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Greetings Fellow Friends and Colleagues!

We find ourselves in Portland for AAZV’s 47th Annual Conference. Welcome! Many thanks to our local hosts, Mitch Finnegan, Tim Storms, and Matt Brooks from the Oregon Zoo, for “having us over for a beer” to quench our thirst for knowledge.

Our Scientific Program Committee (SPC) has worked diligently to put together an informative array of workshops, sessions, and master classes. The feedback you give on the conference evaluations is essential in constructing the next year’s conference. The Nutrition Advisory Group is holding their conference concurrently with our conference this year so be sure to network over some snacks.

Our 2016 conference planning is well under way as we will be holding a joint conference with our colleagues “across the pond.” AAZV will be holding a joint conference with European Association of Zoo and Wildlife Veterinarians (EAZWV) and the Leibnitz Institute for Zoo and Wildlife Research (IZW) in Atlanta in July so plan accordingly. We are excited to bring together members of all three organizations.

Please take a moment to extend a thank you to Rob Hilsenroth and Adine Nicholson. Their dedication to our organization is unwavering. We’ll miss Pam Brownlee this year as she retired in July. We appreciate all Pam has done for the organization over the years. Since Pam has retired there’s a new face in the AAZV administrative office; welcome Kathy Nemaric!

I encourage you get become involved in your organization. It is participation from our membership that allows us to fulfill our vision of optimizing the health, welfare, and conservation of zoo animals and wildlife through education, scientific study, collaboration and advocacy. And speaking of our mission, AAZV has been able to fund 33 research grants since 2012. You will have the opportunity to hear about the results of two of these projects at this year’s conference: sloths as sentinels of ecosystem health and nutritional status of rehabilitated green sea turtles.

Lastly, serving as an AAZV officer the past 4 years has been an incredible experience and I thank you for this opportunity.

With gratitude,

Meg Sutherland-Smith
President, American Association of Zoo Veterinarians
Dear Colleagues and Friends,

On behalf of the Scientific Program Committee (SPC), I have the great pleasure of welcoming you to the 47th Annual Conference of the American Association of Zoo Veterinarians (AAZV). The members of the SPC, Deena Brenner, Susie Bartlett, Allison Tuttle, Kristen Phair, Kelly Helmick, and Scott Larsen have dedicated tireless hours to make this year’s conference a success, along with our gracious local hosts at Oregon Zoo led by Tim Storms and Mitch Finnegan. We are fortunate this year to be offering our conference concurrently with the Association of Zoos and Aquariums (AZA) Nutrition Advisory Group (NAG). I hope you will take advantage of the excellent presentations offered by both organizations.

The conference program continues to evolve each year based on your feedback. This year we adopted an “open call” for all abstracts, with a particular emphasis on a few topics. Our 29 session chairs had the arduous task of selecting from over 245 submitted abstracts to develop 14 scientific sessions. These sessions are filled with cutting-edge presentations and represent a blend of taxa and discipline based themes. An additional 32 posters will present fascinating research and clinical medicine. Based on positive feedback and interest from members, a session focused on leadership is offered this year during the general conference program, in addition to a half-day workshop on the final day of the conference. Several featured speakers will present focused lectures on important topics, such as the great ape health project. Finally, the Masterclass sessions continue this year with a variety of advanced clinically relevant topics.

Twenty-four hours of continuing education credit is available in the program this year, certified by the American College of Zoological Medicine. The 12 amazing and diverse workshops being offered this year allow for up to an additional 19.5 hours of credit. Representing a blend of hands-on, clinical medicine and in-depth didactic presentations, we hope everyone finds a workshop that appeals to their educational and professional needs.

The SPC always welcomes your feedback through the conference survey to help us continually enhance and grow the program each year! We would like to gratefully acknowledge the tireless efforts of Rob Hilsenroth, AAZV executive director, and Adine Nicholson, Julie Fazlollah, Kathy Nemaric, and Matt Brooks for their support in making this year’s conference a success.

Finally, welcome to Portland! We hope you have a wonderful time at the conference advancing your professional development and spending time among friends!! And don’t forget to take a moment to “smell the flowers” and explore the beauty Oregon has to offer!! We hope you return home excited about the future of our profession and the differences we can make in animal health, education, and conservation.

Best wishes,

Jessica Siegal-Willott, DVM, Dipl. ACZM
Chair, AAZV Scientific Program Committee
Supervisory Veterinary Medical Officer, Dept. of Wildlife Health Services, Smithsonian Institution’s National Zoological Park
American Association of Zoo Veterinarians
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The Madagascar Fauna and Flora Group (MFG) is an international consortium (with partners in nine countries on five continents) of 27 zoos and aquariums, a botanical gardens and a university that support conservation at Betampona Natural Reserve and Parc Ivoloina, both near Tamatave, Madagascar. The MFG’s approach to conservation is holistic, and includes animal health as an integral part of its research and management programs. Membership levels are Managing ($10,000/yr), Contributing ($5000/yr), Supporting ($2500/yr), and Friends of the MFG (<$2500/yr). Memberships are made in 3-yr commitments as conservation needs are ongoing and long term.

The MFG was founded in 1988 in response to a request from the Malagasy government for assistance in protecting their biodiversity. Since Madagascar is one of the world’s 10 poorest countries, has a booming population, and faces massive deforestation, the conservation needs of this biodiversity “hotspot” are immense. At Parc Ivoloina the MFG supports a 282-hectare native fauna zoo, eco-agricultural station, botanical propagation center, training center, and an environmental education center. At the 2228-hectare Betampona Natural Reserve, the MFG protects and carries out research in one of the most biodiverse remnants of Madagascar’s eastern lowland rainforest.

