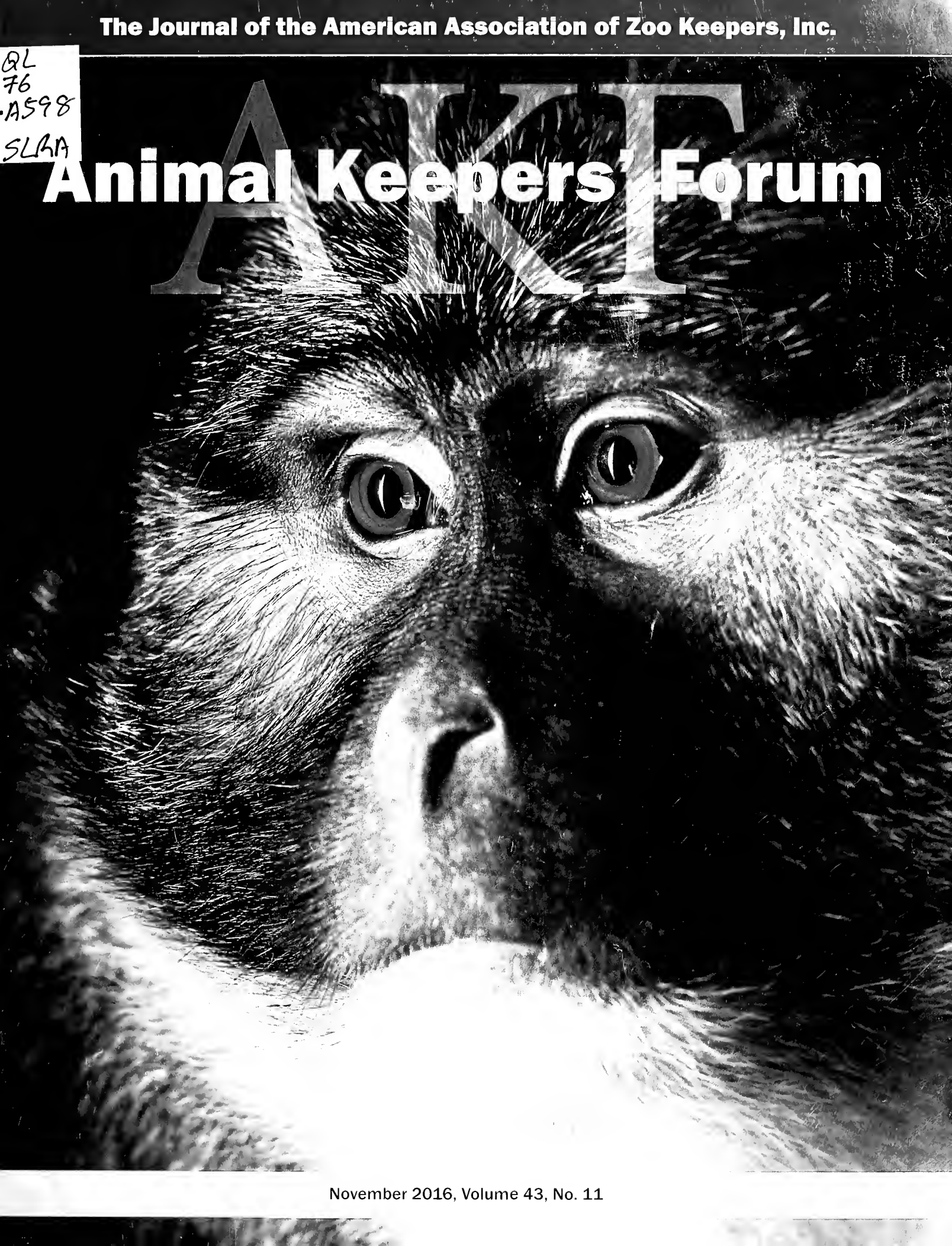


QL
76
A598
SLAA

AKJF

Animal Keepers' Forum





ANIMAL BEHAVIOR INSTITUTE

ADVANCE YOUR CAREER & CONTINUE YOUR PROFESSIONAL EDUCATION *ONLINE!*

Our programs in Zoo & Aquarium Science and
Wildlife Rehabilitation give you the training you need
to grow and advance in your field.

Small class sizes and professional faculty guarantee
you a personal education with the individual attention
you deserve.

START TODAY AND EARN YOUR CERTIFICATE
IN AS LITTLE AS SIX MONTHS!

learning
partner

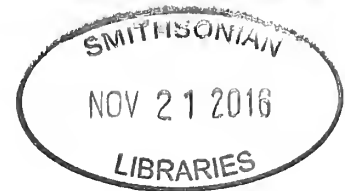
Visit us at
www.AnimalEdu.com

Toll free
(866) 755-0448



a more personal education





305 ABOUT THE COVER

306 FROM THE PRESIDENT

308 COMING EVENTS

309 ANNOUNCEMENTS

BFR Trip Winners
Vital Ground

FEATURED ARTICLES

312-316

*Swamp Monkeys Solve Kerplunk: a progressively
challenging enrichment experiment*

Peggy Hoppe and Eli Baskir

318-322

*Evolution and Natural History of Langurs:
implications for welfare*

Leah Perlman

CONSERVATION STATION

323-325

*Golden Lion Tamarins:
Help Track Tamarins in the Wild!*

TRAINING TALES

326-328

*Don't Squeeze the Jaguar: Voluntary Dart
Training in Jaguar (*Panthera onca*)*

BOOK REVIEW

329

Professor in the Zoo, by Dr. Terry Maple



Step Up

To Quality, Value and Convenience!

Discover what tens of thousands of customers — including commercial reptile breeding facilities, veterinarians, and some of our country's most respected zoos and aquariums — have already learned: with Rodentpro.com®, you get quality AND value! Guaranteed.

RodentPro.com® offers only the highest quality frozen mice, rats, rabbits, guinea pigs, chickens and quail at prices that are MORE than competitive. We set the industry standards by offering unsurpassed quality, breeder direct pricing and year-round availability.

With RodentPro.com®, you'll know you're getting exactly what you order: clean nutritious feeders with exact sizing and superior quality. And with our exclusive shipping methods, your order arrives frozen, not thawed.

We guarantee it.

Order online!

www.RodentPro.com

It's quick, convenient and guaranteed!

P.O. Box 118
Inglefield, IN 47618-9998

Tel: 812.867.7598

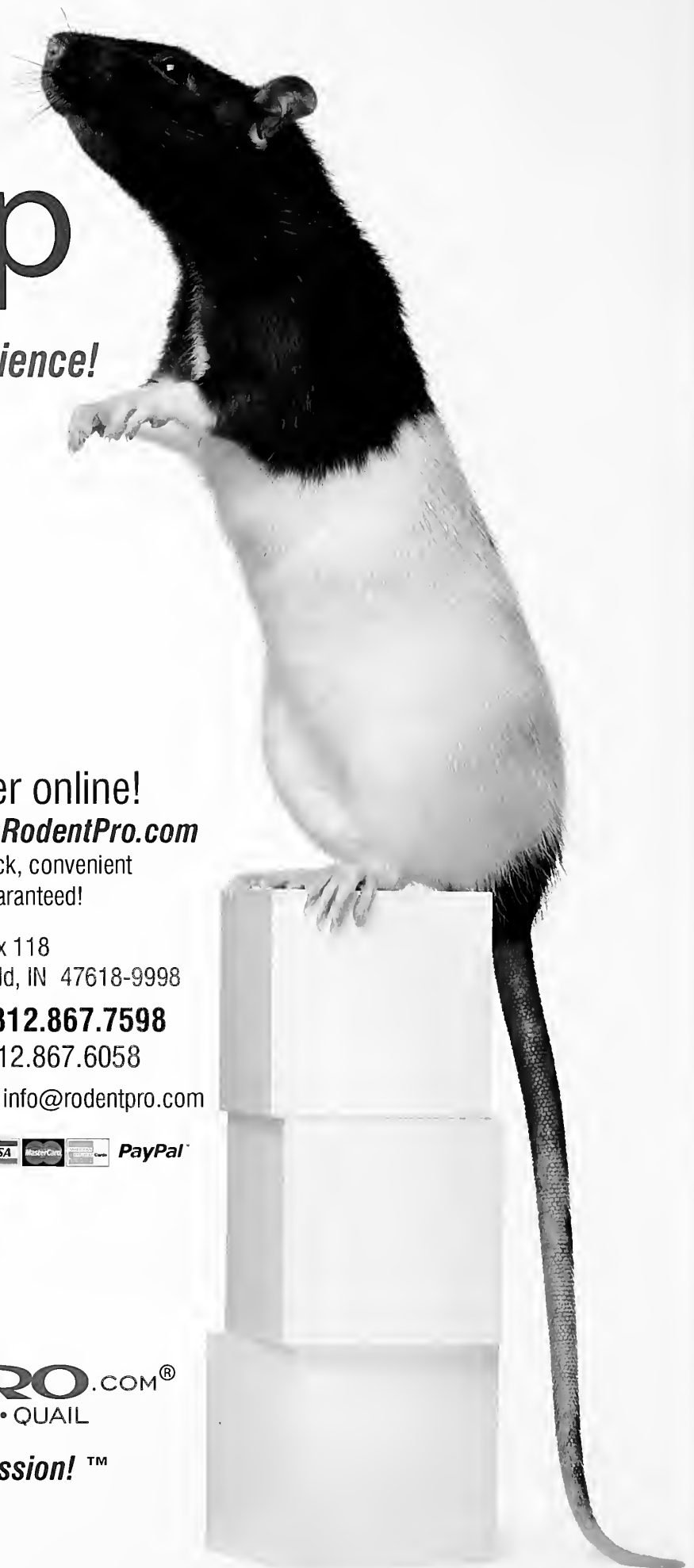
Fax: 812.867.6058

E-mail: info@rodentpro.com



**RODENTPRO.COM®**
MICE • RATS • RABBITS • CHICKS • QUAIL

Feeding Your Reptile Is Our Passion!™





MISSION STATEMENT

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 Ethan Riepl of Saint Louis Zoo. The animal in the photo is a male Allen's Swamp Monkey (*Allenopithecus nigrovirdis*) named Moss. In the wild this species is near threatened due to many of the same issues for other primates: bushmeat trade and deforestation. Swamp monkeys have webbing between their toes and fingers and are known for their ability to swim. Swamp monkeys will swim in order to escape predators such as raptors, snakes and bonobos. This species is sexually dimorphic in that males are larger than females. They can be found in groups of up to 40 individuals.

The Saint Louis Zoo has a pair of swamp monkeys that are housed in an indoor enclosure year-round. These animals are very good at manipulating objects and being able to take objects apart. They are capable of undoing clips, nuts, and clasps and are extremely intelligent.

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/.

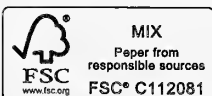
Deadline for each regular issue is the 3rd of the preceding month. Dedicated issues may have separate deadline dates and will be noted by the Editor.

Articles printed do not necessarily reflect the opinions of the **AKF** staff or the American Association of Zoo Keepers, Inc. Publication does not indicate endorsement by the Association.

Items in this publication may be reprinted providing credit to this publication is given and a copy of the reprinted material is forwarded to the Editor. If an article is shown to be separately copyrighted by the author(s), then permission must be sought from the author(s). Reprints of material appearing in this journal may be ordered from the Editor. Regular back issues are available for \$6.00 each. Special issues may cost more.

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, AKF 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)

CHIEF EXECUTIVE/FINANCIAL OFFICER: Ed Hansen
E-mail: Ed.Hansen@aazk.org

ANIMAL KEEPERS' FORUM - EDITOR

Shane Good, Shane.Good@aazk.org

GRAPHIC DESIGNER

Elizabeth Thibodeaux, Elizabeth.Thibodeaux@aazk.org

ENRICHMENT OPTIONS COLUMN COORDINATORS

Julie Hartel-DeNardo, Heather Dunn

Casey Plummer, Dawn Neptune

TRAINING TALES COLUMN COORDINATORS

Kim Kezer, Jay Pratte, Beth Stark-Posta

CONSERVATION STATION COLUMN COORDINATOR

Lauren Augustine

ANIMAL WELFARE COLUMN COORDINATORS

Beth Ament, Pattie Beaven

BOARD OF DIRECTORS AND OVERSIGHTS

PRESIDENT: Penny Jolly, Penny.Jolly@aazk.org

Awards Committee

Chair: Jan McCoy, Jan.McCoy@aazk.org

Vice Chair: Denny Chariton, Denny.Chariton@aazk.org

International Outreach Committee

Chair: Yvette Kemp, Yvette.Kemp@aazk.org

Vice Chair: Adriana De Los Santos, Adriana.DeLosSantos@aazk.org

VICE PRESIDENT/Ethics Chair/Conference Manager: Bethany Bingham,

Bethany.Bingham@aazk.org

Professional Development Committee

Chair: Melaina Wallace, Melaina.Wallace@aazk.org

Vice Chair: Ellen Gallagher, Ellen.Gallagher@aazk.org

BOARD MEMBER: Bill Steele, Bill.Steele@aazk.org

Behavioral Husbandry Committee

Chair: Amanda Ista, Amanda.Ista@aazk.org

Vice Chair: Megan Wright, Megan.Wright@aazk.org

Bylaws

Manager: Jackie Wolfinger, Jackie.Wolfinger@aazk.org

Grants Committee

Chair: Jessica Munson, Jessica.Munson@aazk.org

Vice Chair: Amanda Ott, Amanda.Ott@aazk.org

Safety Committee

Chair: Kelly Murphy, Kelly.Murphy@aazk.org

Vice Chair: Sara Venable, Sara.Venable@aazk.org

BOARD MEMBER: Mary Ann Cisneros, Maryann.Cisneros@aazk.org

Bowling for Rhinos Program

Program Manager: Patty Pearthree, Patty.Pearthree@aazk.org

Vice Manager: Jim Haigwood, Jim.Haigwood@aazk.org

Conservation Committee

Chair: Christy Poelker, Christy.Poelker@aazk.org

Vice Chair: Janee Zakoren, Janee.Zakoren@aazk.org

Trees for You and Me Program

Program Manager: Christy Mazrimas-Ott, Christy.Mazrimas-Ott@aazk.org

Vice Manager: Anthony Nielsen, Anthony.Nielsen@aazk.org

BOARD MEMBER: Vacant

Communication Committee

Chair: Zachary Page, Zach.Page@aazk.org

AAZK Resource Committee

Program Manager: Robin Sutker, Robin.Sutker@aazk.org



One of the great things about conferences is they spark ideas and memories. This year's National American Association of Zoo Keepers (AAZK) Conference brought to mind some of the sayings we have all heard. I was able to relate paper and workshop examples to some of these sayings that are good directions to follow in our daily lives.

