggests a preference for finer substrates. Thus, further testing may demonstrate that short-eared elephant shrews greatly prefer fine substrates to coarse substrates in escape trails. Future studies should reexamine affinity to small rocks and repeat all experiments with a larger sample size.

In regards to future animal enrichment, it was abundantly clear that adding any substrate to the exhibit was enriching. The addition of all substrates invoked inquisitive behaviors in the shrew, such as smelling the foreign material, marking territory, and reestablishing trails. As previously stated, response to the substrate was strongest on the first day, regardless of affinity. By extrapolation, if the same substrate is continuously used as enrichment, it may lose its novelty and effect over time. As such, adding a variety of different substrates on rotation or randomly would be most enriching in the long term for this animal.

Acknowledgments

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EDITORS: Amanda Ista, Milwaukee County Zoo • Mary Ann Cisneros, Disney's Animal Kingdom

Project Mecistops
Conserving West African Crocodilians

Lauren Augustine[1], Matthew Shirley[2], and Matt Eschenbrenner[3]

[1]Smithsonian's National Zoological Park
3001 Connecticut Ave. NW Washington DC 20008
Augustinel@si.edu
[2]Rare Species Conservatory Foundation
P.O. Box 1371, Loxahatchee, FL 33407
mshirley@rarespecies.org
[3]Albuquerque BioPark Zoo
903 Tenth Street SW Albuquerque, NM 87102
meschenbrenner@cabq.gov

The West African slender-snouted crocodile *(Mecistops cataphractus)* is the least known and one of the most critically endangered crocodilians in the world. Historic threats include large-scale loss of habitat, illegal hunting for the trade of leather and bushmeat, and conflict with artisanal fisheries. These threats have resulted in highly fragmented, reduced populations. To date, few studies have examined even the basics of status, distribution and ecology of *M. cataphractus* and, for this reason, Project *Mecistops* was established in 2005. Distributed from the Gambia River in West Africa to Lakes Tanganyika and Mweru bordering the Democratic Republic of Congo, *M. cataphractus* is in the process of being recognized as two unique species - one in Central Africa and one in West Africa. In order to directly address the problem of small population size in the West African species, Project *Mecistops* is working with the Zoo National d'Abidjan (ZNA) to incorporate captive breeding and reintroduction into the conservation of slender-snouted crocodiles.

The ZNA has the largest captive population of slender-snouted crocodiles in the world, but in order to meet Project *Mecistops'* goals of breeding and reintroduction, improved crocodilian husbandry and management was needed. To help staff specialize, the ZNA formed a new crocodile team and began hands-on training to improve crocodile care. In addition to gaining experience at the zoo, in 2014 the crocodile team leader became the first African keeper awarded the Behler Scholarship to attend the American Association of Zoos and Aquariums' "Crocodilian Biology and Captive Management" course at the St. Augustine Alligator Farm and Zoological Park (SAAF). Specialist crocodile keepers from the Albuquerque BioPark, San Diego Zoo, and SAAF gave further training on egg collection, incubation, and crocodile training through visits to the ZNA. During their visit they helped construct an incubator using an old refrigerator retrofitted with the electrical components from a Lyon RL1 Reptile Incubator. Internal temperature was set at 32C with internal humidity between 90 and 95 percent.

This incubator was then used when the first clutch of eggs was laid on the 19th of March 2014. On the 12th of June, after 86 days of incubation, the ZNA successfully hatched the first of what would eventually be 24 *M. cataphractus* neonates. This marked the first successful captive reproduction of *M. cataphractus* at

With the help of its many supporters, Project Mecistops is working to reverse the extinction trajectory of Africa's most Critically Endangered crocodilian.

the ZNA since the 1990's.

Hatchlings will be reared to 1-1.5 meters, optimal release size, before being reintroduced into protected areas of Cote d'Ivoire and throughout West Africa. The reintroduction strategy is being drafted in collaboration with the Ivorian national parks agency, to ensure the released crocodiles are monitored and protected, and with local communities, to increase awareness about the on-going threats to *Mecistops*.

