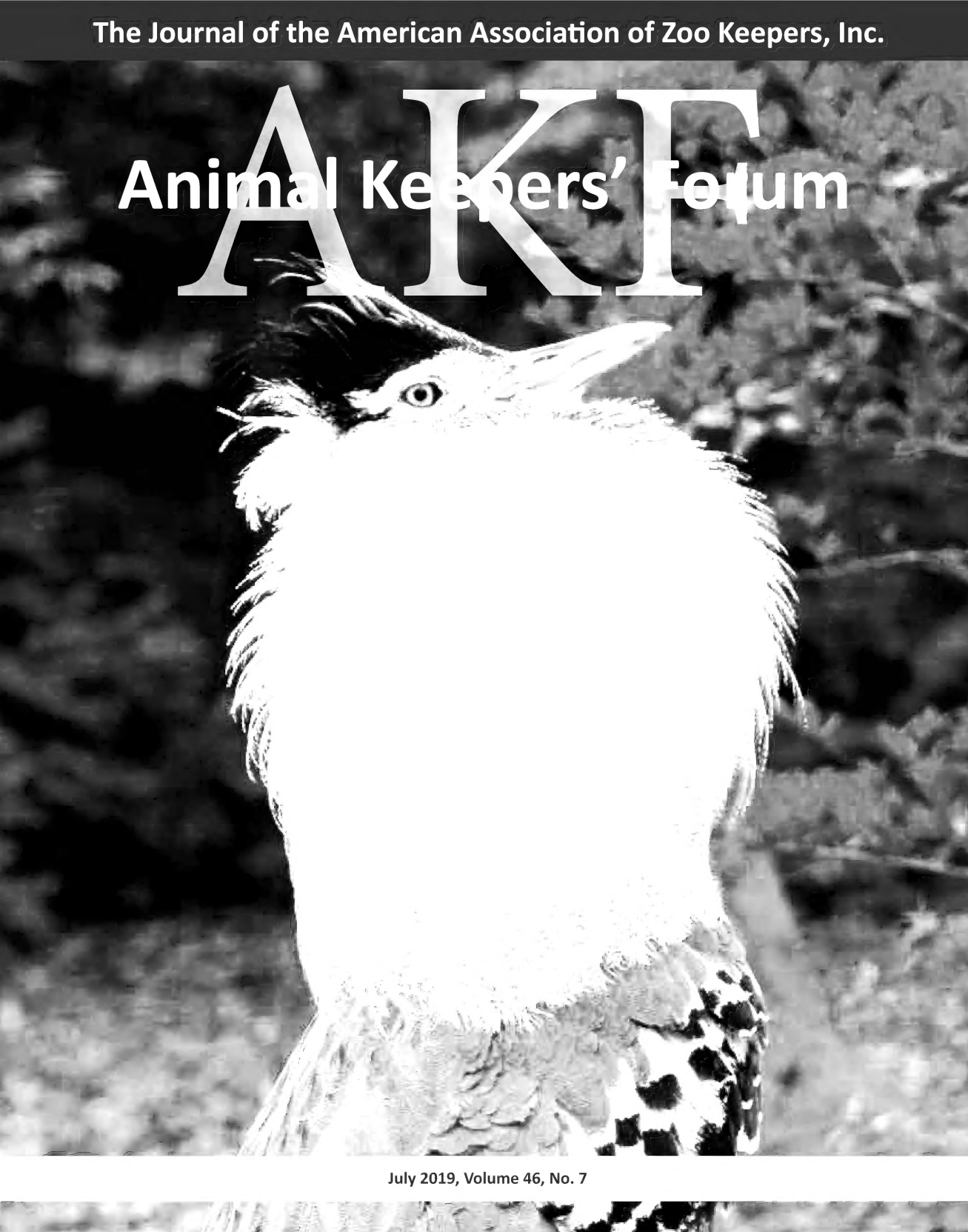


The Journal of the American Association of Zoo Keepers, Inc.

AKF

Animal Keepers' Forum



July 2019, Volume 46, No. 7

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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 photo comes to us from Stephanie Earhart of Zoo Atlanta and features a Kori Bustard (*Ardeotis kori*). Kori bustards are very large, ground-dwelling birds that eat a variety of insects, small animals and some plants. The males are among the heaviest of all flying birds. Rarely flying, and never migrating, these birds stalk the savannas looking for any large insect or small animal to eat and will also consume fruits, flowers, as well as dig up roots of specific nutritive plants. The males attract the females with their deep booming calls, and they show off their plumage to full effect during elaborate courtship displays. Chicks take five years to mature, and adults may live more than 30 years. The species exists in two separate areas of Africa, and those populations in eastern Africa and southern Africa are somewhat physically distinct, indicating that they rarely, if ever, interbreed. Recent threats from large-scale agriculture and the bushmeat trade have resulted in sudden declines in this species.

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.

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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

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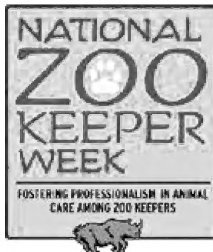


Don't forget to use the following hashtags as you join the collaborative voice of keepers on social media:

#ImAKeeper

#KeepingItReal

#NZKW2019



Please join me in welcoming three new members to the AAZK Board of Directors. James Weinpress and Kristen Scaglione, who were nominated by the membership and appointed by the Board of Directors, will be officially sworn in at the conclusion of the AAZK National Conference this August in Indianapolis. James and Kristen will serve a four-year term on the Board.

In a special call for nominations to fill a term vacated by the resignation of Hardy Kern, Abbie Doan was elected to the Board and her term will end in 2021.

Their biographies are included on the opposite page.

Annually, during the third week of July, we recognize National Zoo Keeper Week. This is our opportunity as animal care professionals, to share our stories, highlight our teams, and engage with members of our community, facility and staff. As you participate in National Zoo Keeper Week, I encourage you to consider this year's theme – Keeping It Real: A Keeper's Life Beyond the Dirt. Don't forget to use the following hashtags as you join the collaborative voice of keepers on social media with **#ImAKeeper**, **#KeepingItReal**, and **#NZKW2019**.

"Each of us brings a different skill set with us when we enter the field of animal care. As we forge the pathways that define our careers as animal care professionals, we develop our passions, and dedicate our actions to wildlife conservation both locally and globally. A career as a keeper is not defined by the dirt on our boots, but in the opportunities in which we wore them".

Warm Regards,

Bethany
Bethany.bingham@aazk.org

New AAZK Board Members



Kristen Scaglione, Akron Zoo

Kristen has been a full-time keeper at the Akron Zoo since 2014. She currently works with carnivores, as well as penguins. Throughout her career, she has always been active within AAZK and has held many titles in the Akron Zoo Chapter of AAZK, including Chapter President for multiple years. She became involved with AAZK, Inc. as a member of the AAZK Resource Committee, becoming Vice-Chair shortly after. She is currently serving as the Program Manager of National Zoo Keeper Week. She joined AAZK just for professional development - what she got was so much more. She has learned invaluable things about our field, been a part of amazing projects and befriended some of the most passionate people she has ever met. "AAZK is an outstanding organization and I am a better keeper because of it. With my new role, I hope to help others have the same experience with it that I've had."



James Weinpress, Seneca Park Zoo

James Weinpress has worked in the field of animal care for over 10 years and has been fortunate to work with a wide range of species. He began his career in the Florida Keys, training dolphins and sea lions, and eventually moved west to Salt Lake City, where he worked with pachyderms and pinnipeds. James currently works as a Zoologist at the Seneca Park Zoo in his hometown of Rochester, New York where he oversees the California sea lion and African lion programs. James joined AAZK in 2015 as a member of the Communication Committee, fielding questions mostly from students contacting AAZK for tips on how to become a zoo keeper. In 2017 he became the Committee Chair, overseeing AAZK's social media platforms, organizational meetings, and membership correspondence. "My involvement with AAZK has played a significant role in my professional development, fine tuning my leadership, time management, and critical thinking skills. I've also had the honor of working with dedicated and passionate individuals within my committee, whose friendships I truly value."



Abbie Doan, Indianapolis Zoo

Abbie has spent her life land-locked in the Midwest but has always harbored a curiosity for the ocean. She attended Bowling Green State University in Ohio and majored in Biology with a specialization in Marine and Aquatic Science. She became a full-time animal care professional in 2008 at the Indianapolis Zoo as a marine mammal trainer. She has been incredibly fortunate to work with many species including seals, sea lions, walrus, dolphins and polar bears. As she has advanced through her zookeeping career she has taken a further interest in techniques in animal enrichment and continuing to help advance her institution into current best practices through our zoo's Behavioral Enrichment Committee. She joined the Indianapolis Chapter of AAZK during her first year as a keeper and has formed long-lasting friendships and gained valuable skills from the organization. She is incredibly proud that the Indy AAZK Chapter is hosting the 2019 AAZK National Conference in Indianapolis! She is looking forward to continuing her involvement with an organization committed to advancing the skills of the most passionate, dedicated and hardworking individuals in our field.

EMPLOYMENT OPPORTUNITY

American Association of Zoo Keepers Director of Professional Development and Conference Management (PDCM)

Part Time – Estimated 20-25 hours/Month

Remote Employment
\$500.00 Month/\$6000.00 Annual

Responsibilities

The AAZK Director of Professional Development and Conference Management facilitates the planning, implementation and monitoring of member learning opportunities for AAZK National Conferences and oversees site and program management for AAZK Conferences with our Host Chapters under the direct supervision of the CEO/CFO of AAZK.