The MFG’s activities are integrated across various disciplines and at both sites are centered on four areas of activity: 1) conservation action, 2) capacity building, 3) environmental education, and 4) conservation research.

Conservation Action

Conservation action takes many forms. At Parc Ivoloina, three priority lemur species are part of breeding programs that serve as reservoirs for global lemur populations. For example, exchanges of the greater bamboo lemurs, *Prolemur simus*, have taken place between Parc Ivoloina and European zoos. The Ivoloina Forestry Station houses a model farm for sustainable agriculture, a tree nursery for endangered plant species, and restoration project for damaged land. The MFG is also part of an emergency conservation action to control the invasive toad, *Duttaphrynus melanostictus*, in the Tamatave region. At Betampona, the ranger patrols of the park are supported by the MFG. From 1997 to 2001, 13 captive-bred black-and-white ruffed lemurs, *Varecia variegata*, were reintroduced into Betampona. Several survived and genetically reinforced the wild population. Around Betampona, there is also an active effort to restore the peripheral zone of vegetation.
Capacity Building

Capacity building includes the use of the Ivoloina Conservation and Training Center at Parc Ivoloina, a facility that includes a lecture hall, a laboratory and dormitories. Training in sustainable agriculture and agroforestry for local farmers and school children is carried out in the villages around Parc Ivoloina and Betampona. In partnership with the University of Antananarivo College of Veterinary Medicine, there is a program to train Malagasy veterinarians in conservation medicine.

Environmental Education

A newly renovated Environmental Education Center offers environmental classes for Malagasy students and teacher training. The community actively participates in several annual events, including World Environment Day. One program that was adopted by UNICEF and replicated at three other conservation sites in Madagascar is “Saturday Schools.” When large numbers of village students failed to pass the exam that would allow them to continue on in school, their parents asked MFG to help them improve (their pass rate has gone from ~15% to 80+%).

Conservation Research

MFG’s conservation research program is multifaceted. Long term mapping and meteorologic data at Betampona are being used to monitor climate change. Plant research focuses on long term botanical plots and regeneration studies. Invasive plants, particularly guava and torch ginger, are a significant problem at Betampona. Mapping of their pattern and spread has been followed by research on how to best eradicate them (e.g., coppicing appears to be a promising management tool). Amphibian researchers have identified 30+ new species at Betampona. Mammalian research has focused on lemurs, particularly following the Varecia reintroductions, and recently began studies on the impact of introduced carnivores and rodents on endemic small mammals and carnivores. The impact of diseases in lemurs, small mammals and carnivores has been and remains a research focus. Recently, a One Health project surveyed the health of people around Betampona and studied their consumption of bush meat (fortunately the population was relatively healthy and bush meat consumption relatively low).

In summary, the MFG offers a holistic approach to protecting and studying an extremely biodiverse and threatened portion of Madagascar. The support of zoos, a university and a botanical garden sustains significant, integrated research, including that related to animal health, habitat protection, education and community development. For more information, go to: www.madagascarfaunaflora.org.

Key words: Animal health, conservation, lemur, Madagascar, research

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AN OVERVIEW OF THE ST. CATHERINES ISLAND GOPHER TORTOISE (Gopherus polyphemus) RELOCATION AND RESEARCH PROJECT, 1994 to 2015

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Abstract

St. Catherines Island (SCI) is a privately owned barrier island off the coast of Georgia. A population of 74 (23 males, 32 females, and 19 immature) gopher tortoises (Gopherus polyphemus) was translocated from a development site in Bulloch County, Georgia to SCI in 1994. Approximately 25-30 free-ranging tortoises had been released from 1987 to 1993 and, consequently, were already present when founders from Bulloch Co., Georgia, were released on the island. The primary habitat utilized by the tortoises is a 162-ha pasture at the north end of the island that was created for cattle grazing in 1950 and planted with several types of grasses. Although grazing by cattle has been discontinued since 1982, the open habitat is maintained primarily by mowing and occasional burning, resulting in savanna-like grassland with a scarce over-story of longleaf, slash, and loblolly pines. Bi-annual trapping was conducted each fall and spring from 1994 to 1998. Annual spring sampling resumed in 2001 and continued into 2013. Several waif and/or rehabbed tortoises have been released on the island after receiving a thorough physical examination and diagnostic workup. The population has been monitored long term for health, disease, reproduction, genetics, spatial ecology, and nutrition. Additionally, a large number of research and training opportunities for graduate and veterinary students have been provided through this effort. Several peer reviewed manuscripts have been published from this long term project. A head start program from eggs collected from nests from this population to supplement other sites in Georgia has been recently established.

Key words: Gopherus polyphemus, gopher tortoise, health assessment, translocation

ACKNOWLEDGMENTS

The authors thank the many individuals and organizations that have assisted with this project over the years. In particular, we thank Royce Hayes and John Behler (deceased).
THE SNOWY OWL IRRUPTION OF 2013-2014: THE ZOO VETERINARIAN’S CONTRIBUTION TO UNEXPECTED LOCAL CONSERVATION

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Abstract

During the winter of 2013-2014, an unusual visitor graced the East Coast of the USA, appearing in the Mid-Atlantic region in the highest numbers seen in over 40 yr. The appearance of juvenile snowy owls (Bubo scandiacus) in more widespread regions provided a chance to collect information about the population movements and health of this species.