As this project continues to add valuable information to the understanding of *M. cataphractus*, other species of crocodilians in West Africa are also being studied. African crocodiles of the genera *Osteolaemus* and *Crocodylus* were previously considered monotypic, but recently evidence has been published supporting splits into three and two species, respectively. These splits have several conservation implications. First, this reduces the known ranges and population sizes of the crocodiles in question, making conservation needs more imminent. Secondly, this increases the number of crocodilian species in need of conservation action, further dividing resources. Lastly, these splits have captive breeding ramifications. Zoological institutions, as well as crocodile farms, have played vital roles in crocodilian conservation. Distinguishing species in captive breeding facilities and ensuring proper pairings to preserve genetic integrity is an important aspect of crocodilian conservation.

Although Project Mecistops is abroad, animal keepers here in the U.S. are doing their part to contribute to this significant conservation effort. In addition to the involvement of San Diego Zoo, the Albuquerque BioPark, and the SAAF, the Greater Baltimore American Association of Zoo Keepers (AAZK) Chapter and the Houston AAZK Chapter both donated funds to support this project and an animal keeper from the Smithsonian National Zoological Park traveled to Cote d'Ivoire in September of 2014 with supplies. With the help of its many supporters, Project *Mecistops* is working to reverse the extinction trajectory of Africa's most Critically Endangered crocodilian.

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EDITORS: Julie Hartell-DeNardo, St. Louis Zoo • Casey Plummer, Caldwell Zoo • Ric Kotarsky, Tulsa Zoo & Living Museum

Planters for Primates:

Using container gardens as animal enrichment

Mylisa Whipple, M.S.
Keeper/Primates
Saint Louis Zoo, St. Louis, Missouri

Introduction:

Providing captive animals with live plants from which they can actually forage can be a great way to bring out the natural behaviors of animals in zoos. Doing so is not only beneficial to the animals by giving them an opportunity to forage more naturally, but can enhance the visitor's experience while at the zoo. Depending on the facilities of a particular zoo, it may be a challenge to provide live plants for the animals for various reasons. For instance, at the primate house at the Saint Louis Zoo, the basic structure of the indoor habitats for the monkeys and lemurs has concrete floors with a variety of rockwork and artificial trees, plus glass between the animals and the zoo visitors. There is no place to include live plants within these types of enclosures. In addition, if typical planters with live plants were installed within the habitats, the animals would most likely decimate or destroy the plants fairly quickly.

After attending the 2011 International Conference for Environmental Enrichment (ICEE) in Portland, Oregon, the author got an idea from one of the presentations. The presentation was entitled "Leaf me alone, I don't need enrichment: Problems and solutions to enriching langurs!" which was given by a staff member from the Howlett's Wild Animal Park in England (Kingston, 2011). In the presentation, among other enrichment devices, they talked about planters they put in their outdoor habitats for the langurs, a type of leaf-eating primate. Each planter was covered with mesh so that the animals could only eat the parts of the live plant growing up through the mesh. These planters appeared to be a permanent installation, rather than something that could easily be removed. However, this was definitely an idea that could be modified into a portable enrichment device for the indoor primates at the Saint Louis Zoo.