The ideal candidate will develop a process for peer review of paper, poster and workshop abstracts submitted for presentation at an AAZK Conference along with coordination of abstract solicitation, sponsorship solicitation, program scheduling and digital application management with a strict adherence to associated timelines, deadlines and reporting. The candidate shall be responsible for compilation of program components into a proceedings for publication in AAZK media. The candidate will work to evaluate, develop and improve continuing education opportunities for AAZK Online. In addition, the position will provide customer service and oversight to AAZK Conferences that meet the goals and expectations of the membership. S/he must be able to communicate within time limits to assist in planning and scheduling the AAZK Conference Program with our Host Chapters. The abilities to multitask and prioritize are essential, as this role involves oversight of hotel contracts, room blocks, catering and banquet event orders, AV equipment, ground transportation, and scheduling of AAZK Conference Social Event programming.

Required Experience

A minimum of two years documented experience in holding an oversight position, leadership role or membership within the AAZK Professional Development Committee **combined** with advanced familiarity in the navigation and operation of AAZK Online, **combined** with serving as **Chair** of an AAZK Conference Host Committee.

Closing Date: **30 July 2019**

Cover letter, application detailing required experience and résumé may be submitted to:
Ed Hansen/AAZK
8476 E Speedway Blvd. Suite 204
Tucson, AZ 85710-1728
Ed.Hansen@aazk.org

Applicants will receive an acknowledgement that their application has been received by the closing date. Those candidates selected for further consideration will be reviewed by an independent party contracted by AAZK for candidate review and selection and final notification will be made prior to 15 August 2019.

AAZK is an equal opportunity employer and all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, disability status, protected veteran status or any other characteristic protected by law.

COMING EVENTS

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

August 4-8, 2019
17th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles - Tucson, AZ
Hosted by the Turtle Survival Alliance and the IUCN Tortoise and Freshwater Turtle Specialist Group. For more information go to: <https://turtlesurvival.org/2019symposium/>

August 26-28, 2019
Orangutan SSP Husbandry Workshop
Fort Wayne, IN
Hosted by the Fort Wayne Children's Zoo
For more information go to: <http://www.orangutanssp.org/2019-workshop.html>

September 7-11, 2019
AZA and IMATA Annual Conference
New Orleans, LA
Hosted by Audubon Zoo and Audubon Aquarium of the Americas
For more information go to: aza.org

September 22-27, 2019
ASSOCIATION OF ZOO VETERINARY TECHNICIANS Annual Conference
Colorado Springs, CO
Hosted by Cheyenne Mountain Zoo
For more information go to: <https://www.azvt.org/page-7741>

September 30 - Oct. 4, 2019
New World Primate TAG Husbandry Workshop
New Bedford, MA
Hosted by Buttonwood Park Zoo
For more information go to: <https://www.bpzoo.org/nwptag-conference-registration/>

October 7-11, 2019
Giraffe Care Workshop
Colorado Springs, CO
Hosted by Cheyenne Mountain Zoo
For more information go to: <http://www.cmzoo.org/index.php/giraffe-care-workshop/>

October 7-11, 2019
"From Good Care to Great Welfare" workshop
Detroit, MI
Hosted by Detroit Zoological Society's Center for Zoo and Aquarium Animal Welfare and Ethics. For more information go to: <http://www.czaw.org/events>

October 17-18, 2019
Animal Training Workshop
Kansas City, MO
Hosted by Kansas City Zoo
For more information go to: <http://kansascityzoo.doubleknot.com/event/kansas-city-zoo-animal-training-workshop/2502109>

April 4-9, 2020
AZA Mid-Year Meeting
Palm Springs, CA
Hosted by The Living Desert Zoo and Gardens.
For more information go to: aza.org/conferences-meetings



August 18-22, 2019
AAZK National Conference
Indianapolis, IN

Hosted by Indy AAZK and the Indianapolis Zoo

www.indyaazk.org

September 13-17, 2020
AZA Annual Conference
Columbus, OH
Hosted by the Columbus Zoo and Aquarium
For more information go to: aza.org/conferences-meetings

Utilization of Thermal Imaging to Monitor Progression of Pregnancy in Giraffe

*Kaitlyn Whisman Vanderwall
Nick Pottratz
Zoo Miami
Miami, Florida*

Introduction

Last holiday season, keepers at Zoo Miami worked together on a fund raiser. Ornaments were created utilizing disks of used giraffe browse, baling twine for hangers, and completed with a stamp of a giraffe calf. The fund raiser was a huge success and with help of some generous donations, we were able to purchase the E8 FLIR thermal imaging camera! This camera has been helpful for our veterinary staff to use as a diagnostic tool for many species and particularly for viewing issues with hooves. Acquiring the thermal camera for our facility also sparked interest in keepers to conduct research studies. Could we determine the date a giraffe would go into labor, based on temperature changes seen around the vulva?

Experimental Design

We began recording images of our 10-year-old Rothschild giraffe's vulva each morning, beginning 45 days before the projected due date. Each image was taken as closely to 7:30 am as possible. We found that the images were less likely to be impacted by the heat of the sun if they were taken early in the morning. The camera was set to a temperature scale of 31.9 degrees Celsius to 36.0 degrees Celsius throughout the study. Some data impacting factors of this study

may be due to sun exposure, ambient temperature, and giraffe activity level. Although we attempted to be as consistent as possible when collecting images, there were some outliers.

Overall Analysis

We hypothesized that vulva temperature would increase as we progressed closer to labor in the pregnant giraffe.

Image 2 was taken 10 days before birth and displays her stomach at around 33-34 degrees Celsius (an increase of at least 2 to 3 degrees Celsius). During this time, her vulva temperature was still reading close to 35 degrees Celsius; no change from previous recordings.

Image 3 was taken roughly 4 hours prior to birth. A large portion of her body shows temperatures around 34 degrees

Image 1. Taken 28 days before birth



Celsius, especially around her abdomen and hindquarters. There was a dramatic increase in the amount of surface area of the body that increased in temperature about 2 to 3 degree Celsius, yet the vulva still remained constant at around 35 degrees Celsius. No thermal images were taken during the birth process due to the time of day which was 11 to 11:30 am, which made environmental conditions inconsistent with previous measurement acquisitions.

Conclusion

Our hypothesis was not supported by the data- in fact, throughout the 45 days prior to labor, the giraffe's vulva remained almost consistently at 35 degrees Celsius. There were a couple days of higher readings that we consider to be outliers. Her lower abdomen began reading 33 degrees Celsius, a rise, at around two weeks before birth. The day she gave birth, a significant portion of her body increased in temperature. In conclusion, thermal imaging of a giraffe's abdomen may be an indicator of when a giraffe will give birth. This could be useful for predicting when a giraffe may go into labor in order to properly manage the herd for the birth event.

Just the Start!

Zoo Miami would like to increase the sample size of this study with our other breeding female Reticulated giraffes in order to determine if this is a common occurrence in giraffe or simply an individual result. Keepers are also hoping to expand this study to other ungulate species.

Acknowledgements

Ron Magill for his assistance in obtaining the thermal camera and his support.



Image 2. Taken 10 days before birth

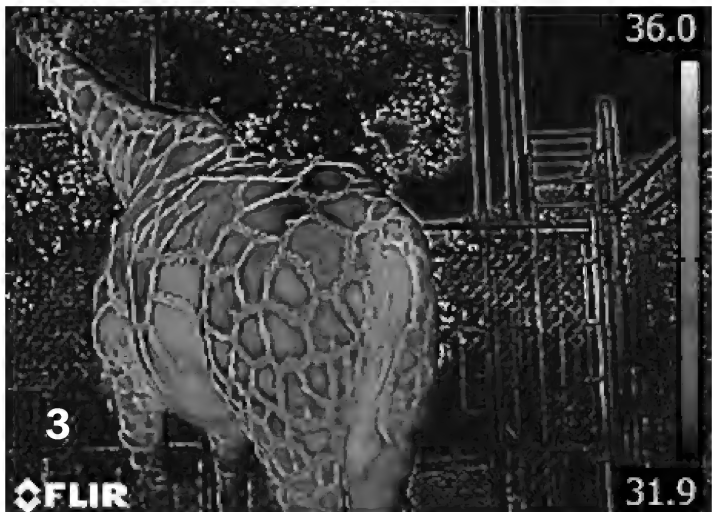


Image 3. Taken about 4 hours before labor

Reality Check: Complications and Complexities Involved with Contraception and Assisted Reproductive Technology Application in Wildlife

David M. Powell, Director of Research, Saint Louis Zoo, Director, AZA Reproductive Management Center
Cheryl S. Asa, Chair, AZA Reproductive Management Center Advisory Board

Back in 2014 one of us (D.P.) did a nationwide survey of keeper attitudes regarding population management euthanasia or culling. Our quantitative results from the survey were published (Powell & Ardaiole, 2015, Powell & Ardaiole, 2016). In several parts of the survey, we solicited comments from keepers about the practice. A book chapter based on those comments is in press (Powell & Ardaiole, in press), and in reviewing those comments, we found a number of comments from keepers regarding their general preferences for more use of contraceptives, more research on contraceptive options, and more use/broader application of assisted reproduction techniques, in lieu of culling. Some of these comments were as follows:

"we might as well start implanting females with sperm that is of the proper sex and from the desirable mate"

"artificial insemination is an option in many species"

"I would encourage broader use of contraceptive methods"

"Contraception may put fertility at a risk... but it is just a risk"

"Better contraception, and more breeding technology should be the focus rather than breeding and culling"

"We should be exploring options for contraception"

We wanted to offer our perspective on some of these comments and provide some insight regarding some of the challenges with applying contraception and assisted reproduction technology (ART) to population management.