Project SNOWstorm (www.projectsnowstorm.org) is a collaborative effort of numerous state governments, wildlife rehabilitation centers, universities, and other entities. The veterinary staff at the Maryland Zoo in Baltimore have a close working relationship with the Maryland Department of Natural Resources and collaborate on projects involving various native Maryland species such as black bears (Ursus americanus), bald eagles (Haliaeetus leucocephalus), and bog turtles (Glyptemys muhlenbergii). The zoo has exhibited snowy owls for several decades, equipping the veterinarians with the knowledge of their common diseases, normal blood values in captivity, handling, and behavior.

During the irruption 22 GPS/GMS transmitters were placed on owls captured in various states. Necropsies were performed on owls that were found dead. Live owls were sampled whenever possible to establish normal complete blood counts, biochemistry values, and toxicology data in wild snowy owls. The Maryland Zoo became the central biobank for blood samples and sampled many of the birds found in Maryland. Injured birds were assessed at the zoo in some cases, including one owl that was treated for a wing tip luxation and subsequently released. This collaborative project highlights the contribution that zoo veterinarians with their unique qualifications can make to larger projects involving native species.

Key words: Bubo scandiacus, irruption, local conservation, snowy owl
WORKING EFFECTIVELY IN A MULTI-ETHNIC CONSERVATION FIELD TEAM IN A DEVELOPING COUNTRY

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Abstract

Working effectively in a field conservation team in a developing country can be very challenging and very rewarding. Understanding the field setting, managing expectations of team members and understanding cultural differences are keys to being able to work effectively.

The Field Setting

A knowledge of the study site's remoteness, climate, geography, infrastructure, security issues, transportation and supply availability are essential to pre-trip planning. These factors define equipment requirements, team composition and project duration.

Managing Team Members’ Expectations

A field team includes a number of individuals fulfilling different roles, all of which are essential to the successful completion of the mission. These roles range from porters and trackers to field biologists and veterinarians. It is important that each team member is treated with respect and acknowledged for his contributions. Each team member should sign a contract that details his duties, pay and duration of employment. This is especially important for daily paid workers.

Understanding Cultural Differences

Acknowledging cultural differences, beliefs and customs is key to working effectively in the field. The ability to “translate” local customs and beliefs into a western equivalent adds to mutual understanding and respect and thus makes for a smooth field experience. Examples of such translations of local customs and beliefs to western equivalents are described in Table 1.

Key words: Developing country, field conservation, field team

LITERATURE CITED

**Table 1.** Translations of customs and beliefs to western equivalents.

<table>
<thead>
<tr>
<th>Local custom or belief</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don’t take the gizzard but, if offered it,</td>
<td>Don’t expect or demand respect or special privilege but, if offered, accept with grace</td>
</tr>
<tr>
<td>accept with grace</td>
<td></td>
</tr>
<tr>
<td>Don’t dart my totem</td>
<td>Respect local customs and beliefs</td>
</tr>
<tr>
<td>Don’t let the phantom get to you</td>
<td>Don’t be the limiting factor in field operations</td>
</tr>
<tr>
<td>Taboo</td>
<td>A gracious way to decline or say “no”</td>
</tr>
<tr>
<td>Cadeau</td>
<td>Reward excellence</td>
</tr>
<tr>
<td>It’s the economy stupid</td>
<td>The average person in developing countries lives on less than $2.00/day</td>
</tr>
</tbody>
</table>
MORBIDITY AND MORTALITY OF ENDANGERED FREE-RANGING GOLDEN MONKEYS (Cercopithecus mitis kandti) IN RWANDA

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Abstract

The golden monkey (Cercopithecus mitis kandti), found in just a few small forests of Central Africa, is classified as Endangered by the IUCN with its population decreasing in number. Little data has been published on this subspecies. Between 2002 and 2014, 36 golden monkeys underwent various degrees of health assessment by the Mountain Gorilla Veterinary Project. All were located within the Rwandan region of the Virunga Massif, in or around the Volcanoes National Park or Gishwati Forest. Of the 36 golden monkeys assessed, there was a predominance of adults (29/36) and males (29/36), attributed to the social structure of the species. Most ante-mortem health assessments were performed during snare removal or relocations under anesthesia with medetomidine/ketamine (average dose 0.033/4.64 mg/kg), dexmedetomidine/ketamine (average dose 0.022/3.91 mg/kg), or ketamine alone (average dose 8.32 mg/kg). Parasitology examination revealed trichuriasis, cestodiasis, and non-pathogenic nematodiasis (predominantly strongyloidiasis). Hematology and biochemistry values of golden monkeys assessed to be healthy were consistent with ISIS reference ranges for their close relative the blue monkey (Cercopithecus mitis stuhlmanni). Serology indicated exposure to viruses similar to Epstein-Barr virus (9/9), hepatitis A virus (8/9), adenovirus (7/9), chimpanzee cytomegalovirus (6/9), Simian foamy virus (5/9), influenza A (3/9), and Simian T-cell leukemia virus (2/9). Causes of death included trauma (16/23), neoplasia (4/23) of which three were lymphoma, gastrointestinal inflammatory disease (2/23), and infectious disease (1/23). Baseline parameters and disease susceptibility from this study are useful data for captive Cercopithecus (guenon) species as well as understanding disease distribution in the Virunga Massif ecosystem.