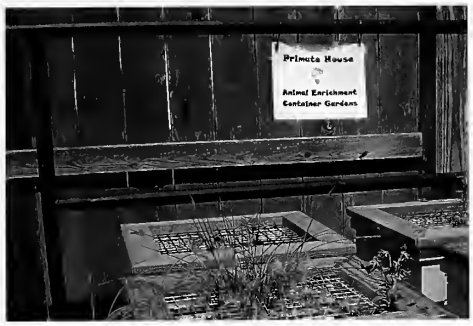
Purpose and General Description of the Enrichment:

The Saint Louis Zoo's primate house is home to three species of leaf-eater monkeys: Black and White Colobus Monkeys *(Colobus guereza)*, Francois' Langurs *(Trachypithecus francoisi)*, and Spectacled Langurs *(Trachypithecus obscurus)*. One of the challenges that zoo keepers face is that it can be difficult to find new ways to provide food enrichment to animals with specialized diets. These are animals that cannot get typical food enrichments that monkeys with a more generalized type of diet could receive. However, by adding live plants to exhibits through enrichment devices, not only can these animals now receive a larger variety of food enrichment, but these devices can also bring out their natural foraging behaviors. Also, these devices can be used for many of the other non-human

primate species, not just the leaf-eaters. They can be provided not only as foraging enrichment, but also as investigational enrichment that may stimulate many of the animals' senses. So, keeping the "leaf-eaters" in mind in particular, but also realizing that this can be beneficial to all of the monkeys and lemurs as well, a plan and proposal was developed for creating portable "enrichment container gardens" for the non-human primates at the Saint Louis Zoo. After the proposal was approved, the primate house staff was able to start building four of these enrichment devices.

The "enrichment container garden" is a deep, light-weight planter used for growing a variety of herbs or other edible plants. The container is sturdy enough to be placed on the ground of an indoor or outdoor animal habitat. It is heavy enough that the animals cannot tip it over, but light enough that keepers can remove it from the animal habitats as needed. A small mesh cover allows the plants to grow through the mesh without allowing the animals to access the whole plant.

Making the Planters:
Four 45.72cm X 45.72cm X 38.10cm (18in X 18in X15in) planters were purchased that could be customized as needed. They were chosen because of their size and because of the materials from which they were made. Each planter was made from a composite of recycled polymers and reclaimed poplar. (New Age Pet EcoConcepts™ Square Planters were purchased from homedepot.com for $69.98 each.) For the covers, a frame had to be fabricated by the zoo's keeper staff. Built out of composite wood and mesh, each cover is 48.26cm X 48.26cm X 2.54cm (19in X 19in X 1in) in total size. The composite wood was used to create a frame and 2.54cm (1in) mesh was attached to this frame using L-brackets. Composite wood was chosen because it is supposed to last longer than regular wood. Two hinges were used on one side of the planter to attach the cover. Then the opposite side of the cover can be locked down with a pad lock run through a latching mechanism that is attached to the cover and the planter. The pad lock was added to prevent the animals from opening the planter lid and having access to the entire plant and soil. Handles were added to the side of the planters to help with transporting them.



Materials Needed Per Enrichment Device:

- Planter box*
- Mesh cover*** with composite wood frame**
- 4 L-brackets with bolts and nuts*
- Metal spray paint***
- 2 hinges with screws*
- 2 handles with bolts and nuts**
- Latching mechanism & Lock*
- Potting soil*
- Gravel ***
- Seeds*/Plants **
- Gardening liner ***
- Grow lights for winter**

*Environmental Enrichment Committee (EEC) funds
**Primate Unit enrichment funds
***Reused/Repurposed items

Planting, Plant Care, and Storage:
For this project, chives *(Allium schoenoprasum)*, rosemary *(Rosmarinus officinalis)*, basil *(Ocimum basilicum)* and cilantro *(Coriandrum sativum)* were the chosen herbs. Because many of the non-human primates eat flowers as a part of their diet in the wild, pansy flowers *(Viola tricolor var. hortensis)* were also planted after receiving proper approval. In choosing plants, three things needed to be considered:

1. The plants needed to be on the zoo's existing approved herb/browse list or needed to be approved by the zoo's veterinarians, nutritionist, and horticulturalist.
2. The plants needed to be something that the animals would like.
3. The plants needed to be able to grow through the mesh.