Contraception

One of the roles of the AZA Reproductive Management Center is to provide information to AZA-accredited zoos and aquariums about contraceptive products and applications. The RMC is always on the look-out for developments in wildlife contraception, whether it is development of new products, studies of reversibility/efficacy/side effects, or regulatory issues. We also monitor contraceptive use in AZA and compile data that are analyzed periodically to address concerns about contraception (e.g. Asa et al., 2014;

Larson et al., 2013) or to monitor trends in use (e.g. Agnew et al., 2016).

One of the major challenges in providing safe, effective, and reversible contraception [and other types of drugs] for wildlife species is that the commercial market is too limited from the perspective of pharmaceutical companies. There are many target species of interest and not enough of each in zoological institutions or the private sector to make it profitable for a pharmaceutical company to invest the time and money in getting a contraceptive product for these particular species (or even very closely related wildlife species) to market (Moresco & Agnew, 2013; L. Rhodes, pers. Comm.). The number of drugs that are FDA-approved for use in animals is much smaller compared to the number of drugs approved for people. Additionally, these drugs are approved for a very small number of species. Veterinarians often find that for "minor species" (species other than horses, dogs, cats, cattle, pigs, turkeys, and chickens) in their practices there are few to no drugs approved for use (<https://www.avma.org/KB/Resources/FAQs/Pages/ELDU-and-AMDUCA-FAQs.aspx>). More on this later. Our

consultants within the RMC estimate that the cost of bringing new drugs for cats and dogs to market through the FDA approval process costs \$10-12 million and requires 7-9 years for long-acting compounds that are more difficult to manufacture (e.g. contraceptive implants). If the drug is intended to be used in animals consumed by humans, the price jumps to \$40 million and the time frame stretches to 15 years. This is relevant because drugs developed for livestock species like cows or pigs could have potential to be used in exotic ungulate species. Even once all of these data are obtained, approval itself comes with an approximately \$500,000 fee plus an annual \$100,000 for the FDA to keep a file on the drug open.

Besides the significant investment of time and money, there are many steps involved in getting an animal drug approved. A great deal of chemical development must be done to FDA standards and the manufacturer must demonstrate that the drug is stable, what chemical processes the drug undergoes in active form, optimal formulations of the drug, stability of the drug from batch to batch during production, and what assessments are appropriate for quality control and consistency. Controlled clinical trials in large samples of animals are also a requirement and often can't be done rigorously or ethically in wildlife species. We can rarely find contraceptive options in the pet or livestock market because, in the U.S., we largely sterilize our pets rather than contracept them, and livestock are virtually never contracepted, they are slaughtered after a relatively short reproductive lifespan. Market research suggests that pet owners and veterinarians are comfortable with surgical sterilization of pets when it is affordable, but it remains to be seen whether preference for non-surgical alternatives for pet contraception would emerge if more products became available and were also affordable.

Non-human primate contraception has benefited from the extensive testing, marketing, and approval of contraceptives for humans, which is a multi-billion-dollar industry. A 2016 report by the Tufts Center for the Study

of Drug development (http://csdd.tufts.edu/news/complete_story/tufts_csdd_rd_cost_study_now_published) found that the cost to bring a human drug to market was just over \$2.5 billion and the process took approximately 10 years. After approval of the drug, manufacturers can expect to spend another \$312 million to test new formulations, dosages, and new indications over the life cycle of the drug. Still, even with this extensive background, we often find that not all non-human primates respond the same to human contraceptives. Some of the callitrichid primates and the prosimians pose more unique challenges in terms of contraception. So even when there is abundant funding and research to assess contraceptive products, as is the case in humans, application to similar species can be challenging. And finding hundreds of millions of dollars in zoos, aquariums, or government agencies for funding more contraceptive research and development is not likely.

Case Study:

*A possible male contraceptive. Some years ago, AZA Wildlife Contraception Center staff learned about bisdiamine, a contraceptive drug that had been in development for human males. Its interaction with alcohol made it unsuitable for general use in men, so it was never brought to market. However, because zoo animals aren't given alcohol, it seemed a promising candidate as a contraceptive for zoo animals. Although a research trial with male wolves (*Canis lupus*) showed it to be both effective and reversible, no drug company could be found that could produce it at a price affordable to zoos. It was estimated that treatment with this drug would cost approximately \$2000/animal/year. Again, zoo animals constitute a very small market, making products limited to treatment of zoo animals unprofitable to drug companies unless they can charge very high fees for drugs.*

So, given the relative scarcity of FDA-approved animal drugs and the even smaller number of these drugs that could be used for contraception, how are we able to provide contraception to many of our species currently? First, in certain circumstances a veterinarian can prescribe an "extra-label drug

use" for an FDA-approved drug. These circumstances include situations where the extra-label use could relieve animal suffering or when no alternative drug is approved for the species or condition. Extra-label drug use is also more flexible for animals that are not being reared for human consumption. An example of acceptable extra-label drug use in wildlife contraception is the use of FDA-approved human birth control pills in great ape species.

Second, in lieu of FDA approval, producers of drugs for minor animal species may pursue having their product indexed by the FDA (<https://www.fda.gov/animalveterinary/developmentapprovalprocess/minoruseminorspecies/ucm070206.htm>). Indexing is a process wherein the FDA reviews the safety and efficacy of an animal drug which probably could not reasonably go through the standard drug approval process because the species involved are either too rare or too varied to go through the traditional kinds of safety and efficacy studies. Indexing allows the drug producer to market their product legally. Indexed drugs however cannot be used for extra-label uses; they can only be used for the species and application for which the drug was indexed. Currently the only FDA-indexed drug that can be used as an animal contraceptive is a formulation of Suprelorin only for domestic ferret (Suprelorin-F: Virbac Animal Health). However, even that drug was indexed (provisionally approved) for treatment of adrenal disease in ferrets, not for contraception.

The third possible way we can obtain drugs to use as contraceptives in zoo animals is to use products that are in early stages of development under what is called an Investigational New Animal Drug (INAD) process, meaning that the drug can only be used as part of a formal research study. Use of drugs covered by an INAD process requires that users keep detailed records of drug dosage(s) used, dates of use, species applied to, individual animal identification and reproductive history, and most importantly, the occurrence of any adverse side effects. These records are provided to the drug manufacturers who then must provide a report to the FDA. Examples of drugs that zoos are currently using as part of INAD

processes include melengestrol acetate (MGA) feed and Suprelorin (also known as deslorelin). The AZA RMC manages the record-keeping for these drugs and reports findings to their manufacturers. A product approved for one species can be difficult or dangerous when applied to another. Some products like porcine zona pellucida (PZP), an immunocontraceptive, can work very well in some species but cause ovarian damage in others. Some products are safe for very short-term use but are associated with serious side effects when used long-term. Synthetic progestins, like melengestrol acetate, are effective in carnivores but use for more than four years significantly increases the risk of certain kinds of cancer (Harrenstien et al., 1996, Munson et al., 2006 for a review). It takes years of accumulation of data to identify the possible side effects or associated pathology, and because these often must be retrospective studies (i.e., searching through records and/or necropsy reports), it can be difficult to control all of the possible variables that could affect findings (e.g., the animal's reproductive history or its age). We rarely have the ability to do properly controlled experiments on effects of contraception. Our zoo populations are too small and the animals are distributed across a number of different institutions and are exposed to different living conditions, husbandry protocols, and have varying genetic, demographic, and reproductive backgrounds.

We don't have the space here to provide an overview of where the various contraceptives that we do use come from. We mentioned that many non-human primate contraceptives come from the human contraception market. In contrast, some of our other contraceptive products come from very small producers who take a special interest in wildlife and arguably provide products to the zoo community in labors of love. For example, PZP immunocontraception is produced out of one small laboratory in Montana. These small operations can manufacture the products currently used in U.S. zoos, but they are not major research and development firms that can invest millions of dollars in product testing and development.

For all of these reasons, we should not expect that our contraception

options for zoo animals will increase dramatically in the future, in fact they could decrease. Additionally, our knowledge of the safety, efficacy, and reversibility of some contraceptive products we can use will increase very gradually over time and thus we may have to take certain risks in applying contraception to wildlife species. We must acknowledge that no contraceptive treatment, be it keeping the genders separated, applying temporary contraception, or permanently sterilizing individuals, is without risk or effects on animals (see Penfold et al., 2014, and Asa, 2016 for discussion). Of course, breeding animals also has effects on them. Thus, we must keep what is best for the animal and the species, and not ourselves, as the primary consideration in selecting among options for reproductive management, and we must bear in mind the goal of maintaining viable populations for the long-term while at the same time supporting good welfare in individual animals.