"Don't keep all your eggs in one basket" — International Rhino Foundation (IRF) spoke about transplanting Sumatran rhinos to different areas so in the case of a typhoon their population is spread out to lessen the impact.

"Sometimes life has tradeoffs" — I learned in a workshop, one facility reduced aggression among their North American otters by increasing their food intake due to perceived decrease in competition for resources.

"Don't give up" — This includes not giving up on yourself or others. A young mandrill from the Houston Zoo has survived and is growing despite a broken arm and an obstructive cerebellar cyst. Her survival is due to the care she has received from keepers and their work to successfully reintroduce her to her dam.

"Trust me" — Trust needs to be built and that is just what the team at the Pittsburgh Zoo worked to do with a male Northern Elephant Seal yearling that came into their care underweight and with eye injuries.

"Respect everyone's abilities and people (and animals) will surprise you!" — Everyone is unique and everyone has different abilities and disabilities. A young ring-tailed lemur at the Lemur Conservation Center surprised everyone with how mobile he has become after losing a hind leg due to a traumatic injury.

"Sharing is important" — A team from the Virginia Zoo traveled to the Philippines to hold animal care and training workshops in a country found to have one of the most critically endangered fauna regions in the world and in vital need of conservation assistance. Of the species inhabiting the area, 78% of them are found nowhere else in the world, ranking them first globally with the most critical and endangered endemic species.

"Patience is a virtue" — Always an important requirement in training any species, including voluntary darting of a jaguar, crate training Speke's gazelle or drawing blood from the front paw of a polar bear.

"We need to work together" — Lewa Wildlife Conservancy is part of the National Land Trust and is a UNESCO World Heritage Site. This unique recognition for Lewa and Ngare Ndare is for their outstanding natural beauty, as well as their varied and impressive ecosystems and biodiversity. Lewa and Ngare Ndare are all connected to Mount Kenya through an elephant corridor. Lewa was instrumental in the creation of this crucial migration passage that serves as a route for landscape connectivity.

"People (Keepers) are resilient" — I want to thank the primate keepers and staff at the Cincinnati Zoo for presenting a unique way to reduce stress and aggression in their family group of Western lowland gorillas.

"Change is inevitable" — Rachael Rufino has decided to adventure into another field and has resigned from the AAZK Board. I want to thank Rachael for her work on the Professional Development Committee, the Communications Committee and for her too short time on the Board!

I love learning opportunities. I hope you will take advantage of learning opportunities at your institution or create some for others. If you know someone who attended the conference, let them know you would like to take a look at the papers and abstracts in the 2016 Conference Proceedings. I am sure they would be happy to share them with you and search #AAZK2016 on Facebook® to check out events at the conference.

Penny Jolly
E-mail me at Penny.Jolly@aazk.org

FEEDER TUBES



The Wildlife Toy Box **Feeder Tubes** are available in five different sizes with the option of custom sizes. The fill port allows for easy fill and easy clean! Animals enjoy kicking this around and dispensing the food. Standard holes size is 3/4", if that won't work place these in custom location and custom sizes!



Order any FEEDER TUBE and receive a discount of 15% at checkout. Offer Expires 11/30/16

Enter Coupon Code: 1999

Order today at www.wildlifetoybox.com

"Helping professionals mold enrichment"

sales@wildlifetoybox.com

(866) 793-0376

www.wildlifetoybox.com

COMING EVENTS

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

December 6-7, 2016

Caring for Elderly Zoo Animals

San Francisco, CA

Hosted by San Francisco

Zoological Society

For more information go to:

<http://animalconcepts.eu/calendar/2016/caringforelderlyzooanimals/>

February 6-9, 2017

6th International Sea Duck Conference

Tiburon, CA

Hosted by Audubon, Ducks

Unlimited, USFWS, USGS, and

California Department of Fish and Wildlife.

For more information go to:

seaduckconference.net/

March 11-15, 2017

23rd Annual Aquatic Animal Life Support Operators (AALSO) Symposium

St. Louis, MO

Hosted by Saint Louis Zoo

For more information go to:

www.aalso.org

March 26-31, 2017

AZA Mid-Year Meeting

Albuquerque, NM

Hosted by ABQ BioPark

For more information go to:

aza.org/conferences-meetings

April 4-7, 2017

International Zoo Design Conference

Wroclaw, Poland

Hosted by Wroclaw Zoo

and ZooLex Zoo Design

Organization

For more information go to:

zoodesignconference.com/

April 17-20, 2017

African Painted Dog Conference

Topeka, KS

Hosted by Topeka Zoo

For more information go to:

<http://topekazoo.org/APDconference/>

April 17-22, 2017

AZA Best Practices in Animal Keeping Course

Buffalo, NY

Hosted by Buffalo Zoo

For more information go to:

aza.org

April 23-28, 2017

ABMA Annual Conference

Cincinnati, OH

Hosted by Cincinnati Zoo and

Botanical Garden.

For more information go to:

theabma.org/abma-annual-conference/

July 12-22, 2017

International Herpetological Symposium

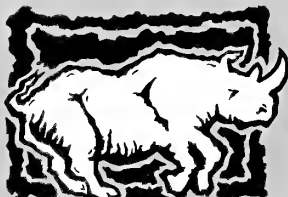
Rodeo, NM

Hosted by Chiricahua Desert

Museum

For more information go to:

internationalherpetologicalsymposium.com/40th-annual-symposium/



**AMERICAN
ASSOCIATION
of ZOO KEEPERS**

August 27- September 1, 2017

AAZK National Conference

Washington, D.C.

*Hosted by the National
Capital AAZK Chapter and
Smithsonian's National Zoo*

facebook.com/AAZK2017

September 9-13, 2017

AZA Annual Conference

Indianapolis, IN

Hosted by Indianapolis Zoo

For more information go to:

www.aza.org/conferences-meetings

Congratulations 2016 Bowling For Rhinos Trip Winners!

- ▶ The top two money raisers each year are offered their choice of a two-week trip to visit Lewa in Kenya or the Indonesian Parks with IRF.
- ▶ #3 is awarded the remaining trip.
- ▶ #4 is now awarded by a random drawing of the top money raisers from each Chapter (excluding top 3).

The 2016 Top 10 Individual money raisers:	
1	Damian Lechner Los Angeles w/ \$50,000-wins 2 week trip to Lewa
2	Angie Snowie Toronto w/\$23,693-wins 2 week trip to Indonesia*
3	Jenny Tibbott San Diego- w/\$20,507-wins 2 week trip to Lewa
4	Toni Piccolotte Jacksonville w/\$18,728
5	Katie Reimers Oklahoma City \$17,406
6	Caitlín O'Brien Lincoln Park \$17,110
7	Joe Hauser Buffalo \$14,000
8	Christina Burges San Antonio \$11,000
9	Lindsay Ireland Detroit \$9,700
10	Sean Ramsdell Tampa Bay \$8,997

**Each trip can only be won once so Angie was no longer eligible for Lewa trip as she won last year.*

Thank you to everyone who participates in Bowling For Rhinos, all those who help spread the word of the plight of the rhino AND to all those who help organize the amazing variety of BFR events each year! Together we CAN make a difference in the world! Woohoo!

BFR Reminders:

The December 1st Deadline for BFR funds to arrive at the AAZK office to be included in the 2016 totals is fast approaching! You can send any late checks, additional Chapter donations, etc. before December 1st and they will be added to your event/Chapter totals. Any funds received after December 1st will be included in the 2017 totals. PLEASE do NOT use the online donation button to send in your event monies as this costs the Association extra money.

Each year, PLEASE check your BFR kits for important paperwork. The AAZK OFFICE MUST receive your "BFR Financial Spreadsheet" (provided in the BFR kit) to comply with IRS rules. If you have any questions filling out the spreadsheet that are not answered in the BFR kit, PLEASE call the AAZK office.



The top 10 money raising Chapters since Bowling For Rhinos started in 1990 (as of 12/1/15):

1	Portland-\$307,342
2	Oklahoma City- \$302,604
3	Los Angeles- \$271,708
4	San Diego-\$239,499
5	Dallas-\$235,971
6	Utah- \$233,715
7	Detroit-\$211,662
8	Lincoln Park-\$170,567
9	North Carolina- \$158,546
10	Greater Philadelphia- \$156,096

Anna Merz Rhino Champion award (formerly named Honorary BFR trip winner) each year wins a one-week trip to Lewa Wildlife Conservancy in Kenya. Beginning in 2017 this will be for 10 nights at Lewa! Kym Janke is the "2016 Anna Merz Rhino Champion award" winner. She has been recognized for her years of dedication and perseverance organizing the San Diego Bowling For Rhinos event.

The 2016 Bowling For Rhinos Chapter Award goes to Detroit AAZK. They are being recognized for their significant dedication and perseverance having Bowled nearly EVERY YEAR since 1990 and having raised over \$222,000 for conservation worldwide. They are being recognized as consistently having an individual on the top 10 list of highest money raisers.



Please send BFR monies to the AAZK Office:
8476 E. Speedway Blvd, Suite #204
Tucson, AZ 85710
Checks payable to: "AAZK/BFR"
Phone: 520-298-9688 (AAZK Office)

Any questions, please contact:
Patty Pearthree, BFR Program Manager
919-678-0449
Patty.pearthree@aazk.org

Where the Grizzly Walks, the Earth is Healthy and Whole

The Vital Ground Foundation Protects the Right Places for North American Grizzly Bears



As an umbrella species, the grizzly bear's presence is often an indicator of the quality and wildness of the landscape, which benefits other plant and animal communities. *Photo by Philip DeManczuk.*



**VITAL
GROUND**

The Vital Ground Foundation is the premier grizzly bear conservation organization in the world— thanks in part to the incredible support from the Brookfield Chapter of AAZK and the Chicago Zoological Society, which have helped our organization save places for grizzlies, wildlife and people. Our organization works to ensure the recovery and long-term survival of grizzly bears, together with the many native species that share their range, through the protection and restoration of core habitats and landscapes.

Vital Ground's mission is to protect and restore North America's grizzly bear populations for future generations by conserving wildlife habitat, and by supporting programs that reduce conflicts between bears and humans. We protect crucial lands that grizzlies need to survive—not only for the bears themselves, but for birds and butterflies, elk, lynx, trout and all the other creatures that share their world.

Vital Ground believes the grizzly bear, as an umbrella species, is nature's barometer of a healthy and complete ecosystem. Because a grizzly's home range covers several hundred square miles—from alpine meadows to valley bottoms—protecting grizzly country benefits plant and animal communities in the wildest, most scenic places on Earth.

When Lewis and Clark made their way across the western United States just 200 years ago, the grizzly bear population in the "Lower 48" states numbered about 50,000. Since then, grizzlies' range has diminished to approximately 4 percent of its historical reach – and its numbers were reduced so drastically that in 1975, grizzly bears in the Lower 48 were protected under the Endangered Species Act.

As a result of these protections—and with the help of dedicated conservation efforts—populations have rebounded in two grizzly bear

Saving some of the wildest, best places on Earth is not only beneficial for grizzly bears, but also favorable for other plant and animal species. Conservation of the landscape benefits people, too.

Photo by Lance Schelvan.



The northwestern United States hosts millions of acres of public land under relatively good conservation protections, and these areas can provide strongholds for grizzlies and other wildlife species.

But separating these core habitats are strips of privately-owned lands often situated in low-elevation valley bottoms in the heart of seasonal grizzly bear habitat where increasing development, traffic and other human activities disrupt wildlife movement across the landscape.

Habitat links between these wild grizzly sanctuaries—private lands that provide food, shelter and security for seasonal foraging and movement—are the focal point of grizzly survival and recovery.