To prepare for planting, the bottom of the planter needed to allow for drainage, and the planters that were purchased already had gaps in the bottom that allowed for this. A gardening liner was added to the inside of the planter and then a small layer of gravel was added on top of this to allow for better drainage and to give the planter more weight to prevent it from being tipped over. Then potting soil was added to the desired height. When adding the soil and planting the plants, it was taken into consideration that only the tops of the plant should grow out of the mesh. This allows for the leaves or flowers of the plants to be foraged on, without the main parts of the plants being damaged. Before giving the planters to the animals as enrichment, the plants need to be given time to establish themselves and grow up through the mesh.

During the warmer months, a storage location was identified outdoors that would allow for plenty of sunlight. During the colder months, a storage location was identified inside our building with plant grow lights and an available water source nearby. Specific staff members were assigned to make sure that the plants were cared for and watered on a regular basis.

Use and Cleaning:
In order to use the planters as enrichment for multiple species during the warmer months, the following protocol was used:

- Planters could only be put into a habitat for 1-2 days at a time.
- They should be placed on a flat surface.
- The lid should be locked in place.
- Once the planter is removed from a habitat, any feces or food that is in or on the planter is removed.
- The outside of the planter is rinsed off (or could be wiped down with a diluted bleach solution if needed).
- The plant is rinsed off with water.
- The planter is placed outside in sun for several days, which allows for disinfection without the use of chemicals, and gives the plants a chance to grow up through the mesh again. Because the planters will be used for multiple species, this time for disinfection is important.

Record Keeping:
A chart was created to keep track of the use of the "enrichment container gardens." Each planter was identified with a number and the types of plants within it were listed with this number.

The keepers would then fill out the chart each time a planter was given to the animals. Information recorded would include the planter number, the group it was given to, the date, the initial reaction of the group, whether or not the plants were eaten, which plants were eaten, and a comments section.

Results:
The enrichment planters have been a successful form of enrichment for the animals. Though not all of the animals necessarily foraged from them, all of the animals appeared to have an interest in them, thus they are still recommended for use as enrichment for both leaf-eater species as well as non-leaf-eater species of primates.

The Budget:
Fortunately, at the Saint Louis Zoo, each unit in the Animal Division has a budget allowance for purchasing enrichment items. In addition to this, the Environmental Enrichment Committee (EEC) at the Saint Louis Zoo also has a budget for purchasing some enrichment items for the different units at the zoo. Once a year the different units must submit proposals to the EEC for desired enrichment items. The primate unit was able to obtain the majority of the money for these enrichment container gardens thanks to the funding provided by Saint Louis Zoo's EEC.

For zoos that may not have a budget for enrichment items, the following could be considered:

- Modify the plans as needed to fit the budget you have.
- Repurpose existing planters or build the planters rather than purchase them.
- Try growing the plants from seed which is less expensive, but takes more time and nurturing.

Changes Made and Future Considerations:

- The enrichment project is now in its second year and a few changes have been made since the project began.

- Growing plants from seed was difficult and the plants did not winter well indoors. Instead, it has been decided to purchase plants or use donated plants each spring to restock the container gardens.

- In 2014, the Primate House received a donation of several basil and rosemary plants. All four container gardens were stocked with a mix of both of these herbs and also pansy flowers that were purchased using the Primate House enrichment budget.

- Because of the natural destructiveness of some of the Zoo's primate groups, particularly the Allen's Swamp Monkeys *(Allenopithecus nigroviridis)* and the Lion-tailed macaques *(Macaca silenus)*, it was decided not to give the enrichment container gardens to these groups during the first year of their use. It was decided in the second year to try one of the planters with the Swamp Monkeys. Unfortunately, they started to take the planters apart. In the future, a plan will be considered to construct planters that might hold up to more destructive animals.

- In addition to this, it will be necessary to construct a separate planter that is specific to animals that have potential health concerns, such as herpes B in Lion-tailed macaques.

- Consider trying to plant other herb and browse options, and consider using plants that grow more quickly.