Key words: Cercopithecus mitis, clinical pathology, disease, free-ranging, golden monkey, Rwanda

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LITERATURE CITED


RETROSPECTIVE STUDY OF MORBIDITY AND MORTALITY OF WILD GOPHER TORTOISES (Gopherus polyphemus) ADMITTED TO THE UNIVERSITY OF FLORIDA, 1998-2014

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Abstract

The gopher tortoise (Gopherus polyphemus) is a vulnerable terrestrial tortoise native of the southeastern United States, and is a frequent victim of direct and indirect human activity. The need for understanding the factors causing morbidity and mortality is of primary importance for conservation efforts. The medical records of 490 wild gopher tortoises admitted to the University of Florida Zoological Medicine Service over a 16-yr period (1998-2014) were reviewed to determine common causes of morbidity and mortality, and to determine the effects of season and animal size on their outcome. Negative outcomes included death and euthanasia, and positive outcomes included rehabilitation, release, or permanent captivity. The two most common clinical presentations were dog predation (39.8%, n = 195) and vehicular trauma (35.7%, n = 175). More tortoises presented during the summer months (74.3%, May-October) than during the winter months (25.7%, November-April). Of all gopher tortoises presented for dog attack between 2007 and 2014, 30.6% died or were euthanized within 3 days of presentation, whereas 59.2% had a positive outcome. Of all gopher tortoises presenting with vehicular trauma between 2007 and 2014, 56.9% died or were euthanized within 3 days of presentation, whereas 34.3% had a positive outcome. The average body sizes at presentation of gopher tortoises attacked by dogs and hit by vehicles were 1.97 kg and 2.69 kg respectively. Human activities, in particular vehicular trauma and predation by domestic dogs, were significant causes of morbidity and mortality of wild gopher tortoises in north-central Florida.

Key words: Dog predation, gopher tortoise, Gopherus polyphemus, morbidity, mortality, vehicular trauma
VETERINARY PATHOLOGY CAPACITY BUILDING FOR CONSERVATION PROGRAMS: EXAMPLE OF THE GIANT PANDA PATHOLOGY INTERNATIONAL EXCHANGE TRAINING WORKSHOP

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Abstract

Postmortem disease surveillance is fundamentally important for any wildlife conservation program. Complete postmortem examinations are essential for investigating causes of morbidity and mortality, for collecting baseline health data, and for building a sample archive for research. For projects operating internationally and in developing regions, there is often a crucial need to build in-country veterinary expertise and/or foster veterinary specialization in areas such as pathology, molecular diagnostics, epidemiology, and medicine of non-domestic animals. Challenges of such capacity building efforts are often logistical, and can include language translation, availability of supplies, and bureaucratic concerns such as permit requirements and tax forms. However, the potential benefits for conservation and for international collaborative relationships are numerous and significant.

Chinese conservation priorities are increasingly focused on reintroducing giant pandas (Ailuropoda melanoleuca) into their native habitats and investing in disease control and prevention. In November, 2014, we implemented a pathology training workshop for Chinese veterinary professionals at the Dujiangyan Giant Panda Rescue and Disease Control and Prevention Base, Sichuan Province, China. This was the first of a series of planned veterinary workshops that are viewed as the initial step in an ongoing effort to build veterinary and epidemiologic expertise in China to contribute to disease prevention and control for giant pandas and other Chinese wildlife. The workshop was attended by 26 participants from 18 zoos, wildlife parks, or giant panda research centers in China. Instruction was conducted via wet labs, lectures, a computer database session, and case-based learning exercises, and language translation was performed by a professional service. Post-workshop questionnaires were administered to participants to evaluate initial outcomes and to elicit feedback. Specific challenges and lessons learned from this capacity building workshop included the need to accommodate unexpected scheduling changes, difficulties identifying Chinese or panda-specific pathology case material, the importance of translators with knowledge of medical terminology, and the complexities of transferring funds internationally for workshop support. The results of the post-workshop survey were positive, and strongly suggest that trainees intend to perform more systematic necropsies on a greater proportion of mortalities. Another valuable outcome was the establishment of new communication channels between wildlife veterinary professionals within China, and internationally. We expect that this will facilitate more open communication and collaboration for pathology and postmortem disease surveillance in the future. Follow-up with participants at 1 and...
2 yr post workshop will be conducted to evaluate longer term outcomes. Training materials from this project, though focused on giant panda pathology, are adaptable to other species and conservation programs, and could be used as a general instructional template for international capacity building in veterinary pathology and disease investigation.

**Key words:** *Ailuropoda melanoleuca*, capacity building, China, giant panda, veterinary pathology

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SLOTHS AS SENTINELS OF ECOSYSTEM HEALTH: EVALUATION OF AGRICULTURAL PESTICIDES IN PLASMA OF FREE-RANGING HOFFMANN’S TWO-TOED (*Choloepus hoffmanni*) AND BROWN-THROATED THREE-TOED (*Bradypus variegatus*) SLOTHS