This is where Vital Ground targets its resources and efforts. Acre by acre, we protect the jigsaw puzzle pieces—the right places—of habitat that

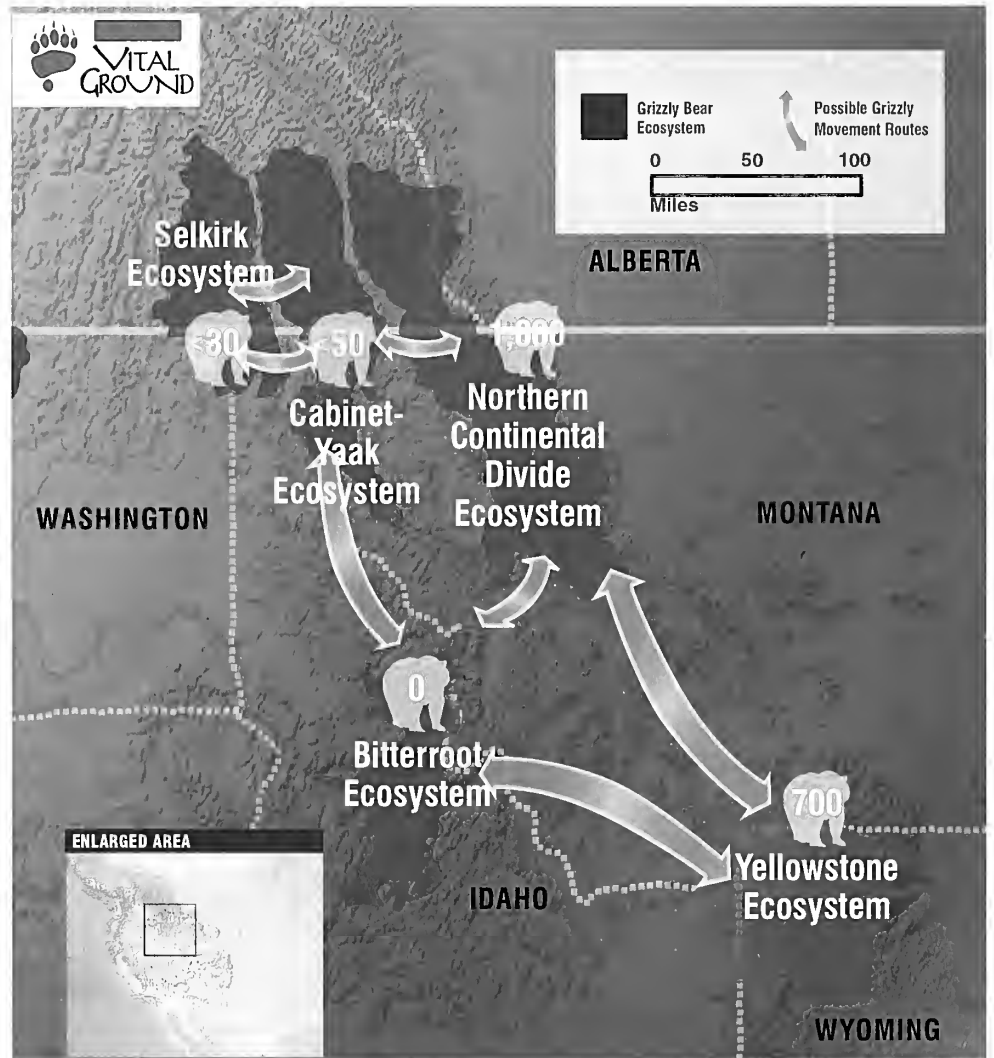
For more information or to contribute to Vital Ground's cause, visit us at vitalground.org/right-place-campaign.

maintain lifelines between grizzly ecosystems. Links that will help sustain bears along with a robust variety of plants and animals that thrive in grizzly country.

Vital Ground is taking action to reverse habitat loss and declining grizzly numbers through The Right Place Campaign. By contributing, you will help us secure key small parcels and make a huge impact for grizzlies, other wildlife, the landscape and people. Please help us protect the right places!

Linking Fragmented Grizzly Bear Populations and Habitat

Maintaining landscape connectivity is crucial to allow natural movements between grizzly bear ecosystems and prevent possible demographic and genetic isolation.



ecosystems, but are still teetering on the brink of extinction in others.

According to the U.S. Fish and Wildlife Service, about 1,000 bears live in the Northern Continental Divide Ecosystem (including Glacier National Park) and more than 700 inhabit the Yellowstone Ecosystem. But the number of grizzlies in the U.S. portions of the Selkirk Mountains and Cabinet-Yaak ecosystems are dangerously low, numbering less than 50 bears each. Unless we act soon, these populations are threatened with further declines resulting from the continued loss and fragmentation of their habitat which will lead to additional genetic isolation.

In Washington's North Cascades, grizzlies may be absent except for an occasional wanderer from Canada, and the grizzly population in Idaho's Bitterroot Ecosystem has vanished entirely.

Swamp Monkeys Solve Kerplunk: a progressively challenging enrichment experiment

Peggy Hoppe, Zoological Manager, Great Apes
Eli Baskir, Behavior Research Associate, Reproductive and Behavioral Sciences
Saint Louis Zoo, St. Louis, MO

Abstract

Providing enrichment to stimulate problem-solving skills is recognized as an important component of animal welfare (Meehan and Mench, 2007), but repeated exposure to the same objects can result in habituation and loss of engagement, and introducing puzzles too difficult to solve can result in frustration. The Saint Louis Zoo primate keeper staff developed a plan to progressively increase the challenge of a “kerplunk” feeder device presented to 1.1 Allen’s swamp monkeys (*Allenopithecus nigroviridis*). A simple device was initially offered so that the monkeys could learn a basic strategy of solving the puzzle to retrieve food rewards. Data were collected from live observations of the monkeys’ interactions with eight difficulty levels of a kerplunk feeder, in which complexity was added to the device by varying the number of rows of holes filled with sticks, type of food reward, or tube opacity. Each variant was presented to the monkeys on three separate trial days for a total of 24 observations. Variants were solved more quickly on second and subsequent presentations, but the time to solve between variants stayed consistent. These results suggest that habituation to a device does occur but can be reduced by using variation to increase difficulty.

Introduction

At the start of summer 2013, the Saint Louis Zoo housed 1.1 Allen’s swamp monkeys, male Moss and female Stone. The pair’s habitat shared a glass barrier with 2.0 lion-tailed macaques (*Macaca silenus*) and had a hallway separated by mesh that allowed visual access to 2.4 guereza colobus (*Colobus guereza*). The swamp monkeys also had visual access through the public space to many lemur species. The male, Moss, had developed a behavior of displaying and threatening the monkeys in the habitats on either side of him, as well as attempting to attack them through the barriers. On one occasion, he chipped his tooth on the glass when trying to bite it. Attempts were made to block visual access, but Moss continued to focus much of his behavior on his neighbors. In addition, Moss would threaten and try to attack the public, especially children. Edinburgh Zoo had a situation with a female De Brazza’s monkey (*Cercopithecus neglectus*) whose pacing was affected by the presence of guests, especially children, and barriers did not decrease these undesired behaviors either (Young, 1998). Instead, Saint Louis Zoo keepers hoped to reduce Moss’ agonistic behaviors with enrichment.

Good enrichment items are thought to offer opportunities for animals to perform activities they prefer over stereotypic behavior and reduce their motivation to perform it (Mason et al., 2006). Keepers at the Saint Louis Zoo developed an action plan for enrichment for our swamp monkeys and Moss, in particular, to reduce his time spent focusing on the inhabitants of adjacent exhibits. Action planning involved using the

Disney Animal Kingdom’s SPIDER model (Disney’s Animal Kingdom, 2009) to answer natural history questions for the species and then brainstorming ways to better enrich the pair. Like many primates, swamp monkeys are very intelligent, have a preference for handling food items, and can easily manipulate objects, including disassembling furniture and enrichment devices (Margulis et al., 2005).

For enrichment items with a puzzle component, as is the case for many types of feeders, an inability to solve the puzzle and retrieve food from the device can induce frustration. Devices that are too simple or presented too often result in habituation and reduced engagement with the item. Staff decided to work on a progressively challenging enrichment project to try to increase problem-solving skills while reducing frustration and loss of engagement, which would in turn hopefully reduce agonistic behaviors. The goal was to offer an enrichment device that could be modified by keepers to become more challenging to solve over time.

Methods

A “kerplunk” feeder device was constructed using a 1 m long by 7.62 cm wide clear acrylic tube. Thirteen rows of 0.95 cm diameter holes spaced 1.27 cm apart were drilled into the tube starting 20 cm from the top and ending 20 cm from the bottom. Two 0.635 cm threaded eye bolts were screwed into either side of the tube 2.54 cm from the top and bottom. Attached to the eyebolts was a 12.7 cm length of 0.3175 cm 7 x 7 strand galvanized steel cable with ferrules to lock the device at the top and bottom to prevent swinging. Keepers added a plexiglass lid that was countersunk into the feeder and secured with a countersunk 2 mm metal pin that went straight through the tube, so animals could not procure food without solving the device. Bamboo sticks were slotted through the holes, and food items were placed atop the sticks. The device was placed in the swamp monkey habitat when Stone and Moss were shifted out during morning cleaning, which occurred for 20 to 40 min between the hours of 0930 to 1230. Both monkeys then entered the habitat and had access to the device for the entire day and night until the habitat was cleaned the next morning around 1000. In addition to the device, the monkeys were provided with either boomer balls, plastic jugs, or cow bells on every study day, as keepers felt these items all exhibited similar amounts of use by the pair.

The first variant of the device was introduced on 30 July 2013 with only two rows filled with sticks, but difficulty was modified in subsequent presentations by increasing the number of rows filled, up to 13. Nine variations of food type, number of rows, and device opacity were tested in sets of three trials, but one set using six rows with grapes and clear pipe had only two trials and was not included in the results. Presentations



Peggy Hoppe holding completed clear kerplunk device. Photo by Carrie Felsher



Kerplunk device in swamp monkey habitat on first day.

of the device took place on nonconsecutive days in 2013 and 2014. Days between presentations ranged from three to 70, with a median interval of four days.

The size and quality of the food item could be varied by provisioning the device either with 213 g of whole grapes or 268 g of an apple sliced into eight to 10 chunks. Grapes were the food type in 20 of 26 presentations and apples the type in the other six. The tube's opacity was switched on 1 March 2014 from clear acrylic to an opaque PVC pipe of the same size with the same modifications, so the monkeys could no longer see the food remaining or its placement atop the sticks inside the puzzle as they worked to solve it. The device was given to the swamp monkeys for eight trials with the lid described above. A more secure lid was used starting on the ninth trial, 26 November 2013, after the monkeys began retrieving food from the device by removing this lid and grabbing food from the top of the tube instead of pulling sticks and allowing food to fall out the bottom. The stronger lid had a similar construction to the old but with a 1.5 cm hose band covering the countersunk pin, so it could not be removed by the monkeys.

The monkeys' interactions with the device were recorded by live observers for 30 min following its introduction into their habitat and for another 30 min in the afternoon between 1400 and 1500. The amount of time needed to solve the device for each trial was recorded when the last piece of food fell from the bottom of the device. This time spent solving was used for a measure of difficulty: The longer the monkeys needed to remove all food from the tube, the more of a challenge it presented. During the observation periods, 30-second interval scan samples were taken for each swamp monkey to record interactions

with the kerplunk device, interactions with other enrichment, eating, locomoting, and social behaviors, including any behaviors directed at the colobus, macaques, or the public (Table 1). In addition, these agonistic behaviors for the male were recorded using all occurrences sampling in order to determine how often they occurred and if their frequency changed with or without the device.

On 13 February 2014, the lion-tailed macaque bachelors that shared exhibit glass with the swamp monkeys were moved one exhibit over, and 2.2 ring-tailed lemurs (*Lemur catta*) with 1.1 black lemurs (*Eulemur macaco*) were put in the adjoining exhibit. Within one week of the move, Moss stopped performing agonistic behaviors towards that side of the exhibit.

Results

In four of six variants using grapes, the swamp monkeys required a longer time to solve the initial trial (20.5 min to 30 min), but second trials were solved in shorter or equivalent times, and third trials were solved even more quickly (Figure 1). Two sets did not follow this trend: When the device was first introduced to the monkeys on 30 July 2013 with only two rows filled with sticks, it was solved in 4.5 min—the fastest solving time of any observation. This quick solution could have been due to the novelty of the device and a greater immediate excitement and interest in this new enrichment. This first day of introduction was removed from analysis as a statistical outlier. The second set that did not follow the pattern of long time to solve for first trial and quicker solve times in subsequent trials was variant 6, whose second trial on 8 February 2014 ended with the puzzle unsolved. According to keeper observation, neither monkey engaged with the device. In previous

Table 1. Ethogram of swamp monkey behaviors.

Behaviors	Description
Interacting with Enrichment Device (ID)	Manipulating the kerplunk device or parts of the device, including food within the device
Interacting with Enrichment (IE)	Interacting with any other enrichment item in the exhibit that is not being used during a focus behavior
Eating (E)	Eating or foraging for any food item not associated with the enrichment device
Locomoting (L)	Walking, running, jumping, or leaping that is not part of a focus behavior
Out of View (OV)	Not visible during scan
Focus Behavior (F)	Includes any behavior that is directed at the colobus, macaques, or public including but not limited to open mouth, jump kick, bite glass, hit glass, vocalize at while watching, displaying, or purposefully watching/staring at a group
Social Agonistic (A)	Any contact aggression including biting, grappling, or hitting
Social Affiliative (SA)	Grooming or resting in contact
Other (O)	Any behavior not previously mentioned

trials, the female had been the primary actor in removing sticks, while the male stood under the device and collected the food reward without working to solve the puzzle. To avoid the male's freeloading, the female decreased her interaction with the feeder, and did not interact with it at all on 8 February 2014.

Variants using apple chunks instead of grapes did not follow the pattern of high initial solve time and subsequently lower times on trials 2 and 3. Keeper observations noted that the large-cut chunks of apple would not fall out of the device until nearly all sticks had been removed. Grapes, conversely, were smaller and more numerous, and would fall from the device periodically, prompting the monkeys to stop pulling sticks and eat grapes as they fell. When working to retrieve apple chunks, the monkeys pulled sticks without pausing as frequently, usually completing the puzzle more quickly than they did on days when the device held only grapes. Because an apple chunk introduces many more factors into the study than just quality of reward (i.e., quantity of reward pieces, how easily items fall from device), only the more numerous grape variations were compared. One-way ANOVA revealed that the resulting difference in grape variations between time to solve first and third trials neared statistical significance, $F(2,14) = 3.62, p = 0.054$.

When examining the data for trends across 23 analyzed observation sessions, no strong statistical correlation could be found between number of total presentations to the monkeys and time to solve the device, which indicates that there was no significant change in the amount of time Stone and Moss took to solve the device from the first to last observation. When looking at the three trials within each of the six analyzed variants, a different picture emerges (Figure 2): A strong, significant negative correlation was detected when comparing time to solve between trials ($R^2 = 0.34, p = 0.01$), which means that, as a group, variants' first trials took longest to solve but were solved more quickly on the second trial and most quickly on the third trial.