Acknowledgements:
Special thanks are in order for the Saint Louis Zoo's Environmental Enrichment Committee for making this project possible. Thank you to the Saint Louis Zoo's horticulture, nutrition, and veterinary staff for their help in providing approval for herbs and plants. Also, a big thank you goes out to all of the keeper staff at the primate house for helping with each aspect of this project, particularly Ethan Riepl (Keeper/Primates), for his handy know-how skills and for building the covers for the planters. Thanks to Joe Knobbe (Zoological Manager/Primates) for his assistance in this project and for providing comments during the process of writing this article. Thanks to Bill Houston (General Curator) for his comments as well.

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Editor's Comments
By Casey Plummer

I must confess, the moment this article crossed my desk, I stole the idea for use in my zoo! This particular enrichment is appealing for a number of reasons – it is novel; it stimulates most of the senses; it's inexpensive; it's easy to remove and clean, and it regenerates! When not in use, the boxes can easily be moved to areas of sun or shade that are already being watered – the boxes can be designed to complement existing gardens. Not only is this enrichment great for the animals, but it allows our horticulture staff to participate directly in animal enrichment – most of the time, when animals "enjoy" the horticulture (i.e. destroy it), it's maddening for the horticulture staff. This enrichment allows the horticulture staff to make creative, usable enrichments without sacrificing their plants! In addition, with a few signs, this is an opportunity to educate our visitors both on enrichment and the symbiosis of the plant and animal worlds.

There ARE New Ways to Train an Old Cat:
How to re-engage interest and compliance in training

Nicole Beaupre and Amanda Giardina, Senior Zoo Keepers
Zoo New England, Franklin Park Zoo, Boston, Massachusetts

Introduction

Zoo New England's training program with Christopher, our 21-year-old male African lion (*Panthera leo*), illustrates our successful use of adaptive methods. Christopher's training program began shortly after he arrived at the Franklin Park Zoo when he was eight-years-old, and most of his behaviors were established within 2½ years of training. Christopher is very food-motivated, which facilitated training, allowing us to perform routine health maintenance without anesthesia. We use the following methods to gain the necessary medical information to provide essential care and create treatment plans.

1. Weighing
2. Oral exam
3. Hand injection
4. Blood collection
5. Blood pressure

After 10 years of consistent training, we began to see a degradation of Christopher's compliance. We have seen him slow down as he ages, resting more often. We had to work with these changes and adapt our methods to successfully continue a training program that meets our veterinary care objectives, asking him for new and complex behaviors.

Training

At Zoo New England, we train our lion using protected contact, without the use of a chute or restraint device. The lion's diet of ground horsemeat is used as reinforcement, with a clicker as a bridge. Training sessions generally are no longer than 10 minutes, four times per week. Christopher's established behaviors include tail present, over, down, hip present, scale, open mouth, station, target, paw, and up.

Through establishing *tail* presentation, we are able to perform two of our more complex behaviors, blood collection (Miller, 2002) and blood pressure (Miller, 2012). The verbal cue of "tail", given in one of his off-exhibit dens, signals Christopher to move his tail under the mesh into a keeper area (Figure 1). We can access Christopher's tail from two positions: *down* and *over. Down* is sternal recumbency with his side pressed against the mesh. *Over* is lateral recumbency with his back pressed against the mesh. Tail presentation was first established for blood collection, and several years later was adapted for blood pressure.