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Abstract

Pesticide exposure is a well-documented risk factor in wildlife population declines, particularly in delicate and threatened tropical rainforests. Costa Rica supports 5% of the world’s total biodiversity, but uses the highest volumes, per unit area, of pesticides in the world. This combination suggests that animals living in Costa Rican agricultural plantations and in surrounding ecosystems are chronically exposed to significant levels of various insecticides, fungicides, and herbicides. Currently, there are no published reports of pesticide accumulation in sloths, which could serve as ideal sentinel species for ecosystem health in Costa Rica, as they are the most abundant mid-size mammal, share habitat with people, and in Limon Province (our study site) there is a high density of conventional banana and pineapple plantations on which pesticides are applied. Within this region, FINMAC, an organic cacao plantation, supports a stable population of sloths, many of which are radio-collared for behavioral ecology and genetic studies. Since fruit plantations border our study site, we hypothesized that sloths, living on the periphery of the cacao plantation, had higher circulating concentrations of pesticides than those living in either the center of the study site, or control animals (sloths living in U.S. zoos). To investigate this hypothesis, we collected blood samples from sloths in three groups; 1) peripheral study site, 2) central study site, and 3) a subset of U.S. zoo sloths. We quantified circulating pesticides, and their metabolites, via liquid chromatography and mass spectrometry and/or gas chromatograph equipped with an electron capture detector, including: 1) chlorothalonil and its metabolite, hydroxyl chlorothianil; 2) diazinon and its metabolite, 2-isopropyl-6-methyl-4-pyrimidinol; 3) thiamethoxam; 4) chlorpyrifos; 5) ethyl phosphonic acid; and 6) ametryn. Information acquired from this study will direct future efforts to determine the impacts of pesticide exposure on sloths, the local ecosystem, and, eventually, human health in Limon Province of Costa Rica.

Key words: Sloth, pesticides, Costa Rica, *Choloepus, Bradypus*, ecosystem health

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THE U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT’S EMERGING PANDEMIC THREATS PREDICT PROJECT: TOWARDS A PROACTIVE PARADIGM FOR EARLY DISEASE DETECTION AND RESPONSE

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Abstract

Most emerging infectious diseases (EIDs) in people originate in wildlife and have arisen in the developing world. Population growth and environmental change bring people into contact with wildlife in unprecedented ways and increasing frequency, yet many nations lack the resources and infrastructure necessary to detect and respond to EIDs in a timely, effective manner. The U.S. Agency for International Development’s (USAID) Emerging Pandemic Threats PREDICT project, led by the UC Davis One Health Institute and the PREDICT consortium (EcoHealth Alliance, Metabiota, Wildlife Conservation Society, and Smithsonian Institution), is advancing global capacity for EID detection and control. Launched in 2009, to date the PREDICT consortium has humanely sampled more than 56,000 wild animals (primarily primates, bats and rodents) with human contact, and has detected 169 known viruses and 815 novel mammalian viruses, including dozens closely related to known causes of human disease. As well, PREDICT has played a key role in investigating the cause of human and wildlife disease outbreaks, including several caused by Ebola virus and yellow fever. In the second 5-yr phase of the project (2014-2019), the focus is now on further elucidating potential EID transmission pathways and spillover risk. Sampling of people and livestock is being conducted concurrently with wildlife sampling at high-risk interfaces involving wildlife value chains, animal agriculture intensification, and landscape conversion for commercialization, in order to document pathogen sharing and spillover mechanisms. In addition, human behaviors that increase risk for exposure to EIDs are being documented, in order to inform recommendations for reducing the potential for disease emergence and pandemics. While core PREDICT objectives center on protecting human health, wildlife conservation benefits include improved diagnostic laboratory capacity and greater governmental awareness and investment in wildlife population management.

Key words: EIDs, emerging infectious disease, spillover, virus, wildlife, zoonoses
EMERGING PARASITIC AND INFECTIOUS DISEASES OF WILD ASIAN ELEPHANTS (Elephas maximus) IN UDAWALAWE NATIONAL PARK, SRI LANKA

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Abstract

The Asian elephant (Elephas maximus), is IUCN listed as an endangered species. With well over 10% of the global Asian elephant population in less than 2% of the global range for Asian elephants, Sri Lanka is home to the highest density of Asian elephants in the world.1 According to the census conducted in 2011 by the Department of Wildlife Conservation of Sri Lanka, there are 5,879 wild elephants living in the country. Human-elephant conflict is the major threat for elephant conservation in Sri Lanka. There are over 200 elephant deaths recorded annually and most deaths are due to anthropogenic activities. Currently there are several preventive measures implemented by the government in Sri Lanka to reduce the human elephant conflict. Among these, attempting to confine the movements of elephants to national parks using electric fences is practiced in a number of areas in the country.

The Udawalawe National Park is a protected area and occupies 308 km² in the southern dry zone of Sri Lanka. The park has been electric-fenced in successive stages, leaving open two exits for wildlife via the Dahaiyagala and Lunugamwehera corridors.1

Udawalawe National Park and adjacent elephant ranging areas are home to 600-800 wild elephants. An average of 12 elephant deaths per year are recorded in this ecosystem.The Department of Wildlife Conservation records all elephant deaths and conducts thorough post-mortem examinations to establish the cause of death. This study reports the results of post-mortem examinations of 14 wild elephants conducted in 2014; deaths of five elephants were due to the parasite Parabronima smithi and one death was due to tuberculosis (TB). The remaining five deaths were due to a variety of causes (e.g., gunshots, accident, orphaning) while three deaths were not conclusive due to decomposed carcasses.