Assisted Reproductive Technology (ART)

Successful application of ART requires a detailed understanding of the reproductive biology of both males and females in every species for which ART is being considered. At minimum, one must know the reproductive anatomy, when both genders are sexually mature and producing gametes (sperm and eggs), when they are reproductively active (all year or seasonally), and for how long. For males, we need to have established protocols that allow us to safely collect semen without harming the male or the sample itself. For example, if a semen sample is contaminated with urine it can't be used for artificial insemination (AI) because urine will kill sperm cells. Unless we intend to use semen for artificial insemination more or less immediately, we also have to learn how to cryopreserve (freeze) it and thaw it safely so that the sperm cells survive the process and are still able to fertilize an egg. Developing semen collection, cryopreservation and thawing protocols can take years and thousands of dollars. For females, we need to find ways to non-invasively (if possible) track their reproductive cycles

so we know how often they ovulate and at what time of year. In some cases hormone tracking isn't sufficient for timing artificial insemination and one must use ultrasound of the ovaries to know exactly when ovarian follicles rupture and release eggs. For many species, artificial insemination must be performed within just a few hours of ovulation in order for sperm to reach the ovulated egg before the sperm die. Alternatively, one can investigate hormonal treatments that synchronize females and induce ovulation so that AI can be planned in advance. Developing the knowledge of these dynamics and protocols for using ART in females can also take years and thousands of dollars, maybe tens of thousands of dollars if staff time is factored into the cost. Even if a species is taxonomically similar to a domestic animal for which ARTs have been used for decades, protocols must be refined for application in new species and this is no easy task (see Gee et al., 2004, Pukazhenthil & Wildt, 2004, Andrabi et al., 2007, Morrow et al., 2009, Sontakke, in press for reviews). These are techniques where the small details mean the difference between success and failure.

Case Study:

The Persian onager (Equus hemionus onager). There are only about 30 onagers in the AZA population and another 60-70 in European accredited zoos (EAZA). These animals reproduce easily, but because so few exist in AZA, ARTs were explored as a way to import new genes from Europe and maintain healthy genetic diversity without having to transport animals overseas. Despite decades of previous research on the reproductive biology of domestic horses (Equus caballus), some very important questions remained. Would desert onagers living in Ohio be more like domestic horses (highly seasonal) or the domestic ass (Equus asinus), which is reproductively active most of the year? How often do onagers ovulate? Is it every 21 days like a horse, or every 28 days like donkey? Can you AI a female that is nursing a yearling foal? It took 10 volunteer interns and one post-doctoral fellow two years of collecting urine five days weekly on 11 animals, and running hormones on 6000 samples for two hormones to find the answers to these questions. We now know onagers cycle

from June-October, ovulate every ~26 days, and do not cycle normally while nursing a foal (unlike domestic equids); all important things to know when deciding who is a good AI candidate and when to perform AI.

Another important question was how to time the AI. In each species, the egg (or follicle) develops to a certain size before it ovulates. In horses, that size is ~3.5 cm diameter, in domestic donkeys about 3 - 3.5 cm. Determining this piece of information took a staff of six people, running animals through a specialized chute system three days weekly for two months, and a reproductive biologist that quickly scanned the ovaries of each female by ultrasound, a process that took about an hour each day. Onagers, it turns out, ovulate follicles of 2.5-3 cm, smaller than domestic horses or donkeys, so without intensive handling and study of the target species (onagers), AI would have been mistimed if we applied what we knew from domestic horses and donkeys.

After three years of labor intensive work to understand female biology and develop ways to freeze semen from males, two foals were produced by artificial insemination. While this is a very positive outcome, the technique has only been successful to date at one facility with a chute where animals can be briefly restrained without the need for full immobilization. This makes the technique limited and even more work is needed to develop methods that are more widely applicable. The story is the same for every new species no matter how closely related they are to another. For example, AI has been successful in white and Indian rhinos, but not black or Sumatran rhinos to date.

Case Study:

The black-footed ferret (*Mustela nigripes*). ART development is challenging particularly when you are working with endangered species because often there are few individuals available for research and development of techniques. Due to previously low success in captive breeding of black-footed ferrets via natural mating, Dr. JoGayle Howard and a group of Smithsonian National Zoological Park (NZP) scientists were asked to join the recovery effort for the species when the last remaining ferrets in the wild were captured and brought into management




facilities. The goal was to develop ART to ensure that each individual would be able to pass genes on to the next generation. Because the remaining seven males rescued from the wild were needed for captive breeding with the 11 females, the team developed much of the ART using the domestic ferret (*Mustela putorius furo*, Wildt et al., 1989; Howard 1993; Howard et al., 1991). Other researchers established what the normal breeding season was for black-footed ferrets and established methods for detecting estrus (Williams et al., 1991, 1992). After several failed attempts at vaginal insemination, it was determined that semen (fresh or cryopreserved-thawed) needed to be deposited directly into the uterine horns via laparoscopy, which takes training that goes beyond traditional methods (Wildt et al., 1989). At this time, BFFs were prioritized for the breeding program and methods could not be tested until all females were bred. This slowed technique development because sample collection usually was at the very end of the breeding season when male semen quality was declining, which is a natural process. The first successful artificial insemination in BFFs came in 1996 nearly 10 years after the BFFs were removed from the wild. Techniques continue to be improved, and since 1996 more than 130 BFFs have been produced via ART. These individuals may have never been born naturally (Howard & Wildt, 2009). ART has allowed for the maintenance of gene diversity and has boosted the current population (Howard et al., 2016).

ART has had a number of “firsts” that are significant for population management in zoos: first onagers produced by AI, first Mexican wolf puppies born via AI with frozen, thawed semen, etc. To date offspring of approximately 50 species have been produced via artificial insemination or embryo transfer (Mastromonaco & Comizzoli, in press); however, there are significant challenges in moving from “firsts” to reliable implementation of the technology. Only a handful of wildlife species (e.g. some bird species, black-footed ferrets, giant pandas, *Ailuropoda melanoleuca*) have artificial insemination successfully developed to be used for species management. It takes many years and significant research funding to get to a “first”, and success is never guaranteed. More complicated procedures such as in-vitro fertilization, embryo transfer, AI with sex-sorted sperm, and others require many more years of research and tens to hundreds of thousands of dollars in funding to make them more applicable to wildlife species. At present, reproductive processes in only about 250 animal species, mainly mammals and birds, have been described adequately enough to permit development of ART (Comizzoli, 2015).

Conclusion

Hopefully, this review provides insight into the significant challenges of relying on contraception and assisted reproductive technology for reproductive management of animal



populations in zoos and aquariums. Contraceptive options exist for all mammal species, but we struggle with having enough options within species and not having a full understanding of efficacy and reversibility in some taxa. Assisted reproductive technology could hold promise for reproductive and population management, but we lack sufficient funding and knowledge of species reproductive biology in most cases to make these techniques broadly applicable at this time. Progress would be improved by more zoos and aquariums being willing to participate in research studies and providing space to hold larger groups of animals so they may serve as breeding centers or research populations. Still, many years and many hundreds of thousands of dollars are needed to make more contraceptive and ART options feasible for use in zoos.

We should expect that advancements in these areas will come very slowly, suggesting we should be open to investigating a variety of options to manage animal populations, including contraception, ART, working with other zoological regions and the private sector; and culling. Society's focus on contraceptive options for humans, feral and wild populations of animals (dogs, cats, horses, pigeons, to name a few) mean that new approaches may come online and become available. However, the zoo community will still have to grapple with determining how safe, effective, and reversible these products are in non-target species.

We should explore all husbandry related options for achieving reproductive success in a **timely** manner before moving to ART since it may be many years before techniques are perfected for many species. Animal care teams should develop outlined and stepwise plans with clear timelines for completing reproductive health assessments, environmental assessments and interventions, and consulting husbandry and reproductive experts to see if novel approaches (introducing scents from unfamiliar conspecifics, changing exhibits, or exhibit furniture, using hormones to stimulate natural breeding, etc.) can help achieve breeding success before attempting ARTs. Consulting the RMC, AZA Animal Care Manuals, SSP Coordinators, SSP veterinary, nutrition, and behavior advisors is also important. Learn more about the AZA Reproductive Management Center and contraception for wildlife here: <https://www.stlzoo.org/animals/scienceresearch/reproductivemanagementcenter/>

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The Current Condition of the General United States Public Knowledge on the Primate Pet Trade and its Impacts on Conservation

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The pet trade is a prominent threat to primate populations and their conservation (Shepherd, 2010). However, primates do not make appropriate pets, and many who own primates do not understand how challenging it is to meet the psychological, social, and physical needs of the pet (Ceballos-Mago & Chivers, 2010; Soulsbury et al., 2009). Therefore, the purpose of this study was to gain an understanding of the current knowledge of the general United States public on owning a pet primate and the impacts of pet trade on conservation. A seven question survey was created using SurveyMonkey and then shared through the social media platform of Facebook. A total of 35 surveys were analyzed. The overall results portrayed that most respondents felt a person would lack the ability and knowledge to properly own and care for a pet primate. They also reported that most primates could pass diseases between themselves and the owner, but they were not sure most of the time, which exact ones. Additionally, this survey showed that most respondents believe that pet primates are largely obtained illegally, and the pet trade industry has negative influences on the conservation of primates. On behalf of these results, ownership of exotic species, such as a primate, should be discouraged. However, the desire people have to be in contact with wildlife is an important factor in regard to promoting conservation. Further research is needed to find a compromise that allows humans to have access to such exotic species, without the entailing negative consequences of ownership. The results from this study therefore, can be utilized in a zoological setting, for example, as a means to narrow the education gap on this topic and aid in the conservation of these animals.

Introduction

Primates are a prominent and familiar species observed within the wildlife trade industry (Shepherd, 2010). Pet primate demand and ownership has fluctuated over the years, and is disseminated throughout parts of Asia, South America, and Africa (Ceballos-Mago & Chivers, 2010). Every year, approximately 40,000 primates are taken into the wildlife trade (Reuter, Gilles, Willis, & Sewall,

2016). Additionally, according to the International Union for Conservation of Nature, more than half of all the primate species are endangered (IUCN, 2016). Therefore, taking a primate from its natural settings, to either a market or straight into pet ownership, impacts both the individual being captured and the conservation of the wild population, plus the biodiversity of the area (Nijman, Nekaris, Donati, Bruford, & Fa, 2011). A large portion of these primates die during transportation from the wild to the market, as they are often under the care of someone who lacks knowledge on the proper welfare of the animal (Nekaris & Jaffe, 2007). Regardless, people own various types of animals. In fact, the affinity between humans and animals is quite intense; empathy, affection, children's benefit, culture, or an interest in wildlife biology, are all reasons people have exotic animals as pets, but this list is not exhaustive (Drews, 2002). Some people view primates as serving as a substitute child, amusement, or as general means of companionship (Ceballos-Mago & Chivers, 2010). However, animal professionals suggest that exotic animals, such as a monkey or ape, do not make ideal pets (Hess, 2011).