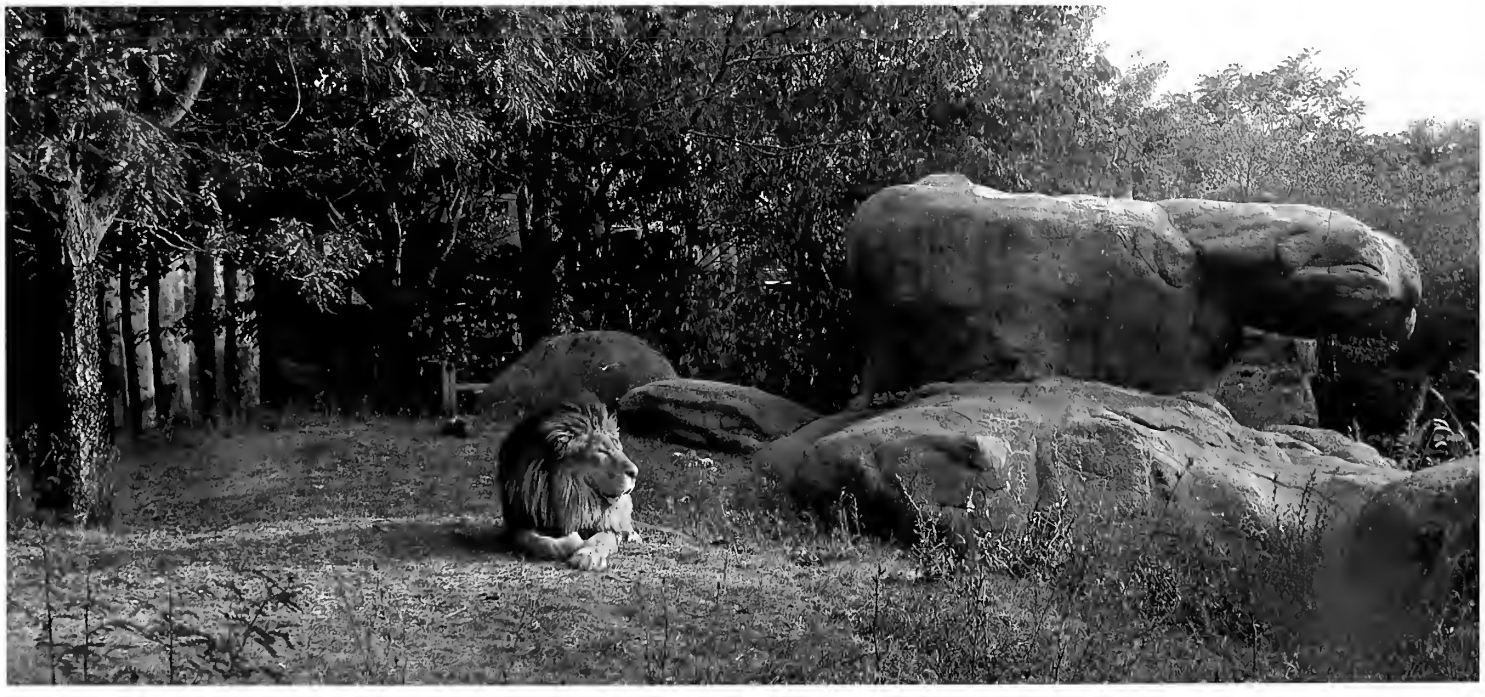

Figure 1

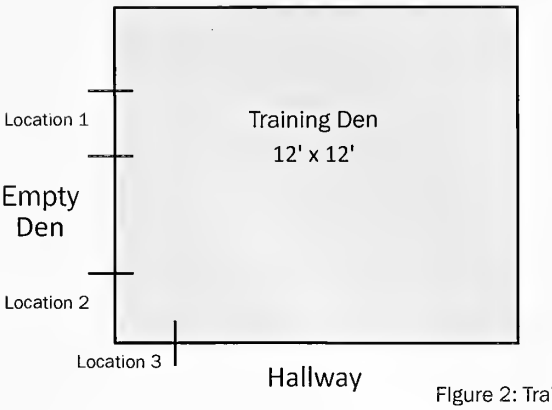

Figure 2: Training Locations

Challenges

Christopher began to lose interest during training sessions, lying down or walking away from even the most basic behaviors. We were obtaining blood pressure readings monthly, collecting blood every two months, and handling his tail during maintenance sessions. We primarily attribute Christopher's drastic decrease in compliance to over-handling of his tail at a time when his abilities were changing with age. It was frustrating as trainers because we were used to training a cat who excelled. It took time to accept that we had to step back and understand that his abilities had drastically changed. In addition to possible over-handling of his tail, we explored other possibilities such as:

1. The veterinarians' increased requests for blood samples as he ages
2. Training too often, sometimes twice daily
3. High expectations from trainers
4. The presence of a veterinary technician
5. Not enough variety in his training routine

Problem Solving

Our first step was to revise our training goals, prioritizing based on what was most important for him medically. Even before focusing on re-establishing tail presentation, we had to come up with creative ways to encourage Christopher to engage with the trainer and begin training, to maintain his interest for the duration of the session, and to increase the likelihood of success in basic training.

To engage with the trainer and initiate participation in a session we:

1. Incorporate play, such as a stick waved under the mesh.
2. Offer novel items, such as a ball or other toy, as a target.

We found both of these effective means to increase engagement with the trainer.

To maintain Christopher's interest for the duration of a session we:

1. Incorporate simple behaviors that he offers readily within sessions, such as *open.* This helps to break up a challenging session.
2. Increase the frequency of food reward while working on more complex behaviors.
3. Change the type of food reward. We have sometimes found greater compliance using beef liver or ground beef.
4. Use play as a reward during good sessions or to break up a longer session.

While troubleshooting ways to maintain his interest we found some techniques to be ineffective, such as giving Christopher a timeout when trainers briefly stepped away, left the building or trained other cats nearby. None of these improved his compliance.

To keep interest in training over time we began to:

1. Vary the time of day for sessions. We train when he is most receptive.
2. Change the frequency of sessions. If we have a good session, we take a day off from training and if we have a bad session, we train again the following day.
3. Strive to maintain his compliance with both trainers. We adjust which of his two trainers act as primary for a given session based on how well he participated for that trainer in the previous session. If he has a good session with a primary trainer, the other trainer serves as primary the next time.

We found that using these approaches helped to make training more novel and kept him interested.

Once Christopher was consistently participating in sessions again, we had to reestablish tail presentation for blood collection. We assigned three locations in one of his off-exhibit dens for his training to standardize our approach, as well as to assess the progression of each training session based on Christopher's participation. At Location 1, trainers have no access to his tail. Locations 2 and 3 give access to either of the two lateral tail veins. We begin sessions asking for simple behaviors at Location 1 (Figure 2), and then proceed to Location 2 or 3 if he is complying. This helps to ensure that we are only handling his tail when he is most receptive to training.

Conclusion

In the last few years, we went from training a highly motivated cat to training a cat that would rarely participate. We were able to regain most of his previous behaviors and motivation once we were able to accept his changing abilities, re-prioritize our training goals, and become more creative in our approaches. We still face challenges on a regular basis. However, with a better understanding and acceptance of changes in Christopher's behaviors as he ages, not only has Christopher developed a renewed interest in training, we have also learned new ways to work through training challenges to continue to provide him with the best possible care.

Acknowledgements
We would like to thank:

- Kim Kezer, Training Coordinator at Zoo New England, who was instrumental in helping us narrow our focus for this paper as well as guiding our development as trainers
- Our editors, Dr. Susan Bartlett, Veterinarian, and Pearl Yusuf, Former Assistant Curator Hooves & Horns
- The veterinary technicians who helped with blood pressure training, Jessica Honeywell and Jean Orlando
- Christopher's past trainers who built the foundation for his training program, Nicole Chiapparo, Suzy Kaplan, Kim Prapuolenis, Victoria Shaw, Nicole Smith, Charlotte Speakman, and Erin Ward
- And of course, Christopher Lion for teaching us patience and helping us to become better trainers.