The five elephant deaths associated with the parasite Parabronima smithi are alarming. This parasite belongs to the Spiruride family and causes caseous ulcers in the stomach wall. On gross necropsy, the margins of the ulcers were elevated and the Parabronima parasites could be observed in the ulcers as well as in adjacent mucosa of the stomach wall. The parasite was identified by morphology and PCR. The age range of affected animals was 2-35 yr. This is the first identification of the parasite, Parabronima smithi and its associated mortalities in wild elephants in Sri Lanka.
The death due to TB is also a major concern. The elephant was a female of approximately 35 yr old. There were typical tuberculosis granulomas affecting > 60% of lung tissue. Histopathology, culture and isolation of an acid-fast organism, and PCR confirmed the causative organism as *Mycobacterium tuberculosis*.

Although tuberculosis is a major re-emerging infectious disease among captive elephants worldwide and a potential concern for wild populations, this is the first confirmed case of tuberculosis among wild Sri Lankan elephants in Sri Lanka, and possibly the first confirmed case in a wild elephant in Asia. *Mycobacterium tuberculosis* is of course also the primary causative agent for human TB. The source of infection for this elephant was unclear, as no data is available regarding its human contacts, and there are no known wildlife reservoirs of *M. tuberculosis* in Sri Lanka. Despite movement restrictions and protection from human elephant conflict, the elephants in the Udawalawe National Park are exposed to large numbers of visitors who enter the park on safari. The zoonotic potential of TB from wild elephants therefore is a matter of concern.

The emergence of parasitic and infectious diseases in wild Asian elephants could be due to chronic stress associated with human disturbances and the increasing density of elephants. Further studies are underway to study the prevalence of these two diseases among wild elephants. In the long term, the effects of anthropogenic activities of habitat destruction and restriction of movements to prevent human elephant conflict in wild elephants in Sri Lanka requires more thorough investigation to protect the species from stress-related diseases that can lead to more deaths and a reduced population.

**Key words:** Asian elephant, *E. maximus*, human-elephant conflict, *M. tuberculosis*, P. smithi

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**LITERATURE CITED**


NEUROLOGIC DISEASE ASSOCIATED WITH *Anaplasma phagocytophilum* INFECTION IN CAPTIVE PRZEWALSKI’S HORSES (*Equus ferus przewalskii*) IN VIRGINIA, USA

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Abstract

*Anaplasma phagocytophilum* (previously known as *Ehrlichia equi*) is an emerging tick-borne pathogen of domestic horses that is the causative agent of Equine Granulocytic Anaplasmosis and affects a wide variety of mammals, including humans. This pathogen was first reported in Virginia domestic horses in 2009 and seems to have an expanding range to match that of its primary eastern North American vector, *Ixodes scapularis*. From 2008-2014, there were four confirmed cases of clinical anaplasmosis in three captive Przewalski’s horses (*Equus ferus przewalskii*) at the Smithsonian Conservation Biology Institute in Virginia, USA. Affected horses exhibited lethargy, weakness, hyporexia, reluctance to move, ataxia and pyrexia. Clinicopathologic findings were varied among cases, but included leukopenia, thrombocytopenia, and anemia. Neutrophilic morulae were not an uncommon finding on peripheral blood smears. Diagnosis was confirmed with a combination of convalescent titers, neutrophilic inclusions, and PCR testing. A fourth horse is suspected to have been affected based on clinical signs, exclusion of other etiologies with CSF testing, and response to empirical therapy. All animals recovered after antimicrobial therapy with oxytetracycline (10 mg/kg i.v. once then i.m. b.i.d. or s.i.d.) and/or minocycline (4 mg/kg p.o. b.i.d.). This case series reveals that *A. phagocytophilum* should be included on any differential list for neurologic disease in an exotic equid within or near an enzootic area.

**Key words:** *Anaplasma phagocytophilum*, anaplasmosis, *Equus ferus przewalskii*, Przewalski’s horse
OPHIDIOMYCOSIS (SNAKE FUNGAL DISEASE) IN NEW JERSEY WILD SNAKES

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Abstract

Ophidiomyces ophiodiicola (Oo) is the leading fungal pathogen of captive snakes and also causes snake fungal disease (SFD), an emerging disease of wild snakes in the United States. Necropsies on carcasses of two wild snakes collected in New Jersey in 2012, a black rat snake (Pantherophis alleghaniensis) and a Northern copperhead (Agkistrodon contortrix mokasen), showed that they died with extensive cutaneous lesions due to ophidiomycosis (SFD) and suspected ophidiomycosis, respectively (Paré and Schantz, unpublished data). This prompted a collaborative New Jersey Department of Fish and Wildlife (NJDFW) and Wildlife Conservation Society (WCS) health survey of free-ranging snakes in 2013 and 2014. The aim of the study was to determine if ophidiomycosis was present among populations of endangered timber rattlesnakes (Crotalus horridus) in the Pinelands and in the Northern Region of New Jersey and if so, to assess the impact of the disease on these populations. Known timber rattlesnake hibernacula, transient basking habitats, and gestation sites were visited from emergence in end-April/early May, and throughout the summer. Sick snakes, defined as any snake with visible skin lesions, were captured and transferred to the WCS Wildlife Health Center (WHC). Snakes were immobilized, weighed, sexed, transponded, and morphometric measurements were recorded. Whole body radiographs were obtained and blood collected. Skin lesions were described and recorded. Biopsies of skin lesions were collected for histopathology and fungal culture. Snakes were housed at the WHC as needed or until lesions resolved, and were then released at capture sites. Ophidiomycosis was diagnosed in snakes from the Northern Region and the Pinelands. Timber rattlesnakes were the predominantly affected species, but disease was also recorded in black rat snakes, corn snakes (Pantherophis guttatus), Northern black racers (Coluber constrictor constrictor), and Northern pine snakes (Pituophis melanoleucus melanoleucus).