The needs of an animal, such as a pet primate, can be hard to meet. Welfare of an animal pertains to their mental health, and their physiological health, such as living conditions and diet (Ceballos-Mago & Chivers, 2010; Baker et al., 2013). According to the United States Department of Agriculture (USDA), their environment or housing should be a size that allows them to comfortably turn around, stand up, and most importantly, be up off the ground away from their excrement and provide shelter from the weather elements (McCann et al, 2007). Primates also eat a variety of food items, such as fruit, insects, small mammals, exudate, or leaves, which might be consumed as an assortment of these, or as a specialization (Rothman, Vogel, & Blumenthal, 2013). In order to have proper welfare, for example, primates need to be able to eat a variety of these items, depending on their dietary needs. In addition to diet, primates are highly active and therefore require more stimulation in their environment than the likes of a dog or another typical

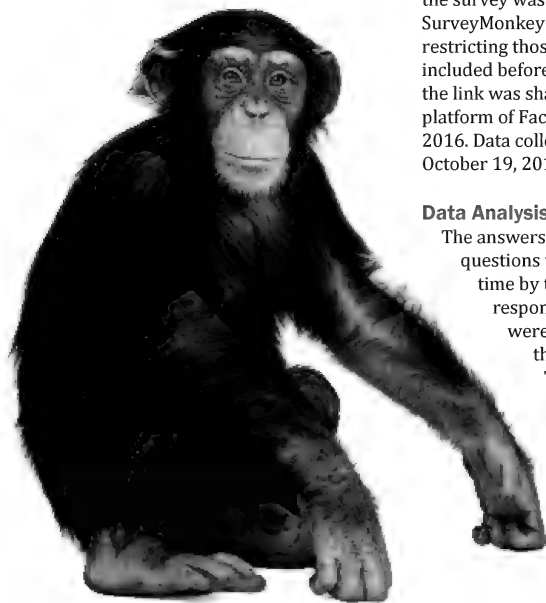
house pet (Soulsbury, Iossa, Kennell, & Harris, 2009). Pet primates can become bored or frustrated, leading to psychological or behavioral issues due to the manner in which they are housed, or a lack of socialization (Soulsbury et al., 2009). The United States Department of Agriculture, also requires that environmental enrichment, or features that improve the immediate environment and welfare of the animal, are adequately provided in order to prevent such problems from occurring (Kulpa-Eddy, 2005). Often times, owners do not address these standards and find their primate to be unmanageable (Duarte-Quiroga & Estrada, 2003). These factors have led owners to either release the primate back to the wild, or end its life following some incident. Those not killed are often reintroduced without regard to health status, behavioral needs, or geographic origin (Nekaris & Jaffe, 2007). According to Chomel, Belotto, and Meslin (2007), over 70 percent of emerging diseases originate from animals; the spread being associated with wildlife contact. For example, this contact can be that which occurs during animal capture and transportation. Additionally, released pet primates can carry parasites into wild populations (Ceballos-Mago, Gonzalez, & Chovers, 2010).

People who own or want to own primates might not be aware of these challenges that come with having them as a pet. Therefore, the purpose of this study is to gain insight into the publics' current knowledge regarding the following: 1) exploitation of primates as pets, 2) primates' necessities for proper welfare and 3) how this influences the population numbers of the species. This study measures the current knowledge of US citizens for future educational applications and to improve primate conservation. It is hypothesized that the results will portray that the average adult in the United States will feel that a primate owner will have minimal knowledge on primate care and the impacts the pet trade has on conservation. If the hypothesis of this study is supported, the results could be utilized in an educational setting to help ensure a future for primates.

Methods

A seven question survey was created in order to evaluate the state of the general

publics' knowledge on the pet trade involving primates (see Appendix I). For the first five questions, the survey respondent was given the scenario that someone they know was considering purchasing a pet primate. Respondents were asked to bear this scenario in mind while answering each prompt. Each of the five questions was open ended. This style question gave the respondent the ability to express their views without pressure to respond in a particular way (Reja, Manfreda, Hlebec, & Vehovar, 2003). These questions investigated potential challenges to the owner of the pet primate, diseases that could be contracted (by the owner from the pet or by the pet from the owner), where the primate might have originated from before arriving at the market for sale, the impact the trade industry has on wild populations, and finally, challenges to the primate if it were to be returned to the wild. Each of the five questions had more than one appropriate answer but wording it as a multiple-choice response would have potentially been a leading question. Because of this potential, open-ended questions were the chosen format most appropriate to gather the same information. Carey, Morgan, and Oxtoby (1996), additionally explained that open-



ended questions can allow the researcher to explore dynamic questions because this design usually does not have a predetermined set of responses. This is also true of the information sought to be gathered during this study.

One study suggested that people were more likely to know more about an animal and obviously care more about it if he or she finds it to be appealing (Drews, 2002). Based off this statement, the sixth question was a Likert scale question (1= strongly dislike to 5 =strongly like) to gauge the respondents' opinion of primates. The last question was a yes or no response style, which asked if the person worked in an animal related field. Because this survey was disseminated via social media, there was the potential factor for biased answers due to the nature of the researcher's social media connections being in the same career field or another animal-based path. In order to evaluate potential skewed data, these last two questions were designed to help provide information on the overall opinion of primates and the demographic career nature of the audience.

An exemption from Miami University's Institutional Review Board was sought and granted. Upon this permission, the survey was created using the SurveyMonkey webpage. A consent form restricting those above the age of 18 was included before the survey began. Then, the link was shared on the social media platform of Facebook on October 7, 2016. Data collection was completed on October 19, 2016.

Data Analysis

The answers to the first five survey questions were reviewed one at a time by the researcher. All the responses for each question were read to find common themes among the answers. These themes were then refined and combined with other themes if deemed necessary. The main themes became codes which were then applied back to the responses. At the same time, an additional person was

recruited to go through the responses and code them as well. This was done to ensure better accuracy of the coding and overall analysis of the results. Both reviewers then compared their analysis of the data to establish what they agreed on or disagreed on in accordance to their codes. The two reviewers established a percent agreement for each question. This concept is known as inter-rater reliability and it should exceed an 80 percent agreement to ensure accurate coding (Hallgren, 2012; Campbell, Osserman, & Pederson, 2013). After the question responses were coded, the frequency count of each code was calculated. Then, this was converted to a proportion of the total so the percentage of each coded theme could be measured. The last two questions were analyzed by calculating the response count for the answer choices.

Results

Researchers received a total of 36 surveys from respondents with one being incomplete. This survey was discarded because only the last two questions had been answered, not the main questions that inquired the more important aspects of the study.

Table 1 shows the results of the first question inquiring about a person becoming an owner of a pet primate and what challenges this person might face in caring for the pet. The majority, 34 percent of respondents, said the biggest challenge would be having the ability to provide quality care for the pet, with the essential resources. Next, 23 percent of respondents said a lack of knowledge on the needs of the pet was the biggest challenge. Others, or 26 percent felt that a combination of not having the ability to care for the pet, or the adequate knowledge, was the main challenge. Owner safety and/ or the unpredictability of a wild animal concerned 11 percent of respondents. And finally, 6 percent felt that lack of an ability to care for the pet and the safety of the owner and possible dangers was the main challenge in caring for their new pet primate. A second table was created to better represent these results. This revealed an important finding with a significant portion of the survey sample revealing that two-thirds or 66 percent, thought the

biggest challenge would be the owner's ability to provide adequate care. Of the three categories, only 29 percent of people were concerned with the owners' knowledge on the pet's needs.

Table 2 shows the results of Question 2, regarding where the pet primate might have come from in order to be sold in the market. This revealed that the most respondents, or 46 percent, stated that the primate was most likely obtained in some illegal manner. Next, 29 percent of respondents, reported that the primate was taken from their natural habitat; 11 percent felt that the primate was obtained legally whether from zoo overstock, or a breeder; 3 percent thought the primate came from either a breeder or the primates' natural habitat. And finally, 9 percent did not know where the primate might have come from.

Table 3 shows the results of Question 3, which inquired how the respondent felt primate ownership would impact wild populations of primates. The majority of respondents, or 40 percent, said that someone having a pet primate would have a negative impact on the current population numbers. Next, 26 percent said that someone owning the pet primate would take an individual out of the wild that could possibly contribute to the future genetic diversity of the species. A total of 9 percent of respondents said the main issue was a combination of the impact having the pet could make on the current and future populations. At the same time, another 9 percent also felt that owning the pet would not make any kind of impact. A total of 3 percent of respondents said the pet primate could serve as an ambassador of some sort to aid in conservation of the species, but 6 percent of respondents felt the only message that was sent to others was one of encouragement to get their own primate. Three percent of respondents' answers did not fit well under any other categories and therefore was placed in its own category. Finally, another 3 percent, felt that it would have a bad impact on the wild population, or send a positive message to others.

Table 4 shows the current state of the overall knowledge that survey respondents had on what diseases

Question 1: What potential challenges does this owner face in caring for their pet primate?