The amount of Stone's interactions with the device over time had a moderate negative correlation that neared significance ($R^2 = 0.21, p$

$= 0.065$), indicating that she interacted with the device less often as the project continued, with the decrease beginning around day 10. Keepers noticed Moss stopped interacting with the device and instead freeloaded by standing under it and collecting food that dropped out as a result of Stone's efforts. Stone subsequently reduced her contribution to solving the device. One-way ANOVA indicated a difference in the number of interactions with the device between Stone and Moss that neared significance, with Stone interacting more frequently, $F(1,32) = 2.80, p = 0.10$.

A significant difference was also detected in the number of interactions with the device between the morning and afternoon, with fewer interactions recorded later in the day. No significant difference was detected in the amount of time required to remove all food from the device when comparing the unsecured and more secure lids. The presence or absence of the kerplunk device in the habitat made no significant difference in the number of behaviors directed by Moss at the public or neighboring species.

Discussion

Our original goal was to reduce Moss' behaviors directed toward heterospecific primates, but it is likely that the kerplunk feeder did not occupy enough of Moss' time to measurably affect his agonistic behaviors. It is interesting that Moss' reaction to his neighbors was so strong, since swamp monkeys can often be found in mixed-species situations in the wild. In these cases, swamp monkeys are usually less than two meters off the ground while other species are in the upper tree canopy (McGraw, 1994). At our zoo, the elderly lion-tailed macaques that neighbored Moss spent most of their time also at ground level near the glass of the swamp monkey exhibit. They were approximately the same size as Moss and did not respond to his displays. Because Moss is a male swamp monkey, his priority would be to defend a troop instead of interacting with enrichment. Staff at Lincoln Park Zoo noted in their swamp monkey family group that young offspring used enrichment more often than the adult male (Margulis et al., 2005). The lack of a reaction from his neighbors may have served to frustrate Moss and maintain the

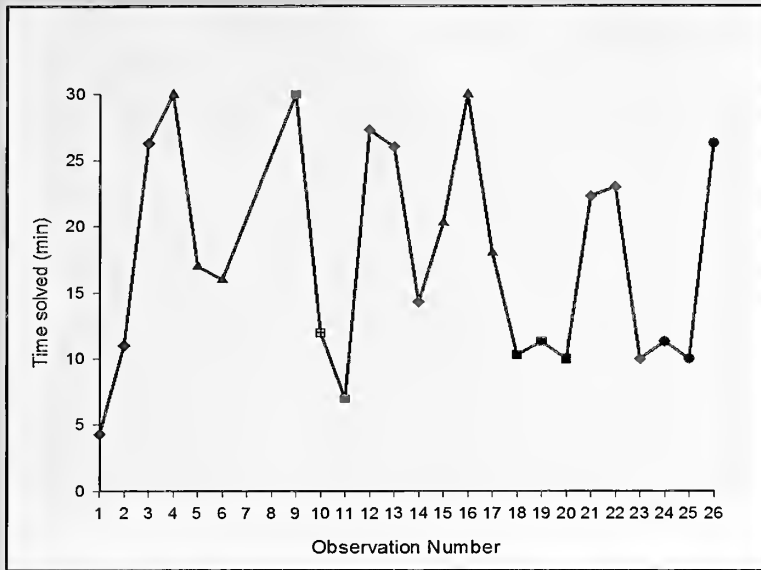


Figure 1. Time to solve feeder device with each set of three trials grouped in color by variation. Yellow cross on observation 10 shows first day the secure lid was deployed. Black squares on days 18-20 and black circles on days 24-26 are variants using apple chunks.

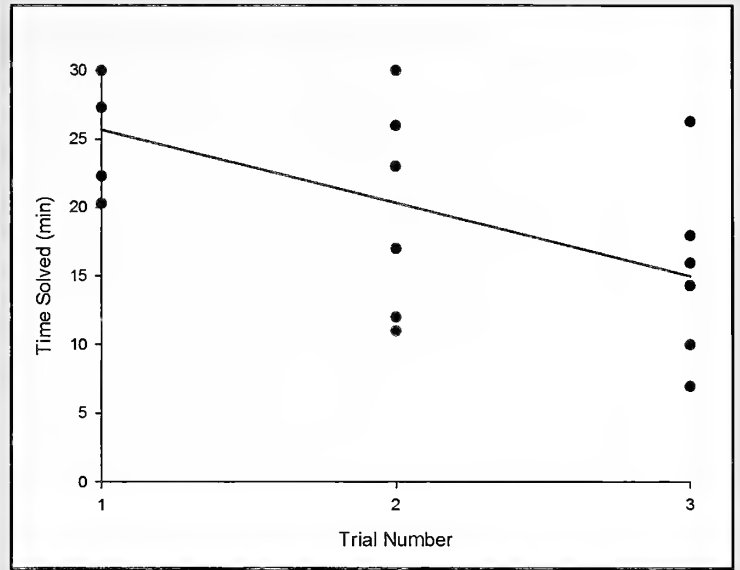


Figure 2. Correlation between time to solve and trial number within each set of variations ($R^2=0.34$, $p=0.01$).

intensity of his agonistic behaviors.

Moss' behaviors directed at other species decreased when the lion-tailed macaques were moved farther away from the swamp monkeys and no longer shared a glass wall. It may be best when animals are exhibiting agonistic behaviors to seek more suitable neighbors by moving either the initiators or recipients of the behavior. The situation at our Primate House did not allow for this option for several months but was used as soon as the opportunity became available.

Primates have a need for continued innovation and complexity in enrichment (Margulis et al., 2005), but food puzzles similar to the kerplunk feeder require additional skills that animals may not have acquired yet (Lutz and Novak, 2005). By offering a progressively challenging enrichment puzzle feeder, the skills an animal does possess can be expanded by providing learning opportunities while maintaining manipulation and interest in the enrichment. Although overall solving time did not change between variations, the amount of time required to solve within a set's trials decreased from first to third trial. These results suggest that as the swamp monkeys learned how to quickly remove food from each variant, changing the setup and difficulty of the feeder again presented challenge and renewed interest. If the animals had completely habituated to all the variations, the expected time to solve at the end of the study compared to the beginning would have been significantly lower, but this outcome was not the case.

It is also interesting to note the differences in contributions of effort to solve the device. At first, the female, Stone, had a greater number of interactions with the device, but this rate decreased over time. Keepers noticed that as Stone solved the puzzle, Moss stood under it, retrieving any grapes that fell. It appeared that, to counter this freeloading, Stone reduced her own efforts, resulting in a day where neither monkey engaged with the device. Because the effort of solving the device became separated from the reward, Stone had less incentive to solve the puzzle. A more direct effort-reward connection may encourage greater participation with a feeder device. Furthermore, a puzzle that requires

active participation from both partners may encourage cooperation instead of freeloading.

Use of the puzzle dropped significantly in the afternoon, indicating reduced interest due to a combination of within-day habituation and lack of continued enticement because all food rewards had already been retrieved by the monkeys in the morning. Lutz and Novak (2005) reported that wild rhesus macaques (*Macaca mulatta*) foraged between 16% and 50% of their time awake, depending on resource availability. When humans provided the food, foraging dropped to 7-8% of the macaques' waking hours. It is not uncommon for enrichment devices to go unused after the food items are gone, because there is little to no incentive to continue spending time foraging. Getting animals to actively participate all day in enrichment, especially non-food enrichment, remains a continuing challenge.

Conclusion

Institutions should try every option to improve situations where an animal's behavior may cause harm to itself or others. Enrichment is frequently used to try reducing stereotypes or agonistic interactions, but it may fail to treat the cause of the behaviors and eliminate them. In this particular case, the frequencies of Moss' threats, displays, and attacks were not reduced until the animals in the habitat near him were moved. Considering the compatibility of neighbors can help limit aggression or prevent its expression.

A progressively challenging enrichment device can prevent habituation and maintain interest, though interest decreases from morning to afternoon as food is removed. Animals interact more with a provisioned device than one with no food, so introducing fresh morning and afternoon enrichments can keep animals active and interested. Because animals may monopolize rewards, consider including multiple devices for each animal in a habitat, or devices that either require cooperation to solve or that prevent food acquired by work done by one individual to be stolen by another.

Acknowledgements

We would like to thank the Saint Louis Zoo Enrichment Committee for suggesting a progressively challenging enrichment project. In addition, we would like to thank the Primate House staff, without whom the project could not have been finished. Ethan Riepl in particular significantly aided in the construction of the kerplunk feeder.

References

- Disney's Animal Kingdom. 2009. Animal Enrichment Programs. Retrieved from http://www.animalenrichment.org/spider/setting_goals.html
- Lutz, C., and M. Novak. 2005. Environmental enrichment for nonhuman primates: theory and application. *ILAR Journal* 46(2):171-177.
- Margulis, S., M. Rafacz, and B. Jacobs. 2005. Quantifying the effectiveness of environmental enrichment: lessons learned and rules of thumb. *Proceedings from the International Conference on Environmental Enrichment*, New York.
- Mason, G., R. Club, N. Latham, and S. Vickery. 2007. Why and how should we use environmental enrichment to tackle stereotypic behavior? *Applied Animal Behavior Science* 102(3-4):163-188.
- McGraw, S. 1994. Census, habitat preference, and polyspecific associations of six monkeys in the Lomako Forest, Zaire. *American Journal of Primatology* 34(4):295-307.
- Meehan, C.L., and J.A. Mench. 2007. The challenge of challenge: can problem solving opportunities enhance animal welfare? *Applied Animal Behaviour Science* 102: 246-261.
- Young, R.J. 1998. Behavioral studies of guenons *Cercopithecus spp* at Edinburgh Zoo. *International Zoo Yearbook* 36(1):49-56. 🐒

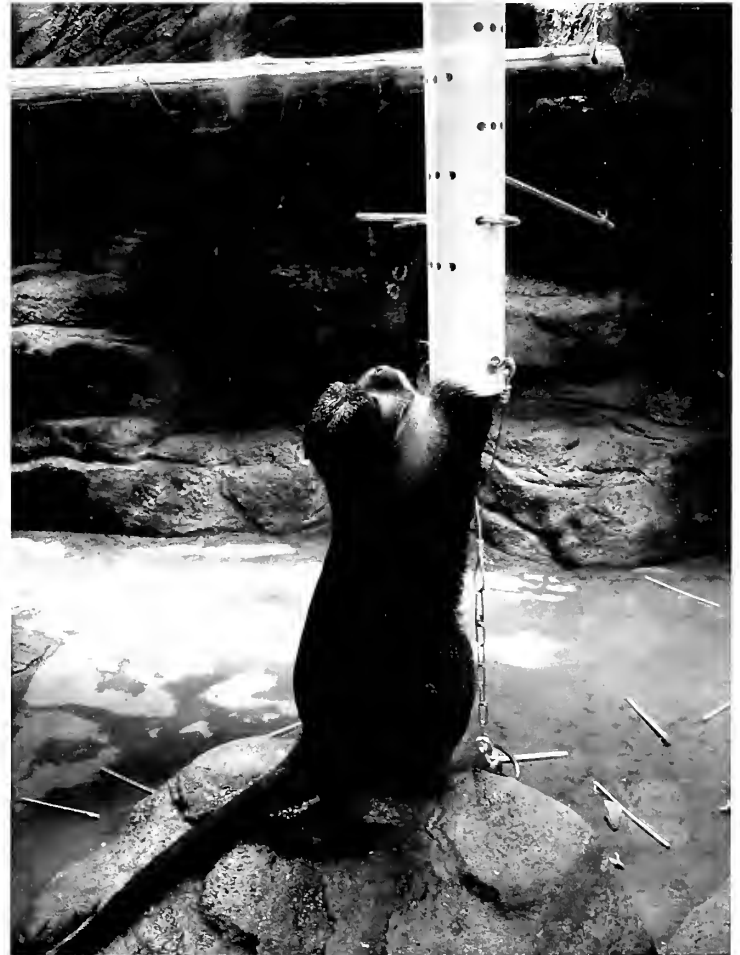


Swamp monkey Moss using the opaque kerplunk device.

Swamp monkey Stone accessing the grapes from the kerplunk device on the first day before the top was added.



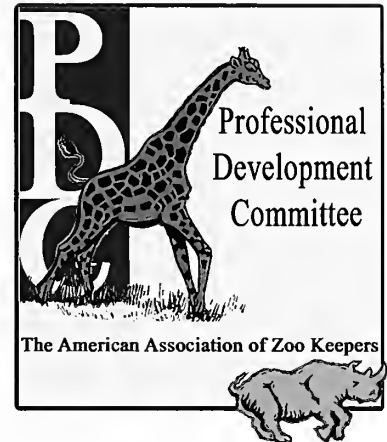
Swamp monkey Moss reaching inside the opaque kerplunk device from the bottom.



AAZK Professional Development Committee First Call for Workshops 2017 AAZK National Conference

The 44th Annual AAZK National Conference
Washington D.C., August 27-31, 2017

Conference Theme:
“Keepers United in Saving Species”



First Call for Topical Workshops

The AAZK Professional Development Committee is pleased to announce the first call for Topical Workshops for the 2017 AAZK National Conference hosted by the National Capital AAZK. The Host Chapter has chosen the theme “Keepers United in Saving Species”, which will highlight how zoo and aquarium professionals work to advance animal care and conservation.

Deadline for Submission of Abstracts for Workshops: January 15, 2017.
Authors will be notified regarding acceptance no later than February 15, 2017.

Workshops – Format

Workshop subjects should be in-depth explorations of animal health, animal management, taxa-specific husbandry, and keeper professional development. Workshops should be two hours in length. Subjects that require more than two hours should be submitted as “Part One” and “Part Two”.