Lesions in affected timber rattlesnakes were often mild, sometimes moderate, and consisted of dried crusts and focal scale necrosis, with or without subjacent tissue swelling, often over the head but also along the body. These were similar to lesions referred to over many years as “hibernation blisters” or “hibernation sores”, and traditionally dismissed by field biologists as being “normal” upon emergence from hibernacula. Hyaline, slender, parallel-walled, branching, septate hyphae were present in H&E stained tissue sections. Surface arthroconidiation, a common histologic feature of Oo skin infection, was noted in several snakes. Culture grew Oo, and identification was confirmed with molecular probes. Infection in one corn snake caused unsightly distortion of facial structures that were severe enough to warrant consideration of euthanasia, but resolved remarkably well with successive sheds. Lesions in a black rat snake were different and consisted of multiple doughy to fluctuant subcutaneous swellings scattered along the lateral and dorsal aspects of the body; these were confirmed to be Oo subcutaneous granulomas, based on histology and culture.
This presentation of ophidiomycosis is atypical for SFD in wild snakes, but is not unusual in captive colubrids. *Oo* isolates usually fail to grow at 35°C; limited thermotolerance and increased immune efficiency may partly explain why lesions in rattlesnakes, corn snakes, and pine snakes typically resolved after successive sheds when snakes were provided with thermal support and a clean environment. Lesions in the black rat snake regressed with systemic itraconazole, but then recurred. This snake is currently on a combined itraconazole and terbinafine treatment regimen.

Results of this study indicate that *Oo* is present in the North Region and Pinelands ecosystems in New Jersey. Lesions identical to those labeled as hibernation sores in the past were determined to be due to *Oo*, suggesting the disease might have been present for over a decade in wild snakes in New Jersey. Heat and sunlight, or thermal support in captive animals, might allow for gradual spontaneous or unassisted regression of lesions with every successive shed in many if not most rattlesnakes.

**Key words:** Ophidiomycosis, *Ophidiomyces ophiodiicola*, snake fungal disease
EPIZOOTIC HEMORRHAGIC DISEASE IN A HERD OF TIBETAN YAK (Bos grunniens)

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Abstract

Epizootic hemorrhagic disease (EHD) is caused by an Orbivirus that affects wild and domestic ruminants, and is most commonly diagnosed in white-tailed deer (Odocoileus virginianus).1 This virus is often transmitted by Culicoides species, or other species of biting gnats and flies. During summer 2014, an outbreak of EHD occurred in southern Oregon, affecting both white-tailed deer and black-tailed deer (Odocoileus hemionus columbianus). During this time, eight Tibetan yak (Bos grunniens) housed on a 200-acre free roaming pasture at Wildlife Safari presented with hemorrhagic disease and fever. Clinical signs in affected yak included hyperthermia, hematochezia, scleral hemorrhage, respiratory distress, hind limb ataxia, presence of a toxic line on the oral mucosa, and peracute death. Marked thrombocytopenia occurred in all affected animals. Aggressive therapy with broad spectrum antibiotics, fluids, and supportive care were attempted in each case, but all eight animals died. Gross necropsy findings included hemorrhage within the subcutis, gastrointestinal hemorrhages, and gall bladder distension. No oral lesions were noted. Histologic findings in these mortalities included widespread hemorrhage, pulmonary congestion and edema, acute myocardial necrosis, multifocal fibrinoid vasculopathy, marked cholestasis, and evidence of hemoglobinuric nephrosis. EHD was identified by PCR in five yaks tested, but virus isolation attempts were unsuccessful. As clinicopathologic findings were similar for all eight dead yak, it is assumed that all died of EHD. These findings differ from a previously recorded outbreak of EHD in Tibetan yak in Colorado,2,3 suggesting that a broader range of clinical presentation for EHD in this species should be considered.

Key words: Bos grunniens, EHD, epizootic hemorrhagic disease, Tibetan yak

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LITERATURE CITED


IDENTIFICATION OF NOVEL HERPESVIRUSES AND ADENOVIRUSES FROM SEABIRDS

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Abstract

Herpesviruses and adenoviruses are significant avian pathogens that usually have coevolved with specific hosts that they may persistently or latently infect. Human impacts on our oceans are significant, and environmental degradation is expected to exacerbate the effects of viral pathogens. Little is understood of seabird viruses. We surveyed diverse seabird species for these viruses, resulting in identification of novel herpesviruses and adenoviruses. Larid Herpesvirus 1, in the genus Iltovirus, was identified from ring-billed gulls (Larus delawarensis). While a herpesvirus has previously been identified in common loons (Gavia immer), we have identified a second novel loon herpesvirus, Gaviid Herpesvirus 2. A novel herpesvirus of northern gannets (Morus bassanus), Sulid Herpesvirus 1, and a novel herpesvirus of Humboldt penguins (Spheniscus humboldti), Spheniscid herpesvirus 1, also were identified. Novel viruses in the genus Aviadenovirus were identified, including Ring-billed gull aviadenovirus 1, Brown pelican aviadenovirus 1, Wood duck aviadenovirus 1, and three from northern gannets. One novel virus in the genus Atadenovirus was identified from a brown pelican (Pelecanus occidentalis), Brown pelican atadenovirus 1. In the genus Siadenovirus, two northern gannet siadenoviruses were identified, Northern gannet Siadenovirus 1 and Northern gannet Siadenovirus 2. A member of the genus Ichtadenovirus found in a ring-billed gull may have been infecting fish prey and likely represented a pass-through. Although further data is needed, the ability of adenoviruses and herpesviruses to recrudesce and cause clinical disease in seen in poultry. The potential clinical significance of these viruses will be discussed.