Table 1: This table portrays the coding themes, the response count and percentages corresponding to Question 1.

| Code | Meaning | Number of Responses | Percentage |
|----------------|---|---------------------|------------|
| C/Care | Ability of the owner to provide quality care with the essential resources | 12 | 34% |
| K/Knowledge | Lack of knowledge on the pet's needs | 8 | 23% |
| O/Owner safety | Owner safety/ dangers of a wild unpredictable animal | 4 | 11% |
| C/O | Combination of Care and Owner Safety | 9 | 26% |
| C/K | Combination of Care and Knowledge | 2 | 6% |
| Totals | | 35 | 100% |

Table 1.5: This table depicts the individual response count for each code, and includes the total number of people who responded to one or two of these categories.

| Individual Codes | Totals | Percentages |
|------------------|--------|-------------|
| C | 23 | 66% |
| K | 10 | 29% |
| O | 13 | 37% |

Question 2: Where do you think this new pet primate came from in order to be sold?

Table 2: This table depicts the codes for the responses and the response count with percentages to Question 2.

| Code | Meaning | Number of Responses | Percentage |
|----------------------|--|---------------------|------------|
| I/Illegally obtained | Black market, smuggled, illegal trade, all through a vendor of some sort | 16 | 46% |
| N/Natural source | Taken from the wild/ their natural habitat/ legality unknown | 10 | 29% |
| B/Breeder | Obtained legally/through a legal breeder/ zoo | 4 | 11% |
| U/Unknown | Origin unknown | 3 | 9% |
| N/B | Combination of natural source and breeder | 1 | 3% |
| Totals | | 35 | 100% |

Question 3: How does having this pet primate impact the wild population of this species?

Table 3: This table shows the response coding, the response count and corresponding percentages.

| Codes | Meaning | Number of Responses | Percentage |
|---------------|---|---------------------|------------|
| N/Nothing | There is no impact on the wild population | 3 | 9% |
| G/ genetics | Impacts gene pool/ genetic diversity | 9 | 26% |
| B/ bad impact | Negatively impacts current population numbers | 14 | 40% |
| M/message | Can send a positive conservation message to others/ presence in a zoo | 1 | 3% |
| W/want | Can make someone else want to have their own pet primate | 0 | 0% |
| O/other | Other or a response that does not fit in any other category | 1 | 3% |
| G/B | Combination of genetics and a bad impact | 3 | 9% |
| B/O | Combination of bad impact and other | 1 | 3% |
| W/B | Combination of wanting their own pet primate and a bad impact on population | 2 | 6% |
| B/M | Combination of sending a message and a bad impact | 1 | 3% |
| Totals | | 35 | 100% |

could be shared by the primate and the owner. Of the sample, 37 percent did not know what diseases could be shared by the owner and the primate. Another 37 percent stated that many types of diseases could be shared. Lastly, of the total responses, 26 percent believe that a few could be shared; they named 1-3 diseases.

The potential problems a primate would face if it were released back into the wild, according to survey results, shown in Table 5, are either an overall lack of social skills due to being imprinted on people, or lack of the ability to adapt or survive in the wild. A total of 49 percent of respondents said the combination of these factors would be the issue, and another 49 percent said just the lack of ability to survive was the issue. Only 2 percent of respondents reported the ability to socialize with other primates and having no fear of humans would be the main problem. Nearly all, or 98 percent, believe that a primate would be ill-equipped to fend for itself, once returned to the wild.

Table 6 shows that 51.4 percent or most of the sample, do like primates. Next, 28.6 percent strongly like primates. A total of 20 percent of the survey sample feel neutral on the topic. Finally, no respondents answered this question as disliking or strongly disliking primates.

As shown in Table 7, a majority of the survey respondents, or 80 percent, do not work in an animal-related field and 20 percent of the survey respondents do work in an animal-related field.

Discussion

Questions 6 and 7 were analyzed first. These questions were utilized within this study in the potential case that the data would be skewed. If the majority of the survey respondents worked in an animal-related field, and/or had a high opinion of primates, the knowledge level of primate care would correspondingly be potentially higher than the average US adult. The data from this circumstance, therefore, would not be representative of the general public. However, this was not the case in the collected data for this study. Even though most respondents did not work in an animal-related field (they might potentially be less knowledgeable about

Question 4: What diseases could be passed between the pet and the owner?

Table 4: This table depicts the codes for responses, response count, and the percentages.

| Code | Meaning | Number of Responses | Percentage |
|----------|----------------------------------|---------------------|------------|
| U/Unsure | Unsure | 13 | 37% |
| F/Few | Named 1-3 diseases or said "few" | 9 | 26% |
| M/ Many | Many, most, or 4+ diseases named | 13 | 37% |
| Totals | | 35 | 100% |

Question 5: What are the potential problems with releasing pet primates back into the wild?

Table 5: This table shows the codes for responses, response count, and the corresponding percentages.

| Codes | Meaning | Number of Responses | Percentage |
|-------------|---|---------------------|------------|
| S/Social | Lacks ability to socialize with other primates/ no fear of humans | 1 | 2% |
| K/knowledge | Lacks ability to survive in the wild/adapt | 17 | 49% |
| K/S | Combination of social and knowledge | 17 | 49% |
| Totals | | 35 | 100% |

Question 6: The level to which you like primates.

Table 6: This table shows the breakdown of the extent that people like or dislike primates.

| | Strongly Dislike | Dislike | Neutral | Like | Strongly Like | Overall Total |
|------------|------------------|---------|---------|-------|---------------|---------------|
| Frequency | 0 | 0 | 7 | 18 | 10 | 35 |
| Percentage | 0% | 0% | 20% | 51.4% | 28.6% | 100% |

Question 7: I work in an animal related field.

Table 7: This table show the career demographics of the survey audience.

| Answer Choice | Responses | Percentage |
|---------------|-----------|------------|
| Yes | 7 | 20% |
| No | 28 | 80% |
| Totals | | 35 |
| | | 100% |

animal care compared to someone in an animal field), their opinion of primates was still positive. At the same time, regardless of these variables, respondents still feel that owning a primate would not be a good idea.

Hence, the findings of this study support the hypothesis that the general United States public feels that a pet primate owner will not have adequate knowledge about what owning a primate entails. However, the results did not support the second half of the hypothesis that the average adult would have minimal knowledge on how the pet trade industry impacts the wild populations. Results of this study revealed that most respondents feel that a person would lack the ability and knowledge to properly own and care for a pet primate. Responses consisted of various factors such as the ability to provide adequate space, the correct diet, enrichment, a clean environment, proper socializing with other primates,

and ensuring the primate is safe from harming itself. Lack of knowledge is also an important, potential challenge and this pertains to the previous issues, in questioning whether or not the owner would know what the primate needed. Respondents gave examples of not knowing the individual needs of the primates, what to expect, what vaccines or permits might be necessary, as well as any training information. These results match that of other studies as well, which showed the needs of the primate were not well known. Previous studies found that owners were sharing inappropriate food, like coffee or alcohol, with their primate and one owner gave fruit to primate that subsisted off exudate in the wild (Duarte-Quiroga & Estrada, 2003; Nijman, Spaan, Rode-Margono, & Nekaris, 2015). In another study, owners believed that primates ate everything and shared rice, and beans with them; only 4 percent of interviewed people considered the

necessity of a special diet (Ceballos-Mago & Chivers, 2010). Commercial primate diets do exist, but often times, if the primate eats a specialized diet, this method of providing food will not be adequate either (Soulsbury et al., 2009). In one additional study, the observed 100 pets had no accessible food or water, and the primates were contained in a cage with no shelter from the weather (Jones-Engel, Schillaci, Engel, Papatungan, & Froehlich, 2006). Primates were observed being kept in a cage or tethered outside to a tree by a short rope or with a chain around its waist (Ceballos-Mago & Chivers, 2010). Even if a person had food, space, or other means to house a primate, this does not necessarily mean they know what exactly to provide or how to care for it.

The survey results of Question 1 also indicate a concern for safety of the owner and the unpredictable nature of the animal. Many primate owners in one study did not know the life span of primates, nor the aggression potential that comes with their sexual maturity (Ceballos-Mago & Chivers, 2010). Respondents of this current study express that the primate is still a wild animal and the owner might not understand its behavior or what is threatening to the animal. Duarte-Quiroga & Estrada (2003) reported that often times, a pet primate would have an aggressive moment involving a member of the household and the pet would be killed as a consequence. Essentially, a communication barrier exists and this can result in a negative situation. Reuter et al. (2015), also shared that pet lemurs in one study were killed when the owner did not understand the reasoning for

the primates' seemingly bad behavior. These behaviors might have seemed like issues to a human, but in reality, this was the normal demeanor of the species. Lack of knowledge on a species' dietary needs in one study, resulted in the primate being punished for consuming insects, which in the wild would be a normal part of their diet (Ceballos-Mago & Chivers, 2010). Survey answers also mention the primate becoming bored and trying to escape, among other behavioral issues, without a naturally stimulating environment. Many owners did not understand the social role that aggression plays in a wild group of primates, and this is normally directed at smaller members, which in a household would be the children (Soulsbury et al., 2009). Overall, these results suggest that most people will not be prepared for dealing with the various behaviors of a pet primate and will not understand its natural demeanor.