Open Workshops – New this year

This new Open Workshop format will offer unlimited attendance (based on the capacity of the ballroom) and will be best suited for panel discussions or lecture-based workshops with a Q & A session at the end.

Topical Workshops -- Held in limited capacity breakout rooms, this format is best suited for small group interactive workshops and will have a cap on the number of participants.

Guidelines for Abstracts:

- ▶ Abstracts should be no more than 250 words and should focus on the main theme of the Workshop
- ▶ Abstracts should be submitted as a Microsoft Word® document via e-mail to: pdcaazk.org.
- ▶ File should be named WorkshopAbstractAuthorlastname2017
- ▶ Please include the following information along with the abstract:
 - Workshop Title
 - Name of the authors and presenters
 - Please indicate ONE contact person that will communicate with PDC
 - Institution/Affiliation
 - Position/Title
 - Workshop Format: Indicate Open Workshop or Topical Workshop
 - Workshop acceptance may be conditional on room availability. If either format would work, please indicate that both would be acceptable.



Evolution and Natural History of Langurs: implications for welfare

Leah Perlman
Caravan Guide:
San Diego Zoo Safari Park
San Diego, California

Introduction

Captivity of primate species is one of the most hotly-contested subjects amongst animal rights activists. One reason the captivity of primate species tends to have more vocal opponents than captivity of other, less charismatic species, is the perception that primates are more intelligent and more capable of understanding their captive situations. With closer scrutiny and the difficulties keeping primate species successfully in zoos, zoos are responsible for ensuring appropriate welfare through aspects of enrichment, dietary needs and social structure.

Welfare is defined by the Association of Zoos and Aquariums (AZA) as “an animal’s collective physical, mental, and emotional states over a period of time, and is measurable on a continuum from good to poor” (Welfare, n.d., para 1). The importance of this welfare in any species is many-faceted and many aspects and specifics for each species must be considered. To help elucidate this, conservation scientists, curators, behaviorists and zoo keepers can look at the natural history and evolution of these animals to help shed some light on what they need to survive and thrive in a zoological setting. For the purposes of this article, the author will focus on langur natural history

and draw conclusions about ideal standards of welfare to succeed in keeping the species.

Evolution and Natural History of Langurs

Also known as leaf monkeys, langurs are members of the Colobinae family. In Asia, there are nearly two dozen different langur species (*Presbytis spp* and *Trachypithecus spp*), many of which are threatened, endangered or critically endangered according to the IUCN Red List of Threatened Species. Ranging from the Himalayas to Vietnamese islands and down into southern India and China, these primates are characterized by their long limbs, thin, narrow bodies and long tails (Groves, 2007). Primarily arboreal, the name “leaf monkey” is appropriate due to the folivorous diet of these animals, making a large stomach, similar to that of a ruminant, necessary for digestion. Asian colobine primates cover an extensive range, with speciation occurring within that range to account for around twenty-four species, though there are still some species that have been contested as to whether or not they are actually sub-species.

Digestion and diet

One of the most notable features of langurs is their digestive system. With a digestive system more like that of cows, langurs survive largely on leaves, but will incorporate fruits, seeds and, very rarely, insects (Joeke, 2006). Markedly, there are large differences in the digestive systems of individual species of langurs. While not true ruminants, langurs and other colobines possess a two-chambered stomach housing symbiotic bacteria that aids in the digestion of the cell walls, an ability mammals alone do not possess. Some langur species possess the ability to digest their own symbiotic bacteria to recoup nutritional losses, creating a situation in which the animal would experience extraordinarily high levels of nitrogen and therefore ketosis. Avoiding this is key and species like the Douc langur (*Pygathrix spp*) produce extra RNase to handle the excess nitrogen produced by their digestion of the bacteria (Zhang, 2006).

Trichromatic Vision

Trichromatic vision is based upon the existence of three color receptor cones in the back of the eye, imparting the ability to see the world in a more colorful way. This type of vision exists in 19 primate species and in old-world species, it occurs in howler monkeys alone (Gilad et al., 2004). Gilad et al (2004) note that the evolution of trichromatic vision coincided with a marked increase in olfactory receptor pseudogenes, genes that do not actually code for olfactory ability. For some perspective, humans have around a 50% proportion of olfactory receptor pseudogenes whereas primates with trichromatic vision have around 30%; primates with dichromatic

or monochromatic vision have only around 20% (Gilad et al., 2004). It would appear that a trade-off has occurred, trading trichromatic vision for an overall loss of olfactory sensitivity.

It could easily be assumed that the loss of olfactory sensitivity in langurs and other old world monkeys could be to a detriment to the animal. However, there is some merit to the idea that, with the evolution of color vision, there came another evolution encouraged by sexual selection in a three-colored world to bring about changes in the pelage color of these animals. The evolution of this ability to better see shades of red and green (as seen with trichromatic vision instead of the blues and yellow receptors in dichromatic vision) likely evolved with an increase in fitness for better foraging abilities for ripe fruits (Fernandez and Morris, 2007). This ability was taken a step further and used for visual assessment of color cues as sexual selection, increasing the number of old world primate species that use colorful sexual signaling (Fernandez and Morris, 2007).

Like male gelada baboon's bright red chests, red eyelids of macaques and baboons, and the colorful faces of male mandrills, signaling conspecifics with color appears to be beneficial beyond sexual selection. Langur infants of many species are brightly colored; silvered-leaf and Francois' langur infants are bright orange. It would be easy to believe that this could be evolutionarily disadvantageous for any species; most other mammal infants use cryptic coloration to remain hidden from predators. However, langurs are primarily arboreal as are their predators. Many of these predators do not see in color; cat species and large snake species all have dichromatic vision and cannot differentiate between many shades of red and green (Fernandez, 2007). In the rich green environment of a forest, an orange baby langur would easily blend into the background of leaves. For a mother langur tasked with keeping track of a curious infant, that bright pelage would make the baby far easier to follow in the leafy cover.

Life in the trees

The evolution of arboreal life in primates is likely the more primitive lifestyle; prosimians, primate precursors, were largely small-bodied with grasping feet and hands, shaped perfectly to grasp branches (Bloch and Boyer, 2002). Additionally, these small prosimians had ankle joints built for leaping, angled perfectly for maximum thrust to leap from branch to branch. Many evolutionary biologists believe that modern primates evolved from primates with tremendously strong gripping hands and feet and flexible ankle joints in order to grasp narrow-diameter branches (Schmitt, 2003).

Arboreal living is no easy task for many animals. Some langur species have even taken arboreal living one step further and adapted locomotor abilities generally found in trees to rocky cliffs and ledges. The Francois' langurs (*Trachypithecus francoisi*) and the white-headed langur (*Trachypithecus leucocephalus*), for example, spend nights in limestone caves in China, using their extraordinary climbing abilities to scale the rough walls in almost complete darkness (Huang and Li, 2005). Stereoscopic vision, much like that of humans, aids in the ability for many of these animals to leap long distances and land accurately thanks to that vision giving them the depth perception necessary to do so. Leaping successes are also reinforced by the abilities of primates to absorb shock into bending elbows and limb flexion to reduce the jarring forces of landing after a long leap (Schmitt, 2003).

Social Structure

Primate social structures are extremely varied, from solitary species like orangutans to species like baboons whose troops can number in the hundreds of individuals (Kappeler and van Shaik, 2002). Some species hold to strict, linear hierarchies and harems while others have more fluid, fission/fusion groups (Chapman and Rothman, 2009). Langurs and many other folivorous species are something of a paradox. Folivores like langurs and other colobines should be found in large groups as group size is limited to resource availability. As leaves are often plentiful in langur habitats, theoretical group sizes could be very large. Safety from predators is another factor in group size; the larger the group, the safer the individual animals within it. The paradox is this; despite all these factors, langur groups tend to be only 40-60 individuals in size (Minhas et al., 2010), relatively small considering available resources. Some theories as to the reasoning for such small groups is the rate at which infanticide occurs in multi-male groups and the time many langurs must spend each day simply digesting their food (Chapman and Rothman, 2009). The energy spent gathering food has bearing on the amount of energy required to digest that food. Resting to digest takes up a large portion of the langur daily activity budget and, in cases such as those, smaller groups appear to be favored.

Evolution of social groupings in primates is complicated simply due to the range of complexities of each species. The diversity of these groups, how and why they arose has a number of factors, not the least of which are the effects of resource availabilities, mating systems, predator avoidance, and parental care (Kappeler and van Shaik, 2002). One major factor in group evolution of langurs has been the rate of infanticide from new males entering a group. Like lions, if a new male takes

over a group of females in a harem system, the new male will often kill infants to force females into estrus again, ensuring the new male will have offspring (Minhas et al., 2010). In species where incidents of infanticide are high, evolutionary shifts may have been made to multi-male groups to confuse paternity as well as changes to female estrous cycles, like cryptic estrus (Kappeler and van Shaik, 2002). As a result, not all langurs are single male/multi-female, but not all langurs have harems, either. There are numerous factors at play, particularly those involving resource availability.

Visual acuity of langurs and other primate species is something to be utilized and built upon from an enrichment standpoint to encourage species-specific behaviors thereby increasing overall welfare.

There are also correlations between the size of the neocortex in primates and the size of groups and complexities of relationships within them (Kudo and Dunbar, 2001). The more complex the relationships between females in particular, the more difficult it is for those individuals to remember the relationships and social hierarchies among them. A larger neocortex would help facilitate navigations of a socially complex world. Males participate in these relationships as well, particularly lower-ranking males in multi-male groups (Kudo and Dunbar, 2001). In fact, some bachelor groups of male langurs have been seen, though these groups are often volatile and short-lived (Southwick and Siddiqi, 1974). Despite the fact that these langur species all belong to the same family, they have evolved drastically different social structures dependent upon a wide variety of factors: environmental, physical, social, and genetic.

Implications for Welfare in a Zoological Setting

Meeting dietary requirements

Ensuring proper nutrition for zoo animals can be a sometimes herculean task. Many species, like koalas, have such specialized

diets that providing them with appropriate nutrition can become expensive and difficult. Some zoos even have eucalyptus flown in on a weekly basis for animals like koalas, simply to ensure the dietary needs of that animal are being met. A number of zoos work with animal and veterinary nutritionists to ensure the appropriate feeding of species in their care.

Langurs require specialized diets. As discussed in an above section, all langurs are folivorous, their digestive systems similar to that of ruminant species. As a result, their fiber intake requirements can be extremely high in order to maintain proper quality of feces (Joeke, 2006). Providing fresh browse to folivorous species is not easy for many zoos, particularly those in areas with harsh winters and surrounded by deciduous trees going dormant in the winter, so feeding less nutritive and less fiber-rich sources of food during times fresh browse is not accessible could potentially have a negative effect on the welfare of langurs in those environments. Joeke (2006) shows that a lack of soluble fiber in langur diets can create feces with too much water, risking dehydration of the animal or losses of other vital nutrients like fatty acids.

Diet is a major welfare issue. Many zoos are non-profit and run a very small budget. Some of these zoos will use leftover and donated foods from restaurants or grocery stores in addition to specially made foods like browse biscuits. Research from Joeke (2006) shows that these diets are often too low in soluble fibers, creating digestive problems and problems achieving complete nutrition. Some investigations into lemur species (also folivorous but not to the extent of langurs) has shown that obesity can be as high as almost 50% of lemurs fed in European zoos (Schwitzer and Kaumanns, 2001). Schwitzer and Kaumanns (2001) note that this could be a result of a lack of overall movement but also a result of improper nutrition. Obesity is also a welfare issue. While these animals are well-fed, obesity could make for an animal whose ability to move and express species-specific behaviors is hampered by their weight, reducing overall welfare and potentially shortening lifespans.

The diet of langurs in zoos should remain variable with access to ample fresh browse to not only encourage natural foraging behavior, but to provide appropriate dietary requirements. Many zoos do not feed their langurs fruit due to the type of fermentative foregut langurs possess, but there are a number of species in the wild that eat both ripe and unripe fruits (Joeke, 2006). Special care should be taken to provide those species with an appropriate amount of fruit in their diet to ensure the fruit-based dietary fiber

is consumed. Rare feedings of fruit as enrichment for langurs could prove beneficial in terms of ensuring good welfare from a dietary and mental stimulation standpoint. Hatt and Clauss (2006) recommend some zoos in areas with more deciduous than evergreen trees make, store, and feed silage (ground and stored leaf matter) to animals with a dietary need for foliage during the times of year fresh browse is inaccessible.

Trichromatic vision and enrichment

Considerations of visual acuity for captive animals are important when discussing welfare aspects. Animals with mono or dichromatic vision are likely to not benefit from colorful enrichment objects in their enclosures. However, animals with trichromatic vision could gain appropriate stimulation from colorful objects in their exhibits. Interaction with enrichment objects has shown to be very important with regards to overall welfare of captive zoo animals (Kroshko and Mason, 2013). Manipulation of objects and exposure to new and novel objects encourages mental stimulation, movement and sometimes social interaction.

Introduction of stressors into the environment is crucial for the mental and physical wellbeing of animals in zoos (Wielebnowski, 2003). The definition of stress was originally coined by a laboratory animal scientist, Hans Selye, who saw it as a non-specific response to any change (www.stress.org). Stress is neither good nor bad in the grand scheme of life. Distress, on the other hand, is stress fatigue; too much stimulation to the point of exhaustion of the capacity to adapt to those changes (Wielebnowski, 2003). Enrichment utilizing a range of senses for animals encourages adaptation to changes, whether the adaptation to that change is eating the food set out in a different location or exploration of a new item on exhibit.