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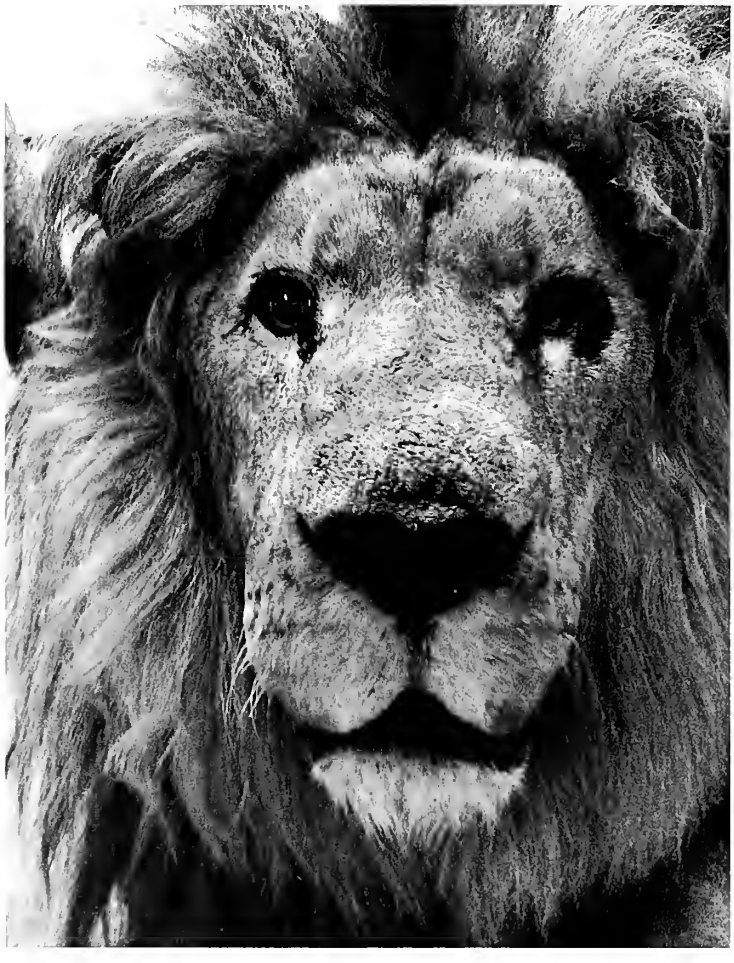
Christopher lion
July 23, 1993 - April 9, 2015



BHC Comments by Jay Pratte

Aside from the great training involved, there are two aspects to this Tale that I like very much. The first is the discussion of why an animal's behavior may change or break down over time. As animals age, their senses will dull, they may be tired more often, or may be enduring some physical (or mental, social, etc) issues that we are not aware of. There could be changes or exhibit dynamics, new keeper staff, construction in the zoo, and any number of things that can trigger behavioral change. The important part is RECOGNIZING that change, and trying to understand why it is occurring. The authors list several ideas and steps they took to address the problem they were observing, and as a result had multiple tools at their disposal to implement some improvements. The problem-solving approach, and willingness to be flexible in applying new ideas, led to a successful goal resolution; in this case, an increase in Christopher's participation. It is a brilliant example of how as trainers we need to think about more than just training an animal to do "X".

It is also good to see the use of non-reward techniques discussed. At some point in our careers, we have all utilized negative reinforcement or punishment methods (i.e.- time out) during conditioning. While they may not be preferred methods, and do have their own resulting potential consequences, often trainers shy away from discussing any application of these, often to avoid "negative" feelings about the training or possibly to avoid judgment. While we strive to advocate and generally use positive reinforcement techniques, there are times when other methods may be necessary. These should always be thoughtful, and the animal should always be provided with an alternative that does enable the possibility of a reward. So it is appreciated that the authors shared their full experiences, along with how effectively they felt it impacted the training. *Thank you for sharing your Training Tale!*

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