During an aggressive episode, there is also unfortunately the potential for disease transmission. In one previous study, most of those interviewed disagreed that monkeys could make them sick (Jones-Engel et al., 2006). The results of Question 4 (what diseases could be shared by the owner and primate), suggest that knowledge of diseases that can be shared by humans and primates is vague. The majority of responses fall under two different conditions: 1) respondents report that they are unsure which diseases could be transferred from one to the other, 2) respondents report that many diseases could be shared between the two species, but the specific diseases were not mentioned. When respondents

in this current survey did mention a particular disease, they said what diseases they thought the human could contract, but they did not specifically state if the diseases could transfer from the human to the primate. It is possible that most people only hear about diseases that primates can spread, but not which diseases they could give to a non-human primate. Some respondents state that due to the genetic similarities between humans and primates, a multitude of diseases could be shared. According to Jones-Engel et al., (2006), respiratory diseases like measles, influenza, and parainfluenza are the most transmissible between humans and primates. In addition, primates can carry B-virus, or Herpesvirus simiae- which humans contract through macaque bites or scratches- and children are more likely to be bitten (Ostrowski et al., 1998). Often, owners would dismiss symptoms of the contracted disease, or would not seek medical attention due to the fear that law enforcement would get involved (Ostrowski et al., 1998). Pet marmosets in one study conducted from 1991-1998 were found to be the source of eight cases of rabies, which occurred during capture of the animal (Chomel et al., 2007). Primates can also contract various parasitic infections, which can be passed to the owner, or even to wild populations if the primate were returned to the wild (Ceballos-Mago et al., 2010).

In the case of an owner returning their primate to the wild, most respondents of this study feel that the primate would suffer or struggle to adapt to life in this new environment, in addition

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to experiencing issues joining a wild group of its kind. Depending on where the primate is housed and where it was obtained, there is a chance the individual will not be released back into its correct habitat (Nekaris & Jaffe, 2007). This can result in the primate not having access to the type of food it would normally eat, or the type of habitat necessary for it to conduct its proper activity budget. Survey respondents voice concern over the primate attempting to return to urbanized areas to seek care such as food and shelter from people, and with the lack of fear of humans, it could be killed from roadway hazards or other people in transit. Survey-takers feel that if the primate were released in its natural habitat, and stayed, it could still have problems adapting to life in the wild because it was used to everything being provided by the owner. This includes protecting itself from predators, foraging, seeking shelter, or joining a group of like species, if it is a troop species. When joining the group, there might be problems as well because the pet was taught social skills from the owner and may not understand what behavior is necessary, or even normal, within the group. Young primates are socialized through family interactions and this is not possible in a one primate housing setting (Soulsbury et al., 2009). The pet would certainly not have benefitted from this captive setting; simply releasing the primate back into the wild is unacceptable because it sets the primate up for failure. To be done correctly, it should go through a rehabilitation system because the staff would aid in making sure it had the appropriate skills and knowledge to survive on its own, and it would be monitored to make sure the adjustment period went smoothly (Cheyne, 2006). Therefore, because of possible law enforcement involvement due to illegality of owning the primate, most owners would probably not seek rehabilitation services for the primate.

In this study's results, 28 percent of respondents report that they assume a pet primate is taken from native habitat such as China, South America, Asia or Africa. There are differing laws in each of these countries as to owning a primate. In fact, many primate species are listed under the Convention on

International Trade in Endangered Species of Wild Fauna and Flora (CITES) and there are specific species that are illegal to trade (Shepherd, 2010). Depending on the area, law enforcement might be low, furthering the negative impacts of the trade (Shepherd, 2010). Indonesian law protects species such as the gibbon, orangutan, or slow loris (Nijman et al., 2015). In Africa, chimpanzees (*Pan troglodytes*), are illegal to trade under international law (Kabasawa, 2009). These laws however, do not necessarily prevent people from obtaining them through trade, or simply just removing an individual from their natural habitat. This corresponds with the data of this survey, in that the majority of respondents seem to be of the opinion that obtaining and owning a primate is illegal. In areas where law enforcement is low, individuals



may have little to no knowledge on the laws of owning wildlife. Therefore, they probably would not consider the possible effects of their actions, nor is there any authority to inform them otherwise. For example, in Venezuela, hunting of primates is strictly illegal, but the rules on owning other animals obtained during hunting are perfunctory (Ceballos-Mago & Chivers, 2010).

A majority of survey respondents said that owning a primate would have a negative impact on the wild population. Essentially, there would be one less member of the population for each primate owned. As a consequence, this also results in there being less members that could contribute to future generations and genetic diversity. Additionally, respondents report that with the current extensive habitat loss, primate ownership negatively contributes to the already diminishing population sizes. Survey respondents also report that a person owning a

primate would also potentially promote primate ownership, again furthering the already declining population numbers. This correlates with one study that elucidated how younger primates are typically preferred and in order to obtain the infant, especially in arboreal species, the mother must be killed (Chapman & Peres, 2001). This makes a direct impact on members of the wild population, especially those with a low reproductive rate. Since many primate species are endangered, a low reproductive rate is that much more detrimental to the future population numbers (IUCN, 2016). Every single member of a population is vital for conservation, and each one taken from the wild is detrimental to the species.

One important concept worth mentioning, that did not come up in the results, is that a primate taken out of the wild for the pet trade may die before it reaches an owner. During travel, or inside the market, often the primate is without food and water, and also is under considerable stress (Nijman et al., 2015). These conditions can weaken the animal's immune system. For example, some species such as the slow loris, siamang or gibbon, have their teeth removed or clipped upon arrival, which is thought to make them safer to humans (Nijman et al., 2015). But often, the primate will die from an infection after this procedure (Shepherd, 2010). If a primate dies within the market setting, another one from the wild must be obtained to compensate the market's stock. The combination of all these individual primates, in addition to the individuals that make it to an owner, make up a substantial overall count of less primates in the wild.

Conclusion

The results of this study support multiple other studies in concluding that there is an overall lack of knowledge on the welfare of primates, the exploitation of primates for the trade industry, and how this influences the conservation of wild populations. Survey results indicate that most participants felt that an owner could not meet the needs of the animal and that most were obtained illegally. Survey respondents reported vague knowledge on the diseases that could be shared between primates and humans; they were mostly unsure, or

knew that diseases in general could be passed, but not exactly specific ones. Lastly, results revealed that people felt if a primate were returned to the wild, it would have a hard time adapting to non-captive life, as well as finding it hard to join a wild population. The consensus of this study supports the literature and matches the hypothesis that U.S. citizens feel that a primate owner would lack the overall knowledge on owning a primate and ensuring its welfare. Basically, people agree that primates do not make appropriate pets.

There are many cultural facets in other countries besides the United States, which involve owning wildlife; these include cultural heritages, or family traditions among many others (Drews, 2002). Several studies also elucidated that empathy was a major justification of owning a primate (Duarte-Quiroga & Estrada, 2003). Obviously, there is also a connection and desire within people to be involved with wildlife. It is this same emotional connection that drives people to take in primates as pets and makes the trade industry harmful. This justification of empathy or cultural tradition are also reasons not to have a pet primate. Pacquet and Darimont (2010) elaborated that as conservationists, a compromise should be found that benefits humans, while protecting animals at the same time. An approach that combines biosynergy (a mutual enrichment of life), and biophilia (human's interest in living things) is the best (Rose, 2010).

A much more conservative approach would be a framework that aims to do the following: Manage the negative impacts of wildlife activities such as tourism, and while at the same time, conduct research to find gaps in the knowledge, to educate the public (Higginbottom, 2003). Therefore, further research is needed on how to educate the public, and on which topics pertaining to exotic pet ownership. Additionally, further research is needed to investigate what other venues could connect people and live primates in a way that is the least detrimental to their conservation. Fostering this connection that humans have with nonhuman primates should strive to make humans care for the animal and promote good environmental practices that ensures a positive future for all species (Rose, 2010).

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Research Update – Elephants for Africa

*Miss Hayley Blackwell, Associate and Dr. Kate Evans, Founder & Director
Elephants for Africa, Botswana*

After more than five years of collecting data on male elephant demographics and social relationships in the Makgadikgadi Pans National Park, we are excited to be expanding the focus of our research into new areas, while continuing our on-going research. The data we have been collecting so far contribute to our long-term dataset, helping to shed new insights into the importance of “bull areas” such as the Makgadikgadi, an area recently re-colonized by elephants after the resurgence of the Boteti River in 2009. At the end of 2017 we took down the last of the camera traps, situated on elephant trails leading to the Boteti River, which forms the western boundary of the Park. After almost three years of continuous surveying we have amassed over 187,000 images! Whilst we have been through these images ourselves and have preliminary data, we need more manpower to cross-check the raw data before we can use it and thus have joined forces with [SnapshotSafari](#), of the University of Minnesota. SnapShotSafari work with

research teams and reserve managers to create citizen science web platforms, in order to process images from camera trap surveys, allowing everyday people around the world to view the camera trap images online and, using helpful guides and tutorials, assist with classifying the images. If you would like to get involved with EFA's camera trap project, please visit [\[snapshot-safari\]](#) to get started; our data should be live in the first quarter of 2019.