Trichromatic vision in old world primate species like langurs should be taken into consideration when creating enrichment plans for those animals. As mentioned in the above section on visual acuity, evolution of trichromatic vision was a trade-off at something of a loss of olfactory abilities (Gilad et al., 2004). Both of these factors must be considered when planning enrichment for langurs. Trichromatic vision opens up opportunities for hiding colorful treats around exhibits, encouraging extensive and far-ranging foraging behaviors. Olfactory abilities are still far better than those of humans so scent enrichment would also be encouraged. Colorful manipulanda, mirrors and other interactive objects are all pieces of enrichment that, if deemed safe by veterinary staff can be used in langur exhibits. Visual acuity of langurs and other primate species



is something to be utilized and built upon from an enrichment standpoint to encourage species-specific behaviors thereby increasing overall welfare.

Locomotive considerations

Allowing species-specific behavior is a major component of encouraging high levels of welfare (Kroshko and Mason, 2013). Largely arboreal, langurs are well-adapted to life in the trees, foraging high in canopies. Opportunities for langurs to forage at high levels, climb and leap from station to station as well as providing access to the ground will allow the animals to display a wide range of locomotive behavior. Setting up exhibits with multiple branch-like areas for climbing, ropes to balance on and options for vertical scaling, opportunities for short leaps and even brachiation, increases the amount of species-specific behaviors exhibited.

In cases such as zoos, however, considerations for safety must be made. Having an exhibit with a high ceiling and high-reaching furniture within it could also potentially prove dangerous to animals in human care. Safety concerns for these langurs should be covered before introducing any animals into an exhibit where a fall risk is high. Nets below high platforms and escape routes must be figured into exhibit design. As social animals, langurs will naturally

chase and interact with each other in ways that are not necessarily positive. As such, if an animal gets into trouble, a safe escape route away from an aggressive conspecific could mean the difference between an animal injured in a fight and an animal with a safe way out to friendlier conspecifics. In an exhibit with a high ceiling, fall risk is high, so safety nets under high beams must be installed to prevent a fatal or injurious fall.

Providing species-specific behavior in this regard is not only beneficial to the animals in the exhibit, but to visitors viewing the animals as well. Demonstrations of adaptations of langurs to an arboreal environment could be a phenomenal experience for a zoo guest. Encouraging utilization of the entire exhibit can be achieved with placement of browse and enrichment in key areas of the exhibit. While this is not an immediate and direct welfare issue, the potential for further-reaching consequences of the guest experience are immeasurable. Langurs in zoos acting as ambassadors to their wild counterparts by displaying natural behaviors in a captive environment could inspire change in zoo visitors. Encouraging guests visiting zoos to spend more time at an exhibit with active animals could increase interest in that species and hopefully contributions of time or money towards langur conservation causes.

Considering social structures

One of the most crucial factors of animal welfare is ensuring each animal has appropriate contacts with conspecifics, should it be a social species (Kroshko and Mason, 2013). For a social animal, the expression species-specific behavior in a group is critical from both a welfare standpoint and a conservation standpoint (Wickins-Drazilova, 2006). Many langur species are endangered, and the opportunity to express normal social behaviors can include mating and hopefully successful birth and rearing of young. In cases of endangered species, each individual is valuable from a conservation and genetic standpoint. Because many langur species exist normally in groups of 40-50 individuals, recreation of a normally-sized group in a zoo environment would be logistically difficult as most zoos do not have adequate space for a group that size. However, smaller groups of some langur species have been seen in the wild and breeding successes are likely not dependent upon group size (Little and Sommer, 2002).

Zoos housing langurs should encourage their animals to display as many species-specific behaviors as possible, but there are a number of those behaviors that could result in injury or death to individuals. Aggressive interactions between males occur in the wild with some

frequency and can result in the death of one or more of those individuals (Minhas et al., 2010). These aggressive interactions become even more difficult to manage in zoos due to the fact that there may be nowhere for a subordinate male to run to escape from a rival male, potentially resulting in severe injury or death. While some aggressive intraspecific interactions are normal and occasionally result in injury to conspecifics, minimizing injurious aggression as much as possible is important for the overall welfare of captive animals. Depending upon the species and their behavior in the wild, a recommendation may be made to keep group structure to a single-male hierarchy to reduce the amount of male-male aggression that could occur. Appropriate social interaction can be further facilitated and encouraged by increasing the amount of environmental enrichment, reducing distress and increasing eustress through enrichment (Little and Sommer, 2002).

Conclusion

Considerations of natural history and evolution in any species of animal must be fully considered before housing that species in a zoo. When discussing the dietary requirements of animals like langurs, providing appropriate amounts of fiber to ensure proper stool quality can be facilitated by feeding fresh browse as well as other high-fiber items (Joeke, 2006). Zoos with long winters and large numbers of deciduous trees may want to reconsider housing folivorous species of animals without a means of finding adequate replacement of the fresh browse. Some zoos with long or difficult winters collect and make silage to accomplish this and their nutritional studies have found it adequate for some non-primate ruminant species (Hatt and Clauss, 2006).


Old world monkey species have evolved the ability to see their world in full color and, while that has coincided with something of a loss of olfactory ability, both senses should still be considered when designing and adapting enrichment for langurs. Langurs spend most of their time foraging and resting to digest; as such, activity budgets and naturally evolved abilities should be considered when designing enrichment programs for these animals (Southwick and Siddiqi, 1974). Encouraging natural climbing abilities at many levels of the exhibit including substrate should also be examined. Locomotive abilities of langurs is largely dependent upon species, but many langurs do spend a portion of their day on the ground and should be stimulated to do so by providing opportunities for enrichment on those levels.

Overall high welfare of zoo animals has shown to increase breeding successes, longevity and positive impressions on zoo visitors (Kroshko

and Mason, 2013, Wickins-Drazilova, 2006). The specialized evolution of langurs and other colobines to their arboreal environment should be a large factor when trying to achieve standards of care to ensure high welfare in these captive animals, especially for endangered langurs. Animal care specialists in zoos are encouraged to research, and provide for the animals in their care from a standpoint incorporating the animals' natural history and evolution to achieve care and conservation goals.

Works Cited

- Bloch, J.I., and D.M. Boyer. 2002. Grasping primate origins. *Science* 298:1606-1612.
- Byron, C.D., and H.H. Covert. 2006. Unexpected locomotor behavior: brachiation by an Old World monkey (*pygathrix nemaeus*) from Vietnam. *Journal of Zoology* 263(1):101-106.
- Chapman, C.A., and J.M. Rothman. 2009. Within-species differences in primate social structure: evolution of plasticity and phylogenetic constraints. *Primates* 50: 12-22.
- Choudhury, A. 2008. Primates of Bhutan and observations of Hybrid Langurs. *Primate Conservation* 23:65-73.
- Eakins, A. 2010. Ontogeny of positional behavior in captive silvered langurs (*Trachypithecus cristatus*). *n.p.*
- Fernandez, A., and M. Morris. 2007. Sexual selection and trichromatic color vision in primates: statistical support for the preexisting-bias hypothesis. *The American Naturalist* 170:10-20.
- Gilad, Y., V. Wiebe, M. Przeworski, D. Lancet, and S. Paabo. 2004. Loss of olfactory receptor genes coincides with the acquisition of full trichromatic vision in primates. *Biology* 2(1):120-126.
- Groves, C.P. 2007. Speciation and biogeography of Vietnam's primates. *Vietnamese Journal of Primatology* 1:27-40.
- Hatt, J.M., and M. Clauss. 2006. Browse silage in zoo animal nutrition: feeding enrichment of browsers during winter. *Second European Zoo Nutrition Conference*, (p. 11). Zurich.
- Huang, C., and Y. Li. 2005. How does the white-headed langur (*Trachypithecus leucocephalus*) adapt locomotor behavior to its unique limestone habitat? *Primates* 46:261-267.
- Joeke, N. 2006. Fibre intake and faeces quality in leaf-eating primates. *Thesis* 1-184.
- Kappeler, P.M., and C.P. van Shaik. 2002. Evolution of primate social systems. *International Journal of Primatology* 23(4):707-743.
- Kroshko, J., and G. Mason. 2013. Identifying "high welfare" versus "low welfare" species in zoo collections. *Journal of Applied Animal Welfare Science* 16(4):386-387. doi:10.1080/10888705.2013.827932
- Kudo, H., and R.M. Dunbar. 2001. Neocortex size and social network size in primates. *Animal Behaviour* 62:711-722.
- Little, K.A., and V. Sommer. 2002. Change of enclosure in langur monkeys: implications for the evaluation of environmental enrichment. *Zoo Biology* 21:549-559.
- Minhas, R.A., K.B. Ahmed, M.S. Awan, and N.I. Dar. 2010. Social organization and reproductive biology of Himalayan grey langur (*Semnopithecus entellus ajex*) in Machiara National Park, Azad Kashmir (Pakistan). *Pakistan Journal of Zoology* 42(2):143-156.
- n.a. (n.d.). *Animal Husbandry and Welfare*. Retrieved from AZA.org : <https://www.aza.org/animal-husbandry-and-welfare/>
- Schmitt, D. 2003. Substrate size and primate forelimb mechanics: implications for understanding the evolution of primate locomotion. *International Journal of Primatology* 24(5):1023-1039.
- Schwitzer, C., and W. Kaumanns. 2001. Body weights of ruffed lemurs (*Varecia variegata*) in European zoos with reference to the problem of obesity. *Zoo Biology* 20(4):261-269.
- Southwick, C.H., and M.F. Siddiqi. 1974. Contrasts in primate social behavior. *BioScience* 24(7):398-406.
- SurrIDGE, A.K., D. Osorio, and N.I. Mundy. 2003. Evolution and selection of trichromatic vision in primates. *Trends in Ecology & Evolution* 18(4):198-205.
- Tague, R.G. 2002. Variability of metapodials in primates with rudimentary digits: *Ateles goffroyi*, *Colobus guerza*, and *Perodicticus potto*. *American Journal of Physical Anthropology* 117(3):194-208.
- Wickins-Drazilova, D. 2006. Zoo animal welfare. *Journal of Agricultural and Environmental Ethics*: 19(1):27-36.
- Wielebnowski, N. 2003. Stress and distress: evaluating their impact for the well-being of zoo animals. *Journal of the American Veterinary Medical Association* 223(7): 973-977.
- Zhang, J. 2006. Parallel adaptive origins of digestive RNases in Asian and African leaf monkeys. *Nature Genetics* 38(7): 819-825.

Photos by Leah Perlman. 

Golden Lion Tamarins: Help Track Tamarins in the Wild!

Kenton Kerns

Biologist, Small Mammal House, Smithsonian's National Zoological Park
Board Member, Save the Golden Lion Tamarin

A GLT in Brazil wearing a radio collar.



Golden lion tamarins (GLTs) are small, charismatic primates endemic to the Atlantic Coastal Forest in Brazil. They are found roughly two hours outside Rio de Janeiro city. As recently as 1970, there were only an estimated 200 golden lion tamarins left in the wild. The main causes for their decline include the loss of their Atlantic Coastal Forest habitat due to logging for agriculture, cattle farming, and urbanization. Now, just 7% of the Atlantic Coastal Forest remains, leaving only 2% of the original GLT habitat. To further confound GLT conservation, hundreds of GLTs fell victim to the pet trade in the 1970's. Today the Brazilian government has enforced harsh fines and jail time for poachers thereby reducing the threat of the pet trade.

In the early 1970s, a number of conservation organizations, including the National Zoo, joined forces to support the call for help from Brazilian scientists observing the crash of the GLT population. A multi-faceted approach involving people and resources from around the world was implemented to stop loss of GLT habitat and bolster their numbers. The GLT conservation program is considered a model for other organizations because of its comprehensive approach and success.

In 1992, Smithsonian's National Zoo's GLT Conservation Program morphed into a Brazilian non-government organization, Associação Mico-Leão-Dourado (AMLD; "Golden Lion Tamarin Association"). AMLD coordinates international efforts to conserve GLTs, and it implements a science-based plan to achieve targets for population survival and retention of genetic diversity. Together, AMLD's plan for *in situ* conservation of GLTs and the international plan for management of GLTs *ex situ* form an integrated arrangement for long-term survival of the species. Here are some of the elements of the two:

In situ

- **Monitoring and management of the *in situ* population.** AMLD systematically monitors 15 breeding groups of GLTs and moves GLT groups as necessary to meet genetic and demographic goals for the managed "metapopulation."
- A **translocation** program for GLTs rescued from forest slated to be destroyed. These animals were moved to a biological reserve between 1994 and 1998.
- A **reintroduction** program moved captive-born animals to unoccupied habitat between 1984 and 2000. Reintroductions were stopped in the early 2000s due to a lack of unoccupied suitable habitat.
- An **education** program focuses on creating a conservation ethic and environmental awareness in local communities within the GLT geographic range, especially local teachers and their students.

Ex situ

- A **captive breeding** program, wherein GLTs in 138 zoos worldwide are scientifically managed to retain the genetic diversity of founders and be ready for reintroduction if need be.
- A focus on **education** opportunities throughout the world to tell the story of GLTs through interactions with zoos that care for tamarins, professional conferences and workshops, and classes for students.

The culmination of all these factors slowly but surely led to an increase in protected habitat, a decrease in habitat loss, and an increase in the number of GLTs in the wild. Most importantly, it created an understanding by people living in Brazil about their own endangered animal; prior to these conservation efforts, many Brazilians did not realize that GLTs were endemic to the Atlantic Forest and nowhere else. In 2003, GLTs became the first primate to be downgraded from Critically Endangered to Endangered. In 2014, new numbers for the GLT population were released: new census methods doubled estimates from about 1,800 to **3,200 GLTs in the wild!** There are another 500

Is your zoo interested in housing golden lion tamarins? Contact the International Studbook Keeper Jennifer Mickelberg (jmickelberg@zooatlanta.org) for husbandry information and possible placement options.

A GLT radio collar (from Holohil System Ltd.), GPS unit, and radio telemetry receiver.



GLTs in zoos around the world as part of the international studbook and cooperative breeding program.

Tracking Tamarins

In order to locate and follow tamarins in their dense Atlantic Forest habitat, AMLD biologists affix radio collars to one or two adults in a monitored family group. AMLD uses a telemetry receiver and antenna to locate the collar's unique "beep." Once located, the team follows a group and monitors their location behavior and any threats. A GLT family group can occupy 1.24 acres of Atlantic Coastal Forest, so radio telemetry is imperative for locating the animals. Staff in Brazil have been using radio collars to track tamarins for over 30 years for a number of reasons:

- **Monitor the health and size of the wild tamarin population.** Individuals in each group are identified, and a detailed account of births, deaths, and range of the group are logged, showcasing long-term pedigrees of GLT family groups.
- **Manage the wild tamarin population.** Translocated groups that were moved from threatened habitats to viable sites are tracked to study their acclimation to their new home, and staff is able to intervene if needed.
- **Detect threats to golden lion tamarins and their forest.** Staff members tracking tamarins are the first to know if a tamarin has been trapped or if their habitat has been encroached upon by fire or deforestation. Such issues are promptly reported to the Brazilian authorities.
- **Locate animals for ecotourism groups.** A few groups of tamarins have been released on privately owned forest, and ecotourists are invited to visit GLTs in the wild. In order to find them quickly and safely, staff members track the groups' radio collar signals.

What can you do to help?

It costs about \$10,000 annually to support the telemetry budget for golden lion tamarins. This includes 55 radio collars a year, radio telemetry receiver units and antennae, and GPS units. Each radio collar has a small battery so as to not weigh the tamarin down, but each one only lasts six months.

In 2015 we are kicking off a new program: Track-A-Tamarin! Our goal at Save the Golden Lion Tamarin is to raise \$10,000 by December 31st each year that can be sent directly to Brazil to support the continued tracking and monitoring of the wild GLT population.

We're excited to announce that Holohil Systems, the company that supplies the radio collars, has agreed to donate \$1,000 for every \$9,000 we collect!

We're challenging individuals and groups to think of creative ways to fundraise for GLTs and the Track-A-Tamarin campaign. Georgia AAZK raised over \$1,000 for GLTs at a Brazilian Bingo event earlier this year. Check out Save the Golden Lion Tamarin's website (savetheliontamarin.org) and Facebook page (facebook.com/saveglts) for much more information on Track-A-Tamarin. SGLT is the American sister non-profit to AMLD, and we are always looking for passionate individuals to share the story of GLTs and lead fundraisers and events for SGLT. 🐼

AMLD staff using an antenna to follow a GLT radio collar's signal.



Don't Squeeze the Jaguar: Voluntary Dart Training in Jaguar (*Panthera onca*)

Rachel Thayer
 Aquarist I
 Tennessee Aquarium
 (Former Keeper II at Chattanooga Zoo)

Lacey Hickle
 Veterinary Technician
 Chattanooga Zoo

It is widely agreed upon in the zoo field that animals which are sedated under less stressful conditions generally have fewer risks associated with sedation. Smoother induction leads to more stable patients and can mean smoother recovery. Under this premise, the primary jaguar keeper and veterinary technician sought a voluntary conditioned behavior that would create a positive and less stressful situation for administering sedation to one of the zoo's 2.0 jaguars (*Panthera onca*). Both jaguars had had issues with sedation in past physical exams, such as hyperthermia and slow recovery. The training began with both jaguars, but as the physical exam date approached, one individual, "Jean", was making more progress than the other, so the team decided to focus the training on "Jean". The other individual, "Phil", is currently being trained for this behavior.

Challenges:

While developing our planned approach, the training team faced several challenges. The jaguar holding facilities presented one of the largest obstacles. There are no chutes or squeeze sections to conduct training sessions. The dens also shift directly to the exhibit, so there are no exterior chutes or sections of fencing that could be utilized. One den had a section of mesh between it and the adjacent den, which was large enough to be used to train a *present side* behavior. This area became the training station.

Initially, the training began with the intention of training a standard voluntary injection behavior, using a *present side* behavior as the starting point. Problems arose when it appeared that neither jaguar was comfortable turning away from the keeper. Attempts were made in shaping *present side* by targeting the jaguars laterally, alongside the training station mesh. Both jaguars responded by walking in a side-step manner, but remained facing the keeper. The keeper also tried isolating just the head movement by targeting to the side in very small increments to attempt to train the jaguars to turn away, but this was also unsuccessful. It was clear the jaguars would need some sort of makeshift "squeeze" to assist in presenting their sides to the keeper.

Several arrangements of logs, cinder blocks, and landscaping timbers were tried to create the "squeeze" area, but none could hold up to the destructive nature of jaguars. Around this time, the keeper attended the Felid TAG 2014 meeting where a presentation was given showing a large, heavy-duty rubber trough used to train a *present side* behavior in

jaguars and other large felids. The keeper realized this could be used to create the "squeeze" needed to continue training. A large, rubber trough was soon incorporated into the set up, and the keeper began to shape the *present side* behavior.

The final challenge the training team faced was positioning the jaguar close enough to the mesh to either hand-inject with a needle and syringe or to use a pole injector (jab-stick). As with the keeper, the veterinary technician was also inspired by a colleague at a national conference. At the 2015 Association of Zoo Veterinary Technicians Annual Conference, a vet spoke about using a dart gun at close range rather than hand-injecting with a needle and syringe or jab-stick. For the safety of the animal, the dart pistol is charged to a low pressure, which releases the dart at a lower velocity than in normal darting situations. Using a dart increases the chance of administering the full dosage of medication rather than a partial. With a dart it usually stays lodged in the animal's skin and/or muscle, as opposed to the needle coming out if the animal moves away from the sensation of being hand-injected. Our training plan was adjusted to administering a voluntary close range dart behavior instead of a voluntary hand or pole-injection behavior.

Methods:

This behavior was trained using operant conditioning over a period of about a year and a half, though progress really began to be made after the incorporation of the rubber trough, about six months into training the behavior. A clicker was used as a bridge. The main reinforcer was hot dogs, due to their cost effectiveness and ease in spearing onto a feeding stick. However, the jaguar that completed the behavior has an exceptionally high food motivation, and the keeper found that any food reward was effective as a reinforcer for this individual.

Initially, the heavy-duty trough was set up approximately three feet away from and parallel to the mesh, creating a "squeeze" large enough for the jaguar to be in and not to feel confined. The ends were left open to give the jaguar the choice to leave the station at any time. Training began by using previously established *target* and *lay* behaviors. The jaguar was targeted into the area between the trough and the mesh, bridged and rewarded. Once comfortable with entering the squeeze area on cue, the jaguar was immediately cued to *lay*, bridged and then rewarded. *Lay* was added to the chain to keep the jaguar in position long enough to be darted. A large Saurus Egg enrichment ball, by Otto Environmental,

was moved to one end of the training station to be consistent with which side the jaguar could enter from.

As the jaguar became more comfortable with the training station (squeeze) and lying in the area, the trough was moved closer to the mesh, in increments of about six inches. These approximations continued until the trough was about one and a half feet away from the mesh. This distance seemed to be the limit of this jaguar's comfort with confinement.

At this point in the training the vet tech participated in training sessions as the second trainer. Two trainer sessions began with the keeper targeting the jaguar into the squeeze and asking to *lay* as normal, while the vet tech slowly approached the mesh. This progressed to the vet tech kneeling in front of the jaguar's hip. When the jaguar was comfortable with this, the vet tech poked the hip several times with a metal skewer while the jaguar was continually reinforced as long as he stayed lying in position. Poking the hip was part of the training before the transition was made from injecting with hand or pole to a voluntary dart. Another factor in changing the behavior to *voluntary dart* was because the jaguar was not comfortable being confined in the small area necessary to bring him within reach of a syringe or pole.

When the training team opted to change the behavior from hand or pole-injection to voluntary dart, the behavior was still approached in a similar manner. The dart pistol to be used was by DANiNJECT. The vet tech began with bringing in only the CO2 chamber for the dart pistol, to test the jaguar's comfort level with the equipment. The jaguar was targeted into the squeeze as normal, and the vet tech slowly approached the mesh with the dart pistol chamber, while the jaguar was continually reinforced to keep him lying in position.

When the jaguar seemed comfortable with the dart pistol chamber, the vet tech brought in the dart pistol barrel and chamber, fully assembled. The jaguar had an immediate negative response to this, as if he recognized the dart pistol from previous sedations. The keeper utilized redirection by asking for her to follow a target to turn her focus back to training while the vet tech disassembled the pistol's barrel and chamber. With the pistol in two separate pieces, the jaguar was willing to cooperate with the training session and targeted into the squeeze and lied down. The keeper continually reinforced the jaguar while the vet tech approached with the pistol in separate pieces.

The final step was to bring the jaguar into the squeeze, ask him to *lay*, and continually reinforce as the vet tech approached with the pistol in two pieces, assembled it as she got to the mesh, and was able to line up a shot at the jaguar's hip and release the trigger multiple times without charging the pistol. The jaguar would sometimes turn to look at the vet tech or the pistol, but never chose to leave the training session.

On the day of the annual physical exam, the training went just as the training team hoped. The dart with the sedative was preloaded into the barrel of the dart pistol. The jaguar calmly came into the squeeze, laid down, and stayed in position as the vet tech approached, assembled the pistol and charged it to about 1.5 bar of CO2, took aim with the end of the barrel about a foot away from the jaguar's hip, and expelled the dart. Unfortunately, the dart ejected from the needle on impact, so a full injection of sedative did not occur. The training team suspected that the dart had been previously used, which can lead to issues with the dart and needle staying intact. However, the jaguar needed more medication to be fully sedated for the exam. All in all, three darts had to be used to fully sedate the jaguar, so a second dart at least would have been needed to sedate the jaguar, even if the initial dart had stayed intact and given a full dose of sedative.



Training station set up (Photo by Rachel Thayer)



Targeting the jaguar into station. (Photo by Rachel Thayer)



The vet tech approaches and assembles the dart pistol. (Photo by Rachel Thayer)



The vet tech aims the assembled dart pistol while the keeper reinforces the jaguar. (Photo by Rachel Thayer)

Conclusions and Recommendations

The training team feels that the voluntary dart behavior was successful in that it was trained to completion and allowed for the initial dart to be given under low stress for the jaguar. The keeper would also like to note that in the first training session following the physical exam, which occurred about two days later, the jaguar came into the squeeze and fully participated in the voluntary dart behavior without any regression. Currently, the zoo's other jaguar is being trained for voluntary dart, with an expected annual physical in late fall.


From this experience, the training team offers the following recommendations:

Keepers should strive to maintain a great working relationship with vet staff. Vet staff can be instrumental in not only suggesting new health related behaviors to train, but can also be an integral part of the training

itself. This cooperation will be beneficial to both parties and to the welfare of your animals.

Participate in workshops and conferences and learn from what colleagues are doing at their respective institutions. If you feel your ability to train is hindered by your facilities, try some creative solutions. Think outside the mesh! Always use a new dart, especially if you may only have one chance to sedate the animal.

Acknowledgments

We would like to thank our General Curator, Stacy Laberdee, our Veterinarian, Dr. Anthony Ashley, and Training Coordinator, Tawnya Williams, for their support and encouragement in pursuing this training. We would also like to thank our colleagues from Felid TAG and AZVT for their helpful tips and inspiration. 

BHC Comments by Kim Kezer

Many times we are presented with an animal that is distracted by an unexpected stimulus during a training session. It is our job as trainers to be aware of our surroundings at all times and be prepared to manage what can influence the animal's sudden change in behavior. When an animal is in a state of emotional arousal we need a teaching technique to redirect their focus back to training. In the jaguar's case, she was distracted by the presence of the fully assembled dart pistol. Seeing her reaction, the trainer quickly redirected her focus off of the pistol and onto doing other behaviors.

When an unforeseen event happens, depending on the situation, I like to let the animal acknowledge the distraction so they can learn to cope with unexpected events and that this is no big deal. Your plan should be adjusted depending on their level of intensity to the distraction. If it is just a matter of getting them busy doing something else like a simple target, while in the presence of this distraction, then redirection is a perfect approach. If the animal's level of intensity provokes an extreme adverse reaction or a shutdown of the training session, you have more work ahead of you and desensitization training would be in order. Habituation to a frequently repeated stimulus, for example service trucks driving by while training, is another way of developing those coping skills to diminish an undesired response.

Collaboration, sharing of ideas and professional development is such a fabulous part of what AAZK does. By going to National Conferences you can participate in hands-on workshops, in addition to attending paper and poster presentations you can walk away with some excellent ideas to take back to your facility. You never know how one small idea can be adapted to be useful for another situation. I wonder how the jaguar training would have proceeded if both the keeper and the tech did not have these experiences to share after returning from their conferences. I would wager that something similar would have developed eventually, but seeing the success others had using a tub in a similar situation demonstrated easy implementation. By sharing this Training Tale with the AAZK membership some of you may take away, "Hey, that's a great idea" and "Thanks for the tip about the dart!" This is the spirit of what we hoped these Training Tales would be. Sharing the smallest experiences can go a long way to help provide ideas to our peers. Congratulations on your success and thank you for sharing your Training Tale with us!

We want to hear your Training Tales

– the good, the bad and the fabulous!

Please submit your "Training Tales" and experiences in operant conditioning to share with *Animal Keepers' Forum* readers. This opportunity provides a convenient outlet for you to exhibit your training challenges, methods and milestones with the AAZK member network.