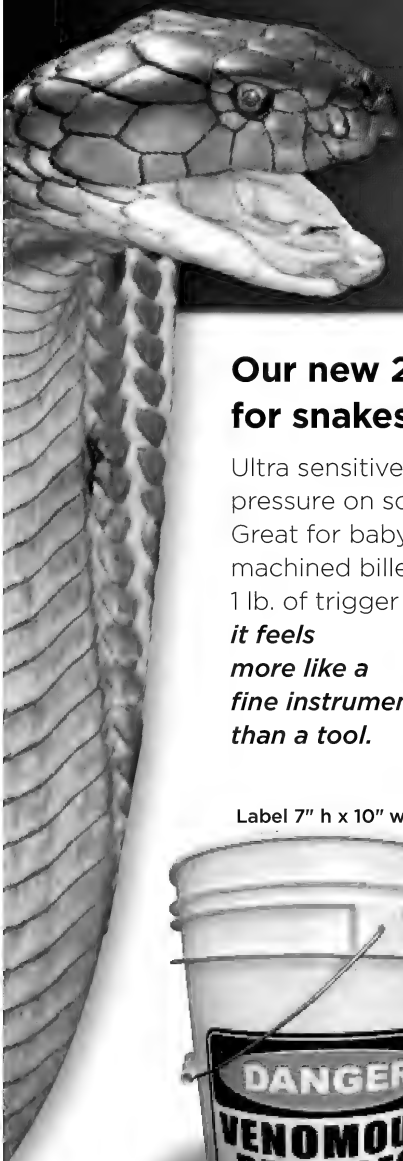
What is fascinating about this elephant population is that it is almost entirely made up of transient bulls, which spend periods of time in the park before leaving and then returning months later. This raises new questions about where elephants are coming from before arriving at the National Park, and where they go when they leave and the significance of the park to the Botswana population.

We have designed new research methodologies to investigate these questions and we plan to launch this

work in 2019. The first step will be to carry out spoor surveys along the boundaries of the park. This will involve recording signs that elephants have crossed over the boundaries, identifying the major exit and entry points and gaining an initial idea of the movement patterns of arriving and leaving elephants. Closely related to this is the movement of elephants through the neighboring community lands, which border the National Park, which we also intend to study in more detail. These aspects of our future research will address the concerns of both local, by understanding how elephants are utilizing their lands farmers will be better equipped to mitigate, and national stakeholders, providing vital data so they can align agricultural land uses and potential wildlife corridors to limited conflict and allow freer movement of wildlife between protected areas.

We look forward to updating you on our findings and thank you for your continued support. 🐘





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Sausages, It's What's For Dinner

Libby Hayes, Animal Keeper II
Dallas Zoo
Dallas, TX

The Dallas Zoo is currently home to 2.3 Sumatran tigers (*Panthera tigris sumatrae*). The tiger keepers are always searching for ways to offer unique, novel enrichment. The Dallas Zoo's enrichment approval process includes reviewing any submitted enrichment item for approval or denial for all species at one time. While this process can sometimes be time consuming, it does allow for a variety of items to be approved for a species for which an enrichment device may have not originally been intended. When I was looking to create more varied enrichment for our tigers, I saw that a variety of unique puzzle feeders such as barrel spinners and windmill-type devices were already approved for our cats but had never been tried before

with the tigers. This was likely due to not having a food item that could be presented in them easily. In the past, the zoo had offered Mazuri® Exotic Feline (a dry cat food) as enrichment with some success with cougars and lions, but the tigers didn't care for it. Due to the limited success, it is no longer carried by our Animal Nutrition Center and, therefore, using a dry cat food in these puzzle feeders is not currently possible.

Puzzle feeders were disregarded for a long time due to this challenge, but during a conversation with a member of our research team and one of our interns, we decided that there must be some way to utilize the diet they already receive. Our tigers do not eat small chicks or mice that would be more likely

to fall from a puzzle feeder; the majority of their diet consists of 'wet' ground and chunk meat. It was at this time that the idea of a drier form of meat, such as a sausage, was brought up. The fact that sausages have a non-sticky outside, the meat doesn't fall apart, and they aren't particularly messy when it comes to blood were all positive attributes.

To begin, we spoke with our Animal Nutrition Center about ordering actual sausage, but a concern related to dietary values and quality of the sausage came up. It was then that the idea of stuffing our own sausages came up. I had never done something like this before, nor had any of my coworkers, so a lot of research ensued.



With online research, which also included watching several YouTube videos, we learned that there are a lot of varieties of sausage casings but only some of them are natural. Based on our veterinarian's suggestion, we chose a pork derived casing and purchased a small package to test with our animals before buying in bulk. What if our picky cats didn't eat it?

After receiving our casings, we had to figure out how to stuff them. While we were willing to spend approximately \$10 to test the theory that the tigers would eat the sausage and that sausage would actually work in a puzzle feeder, we didn't want to purchase a sausage maker until we knew it would be a success. It was at this time we "zookeeped it up" and modified a 60 cc syringe to be our sausage stuffing machine. We removed the top of the syringe using a Dremel® to make the hole large enough to pass our ground meat through easily. The casing was then slid onto the syringe and tied at the top to keep the meat from being plunged out of the casing. This took multiple attempts and several modifications to find the most efficient method, but ultimately we could make two sausages with only having to tie the casing one time. We tied it initially, squeezed the entire syringe of meat into the casing and then would twist the sausage to create two sausages and

cut at the twisted location. This method significantly increased the efficiency of the process.

After a number of successful enrichment interactions for our tigers with the newly developed spinning barrel feeder, it was decided to continue with this method of enrichment and purchase an actual sausage machine. Yet again, a lot of research went into deciding which machine was best for our needs and our budget. We went with a low-cost model that most importantly allowed for a large portion of meat to be processed at a time. We can now slide a large piece of casing onto the sausage maker, make one tie at the end of the casing, squeeze several pounds of meat through, and then twist the sausages into the desired portions and cut to separate.

Making our own sausage has proven to be a beneficial way to increase foraging time and also develop problem-solving skills with the zoo's tigers. Some of the tigers spin the barrel with one paw while others stand on it and 'walk' the barrel around. Some tigers head butt the barrel and others even attack it from above. We look forward to creating new and exciting puzzle feeders in the future now that their diet is no longer a limiting factor. 🐾

ENRICHMENT OPTIONS REVIEW

This article addresses a challenge that every keeper faces at some point: coming up with new and engaging ways to encourage natural behavior! Based on the specific institution's approval process, the keepers started out with a tiger-approved item that was not practical due to logistics. But they brainstormed and then engineered a new solution in order to meet the goal they set for their tigers. Through the process of trial and error, they were able to develop a system that created the necessary components to make their puzzle feeder tiger-friendly. The keepers not only observed their intended goal behavior, but also reported seeing additional positive interactions with the enrichment device!



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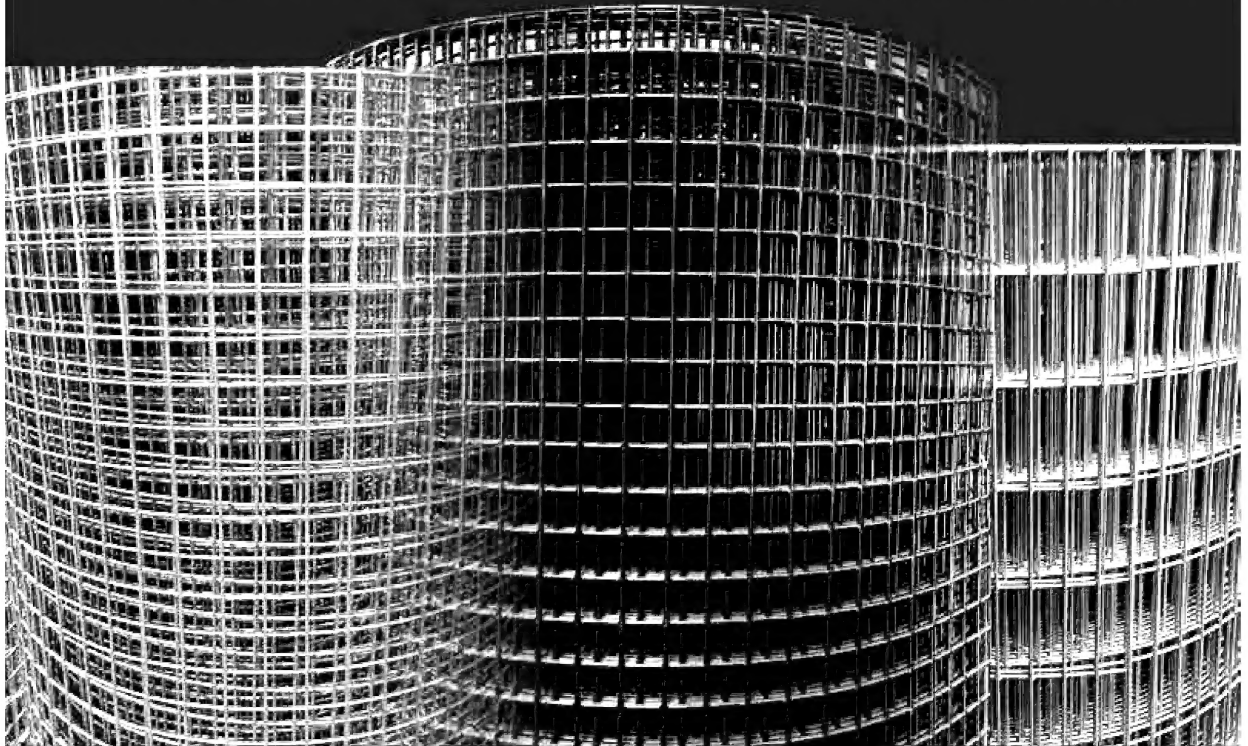
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Goofy Stuff



WARNING

Only the most insanely creative individuals should venture into this area. Most normal people look at stuff like this and think “Why am I wasting my time looking at this? No one in their right mind could ever use this stuff!”. Well.....we’ll see about that! Come on in my twisted brothers & sisters. Show the normal people how its done!!



Photo Courtesy of Indianapolis Zoo

Cube on a Stick

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Little League baseball is a very good thing because it keeps the parents off the streets. -YOGI BERRA

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