Please submit entries based on the following guidelines:

- ▶ Submit a brief description of a training project at your facility. These can be 500 words or less, in text or bullet points – it can be longer (up to 1000 words); however, short and simple descriptions with a few images are just as perfect. Details should include the following:
 - Define the training goal (what did you try to do and for what purpose?)
 - List important steps (How did you do it – include plans that changed along the way/what worked and what didn't work)
 - Timeline used (how long did it take)
 - Tips you learned along the way
- ▶ Include 3-5 digital photos that clearly depict the animal in the learning process or performing the desired goal (provide photo caption and photographer of each image). Photos need to be 300 dpi and at least 1200 x 1800 pixels.

Please send entries or questions to:

Kim Kezer at kkezer@zoonewengland.com or
Shane Good at
shane.good@aazk.org

(use Training Tales Submission as the subject)

Professor in the Zoo

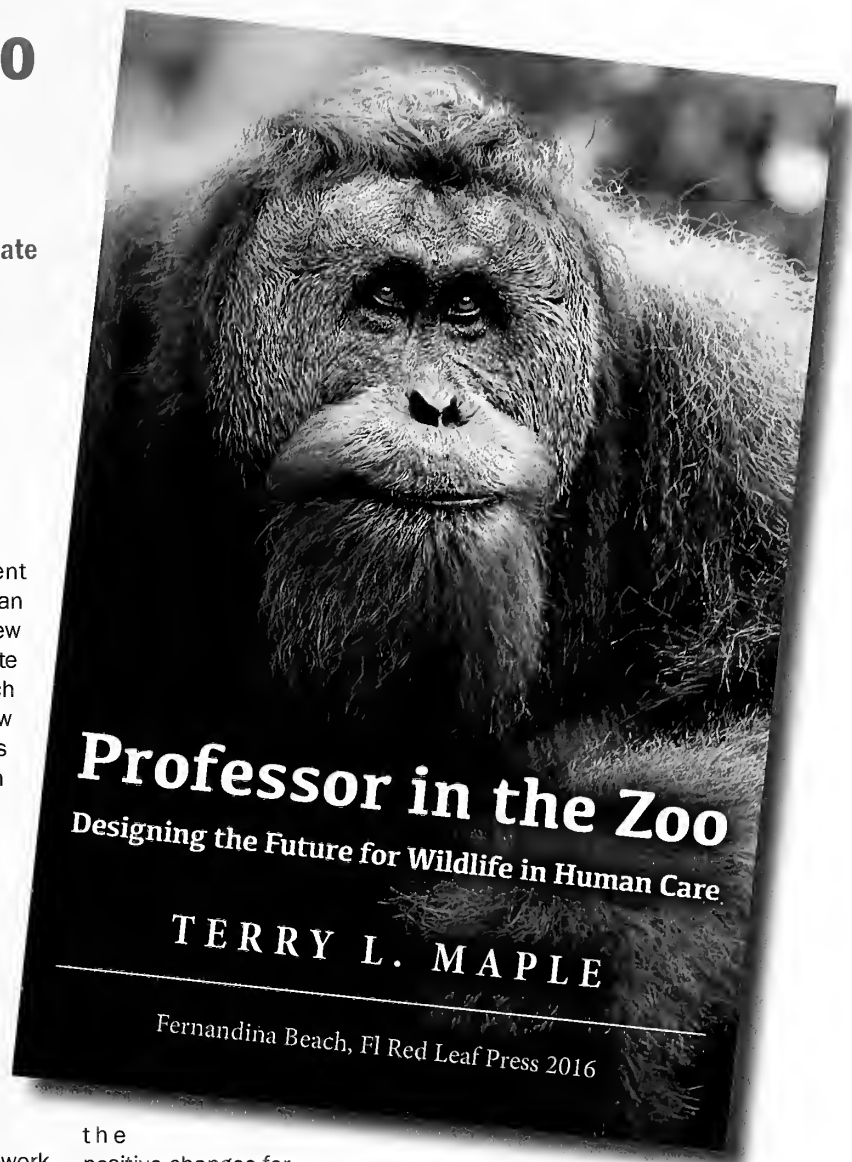
by Dr. Terry Maple

Reviewed by Austin Leeds, Graduate Research Associate
Cleveland Metroparks Zoo

Dr. Terry Maple, the retired director of Zoo Atlanta and current Professor in Residence at the Jacksonville Zoo, has made more than his fair share of changes in zoos. The epilogue of Dr. Terry Maple's new book *Professor in the Zoo* (Red Leaf Press, 2016) opens with a quote from the famous children's book *If I Ran the Zoo* by Dr. Seuss which reads "But if I ran the zoo, said young Gerald McGrew, I'd make a few changes; that's just what I'd do." No quote is more fitting to end this book written as both a memoir of Dr. Maple's career as well as an informative reference on how to effectively manage modern zoos. In this book Dr. Maple discusses the current state of zoos, using his past experience at Zoo Atlanta as an anecdote for where the field has come from, and his current work in progress at Jacksonville Zoo to discuss where the zoo profession is (or should be) headed.

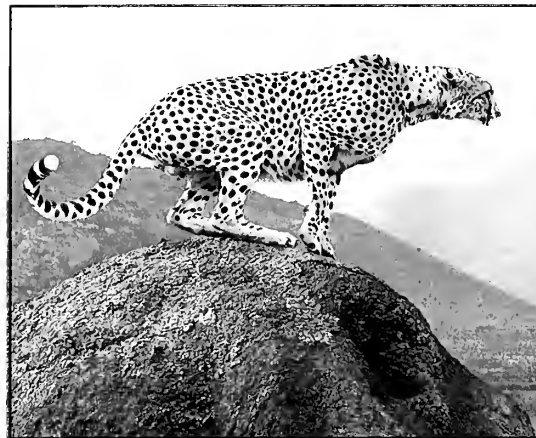
Throughout this book, as well as previous works, Dr. Maple emphasizes the need for what he calls empirical zoos, or zoos that are managed based on data and evidence. Using his time at Zoo Atlanta as a blueprint for others, Dr. Maple discusses not only how he built such an empirical infrastructure into Zoo Atlanta but also discusses the advantages this system had for animal care, conservation, and public image. The outcomes of such a framework have benefits for all staff in zoos – not just directors. An empirical-based system allows for the optimization of everything from providing optimal animal enrichment to managing guest experience. While Zoo Atlanta was fortunate to have a wealth of academic and research institutions nearby to help with the initial capacity building, this book provides insight into how any zoo in any region can form collaborations and build internal capacity to develop an empirical framework by which to operate. As zoos continue to evolve into conservation and welfare-focused organizations, the need for increased empiricism will expand. In *Professor*, Dr. Maple discusses how this is truly possible for all zoos, and how individuals at all levels within zoos can contribute.

Throughout this detailed yet easy to read book, Dr. Maple covers a wide range of topics with a strong focus on animal welfare and conservation advocacy supported by his empirical framework. Of particular interest to zoo professionals should be two back-to-back chapters, the first focusing on elephants in zoos and the next focusing on cetaceans in zoos and aquariums. The juxtaposition of these two chapters is significant and Dr. Maple discusses these two separate but related topics quite eloquently. Elephants, a strong example of what zoos can do to provide optimal environments for animals, demonstrate how a focus on research and collaborative partnerships have shaped a whole new management and husbandry philosophy over the last 20 years. Looking even further back,



the positive changes for elephants underway in zoos are a mirror of the changes for great apes, specifically gorillas and orangutans, that Dr. Maple initiated at Zoo Atlanta in the 1980's (a thorough discussion of which occurs throughout *Professor*). Cetaceans are the next chapter (figuratively and literally) of change in zoos and aquariums. What that change will be is unknown at this time, but Dr. Maple's discussion of this delicate topic, focusing evenly on the issue, provides strong discussion points on what should be emphasized moving forward. This is a necessary read for zoo professionals as the changes that have occurred with great apes and elephants, which are now focused on cetaceans, will likely continue on to different species in the future. To date, no better written description of the issue and opportunities for growth and improvement are available.

Professor in the Zoo is a unique book, but what separates this book from others is the diversity of topics covered, the important and timely discussions generated within its chapters, and the ease by which it can be read by anyone. *Professor* is a memoir of the over 30 year career of Dr. Terry Maple and a reference for zoo professionals at any level on how they can bring empirical decision making into their daily work. *Professor* is a history of zoos over the last 30 years and an in-depth discussion of where zoos could be headed in the future. *Professor*, like all of Dr. Maple's books, is a must read for any zoo professional. 🐘



Membership with the American Association of Zoo Keepers includes a subscription to the *Animal Keepers' Forum*, member rates for AAZK events and products, access to the Members Only section of aazk.org, plus much more!



Join today at AAZK.ORG

BIG CAT INTERNSHIPS AVAILABLE



Join us in

"Saving Tigers One by One"
As seen on Animal Planet®
"Growing Up Tiger"



Learn about Big Cat Management. Internship involves Animal Care Apprenticeship and Public Education. We offer experience that counts towards employment.

TIGER MISSING LINK FOUNDATION • TIGER CREEK WILDLIFE REFUGE • Apply at: www.tigercreek.org



CONSULTING & DISTRIBUTING, INC.

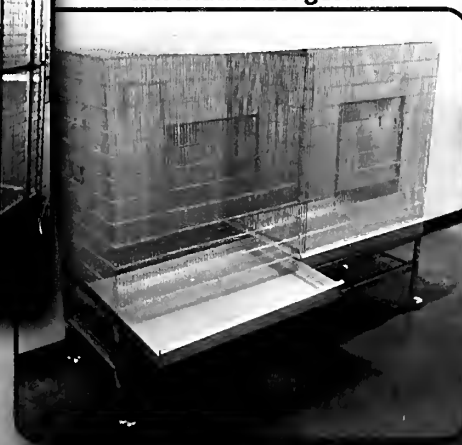
Call us for all of your caging requirements!



Cut & Clip Class III Caging



Utility Caging



8620 E Old Vail Road, Suite 100
Tucson, AZ 85747
P: (520) 434-8281
F: (520) 434-0151
www.athruzcages.com

ASSOCIATION OF ZOOS & AQUARIUMS





Lyon ProCare Critical Care Units

The Lyon ProCare CCU assists veterinary professionals in providing the best oxygen therapy care to a variety of animals.

Our largest units (CCU 48 and 60) were designed with leading practitioners for larger animals such as chimpanzees to meet the demanding needs of critical care, proven by years of actual use in veterinary hospitals, emergency clinics, teaching hospitals, rescue facilities and zoological institutions.

The goal of oxygen supplementation is to increase the oxygen concentration of inspired air, improve blood oxygenation, and increase tissue delivery of O₂.

Lyon's Critical Care Units are great for avian and exotic patients because they are low stress and noninvasive. It is the go to unit for thousands of veterinary professionals world wide.



CCU Bank: 18,36 and 60

DIMENSIONS:

ProCare CCU 18: 22 ¼ W x 22 H x 23 D P/N 912-120

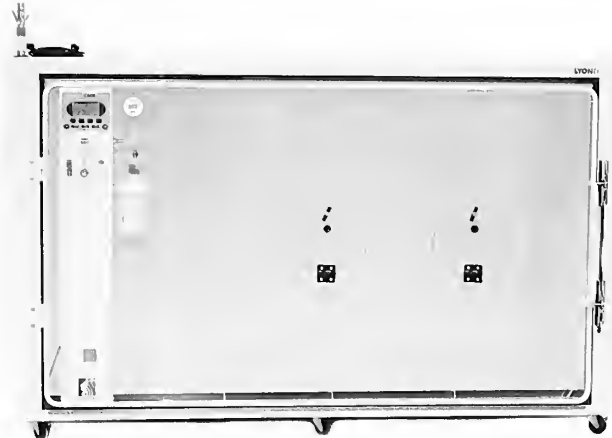
ProCare CCU 24: 28 ¼ W x 27 H x 23 D P/N 912-103

ProCare CCU 36: 40 ¼ W x 27 H x 23 D P/N 912-104

ProCare CCU 48: 52 ¼ W x 33 H x 25 D P/N 912-140

ProCare CCU 60: 66 ¼ W x 39 H x 31 ½ D P/N 912-119

*All dimensions are in inches by Width X Height X Depth
*Specifications subject to change without notice



ProCare CCU 48 912-140

STANDARD FEATURES

- 5 Sizes
- Double Walled, Insulated all Metal Construction
- Powder Coated for Superior Durability
- Digital Display
- Relative Humidity Display, Monitoring and Alarm
- Passive Cooling System
- Oxygen Induction System
- CO² Scrubbing
- Easy Lift Removable Door
- Auxiliary Access Port(s) depending on unit size
- IV Tube Access with Integrated Bag Holder
- Interior LED Lighting
- Nebulizer System
- Removable Floor
- Optional Cart with Storage Shelf and Casters
- Lyon TrueDimension™ Sizes are Actual Interior Useable Space
- Oxygen Inlet Terminated with DISS 1240 Male Adapter



8476 E. Speedway Blvd.
Suite 204
Tucson, AZ 85710-1728
U.S.A.

ADDRESS SERVICE REQUESTED

Non Profit Org
U.S. Postage
Paid



"Dedicated to
Professional Animal Care"



*****AUTO**3-DIGIT 200
P1 S8
Smithsonian Institution Library
Nhb 25 Mrc 154
PO Box 37012
Washington DC 20013-7012

 facebook.com/AAZKinc

 @AAZKinc

Sound Nutrition for Nature's Royalty



Central Nebraska Packing, Inc. offers:
Classic & Premium Frozen Carnivore Diets

• ALSO AVAILABLE •
HORSE SHORT LOINS / HORSE & BEEF BONES
MEAT COMPLETE WITH TAURINE (RAW MEAT SUPPLEMENT FOR ALL CARNIVORES)

MEMBER: AZA | AAZV | AAZK

NEBRASKA BRAND



877.900.3003 | 800.445.2881
P.O. Box 550, North Platte, NE 69103-0550
info@nebraskabrand.com • nebraskabrand.com

FELINE & SENIOR FELINE | BIRD OF PREY | CANINE | SPECIAL BEEF FELINE