Key words: Adenovirus, herpesvirus, phylogeny, seabirds, virus surveillance

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LITERATURE CITED

EFFICACY OF INTRACOELOMIC ENROFLOXACIN FOR THE TREATMENT OF SEA STAR WASTING DISEASE IN FOUR SPECIES OF CAPTIVE ASTEROIDEA

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Abstract

Sea star wasting disease (SSWD) is associated with one of the largest marine wildlife die-offs ever recorded, killing millions of sea stars from Alaska to Mexico since the summer of 2013.1 Over 20 species of sea stars have been affected by SSWD. Anecdotal reports suggested that enrofloxacin administered via intracoelomic injection (i.c.) was effective in treating SSWD in captive sea stars. Fifty-two sea stars from the five genera (Pycnopodia, Pisaster, Evasterias, Dermasterias, and Orthasterias) all showing early signs of SSWD, were randomly assigned into a treatment group (n = 26, enrofloxacin 5 mg/kg, i.c. q4 days) and a control group (n = 26, saline 0.9%, i.c. q4 days) for a total of six treatments. Animals were monitored and graded for severity of lesions twice daily. The scores were not significantly different between groups throughout the study period. At day 20, after four treatments, the mortality rate was 100% and 77% in the control and treatment groups respectively and was not significantly different (P = 0.55). At day 30, after six complete treatments, the mortality rate in the treatment group was 95% and there was no significant difference between the two groups (P = 0.9). While enrofloxacin given intracoelomically at 10 mg/kg to sea stars results in high drug concentrations in the hemolymph of sea stars (J. Rosenburg, pers. comm.), administration of enrofloxacin by injection did not alter mortality rates significantly in captive sea stars affected by SSWD and is therefore not recommended for the treatment of this disease in commonly affected species.

Key words: Dermasterias, enrofloxacin, pedicellariae, Pycnopodia, sea star, sea star wasting disease

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LITERATURE CITED

THE NORTH AMERICAN MODEL OF CONSERVATION: AUTHORITIES AND MANAGEMENT OF DISEASE

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Abstract

The North American Model of Wildlife Conservation is a retrospective model that has guided wildlife management and conservation decisions in the United States and Canada for the past century. The model's foundation was laid in the 19th century’s conservation movement as the result of the near extinction of several species of wildlife, including the American Bison, and the rise of sportsmen with the middle class. Sportsmen's organizations rallied and advocated for the preservation of wilderness areas and wildlife conservation. The North American Model of Wildlife Conservation is comprised of seven principles or tenets. These tenets are established in law and public policy in the United States:

1. Wildlife as public trust resources
2. Elimination of markets for game
3. Allocation of wildlife by law
4. Wildlife should only be killed for a legitimate purpose
5. Wildlife is considered an international resource
6. Science is the proper tool for discharge of wildlife policy
7. Democracy of hunting

States hold authority to manage fish and wildlife species and set “take” regulations. The federal government has statutory authority over migratory bird species, threatened and endangered species, and wildlife on select federal lands (some national parks) as deemed by congress. Recognized tribes of native people maintain rights to wildlife on ceded lands and some rights on public lands. While state, federal and tribal agencies hold public trust authority of wildlife, the habitats required for wildlife range over all land ownership, including private lands. In addition, certain federal and state agencies have deemed that some wildlife species can be privately owned and have designated them as livestock. Anti-trust laws come into play, making sale and movement of these animals legal.

So, how do authorities address the movement of disease that affects wildlife, livestock and even people? It is a complex quilt of give and take, between individual rights and the public trust, between agriculture and conservation. Two examples from my time with the Michigan Department of Natural Resources will illustrate the complexity of authorities and the tug of competing values.

In 1975, a deer was found to have bovine tuberculosis in Michigan's northern Lower Peninsula. At that time it was believed that bovine tuberculosis was unsustainable in wild deer populations. Fast forward 20 yr and a second positive deer was killed by a hunter and additional testing of the deer of this area was undertaken. Additional diseased animals were found, and so began a multi-decade
battle to try and eradicate bovine tuberculosis from wild deer in Michigan. Since that date, the disease has been found in numerous cattle herds, in the wild deer herd, a privately owned deer farm, in farm cats, in raccoons, and in people. Private livestock has been destroyed and the owners compensated for the value of their loss. Deer have been killed by government sharp shooters, by hunters and by landowners. The U.S. Department of Agriculture has tied their rules for livestock trade to wildlife regulations in an attempt to curtail spread of disease. The State Natural Resources Commission, the body with authority over the method and manner of “take” of game, has passed regulations allowing abundant harvest of deer, required disease testing, and enacted restrictions on the placement of feed and bait for wild deer (thought to contribute to the spread of disease). After two decades, an investment of over $200 million and the killing of thousands of animals, the disease continues to spread.

Lessons learned with bovine tuberculosis, prompted Michigan officials to develop response plans for other diseases including avian influenza and chronic wasting disease. In 2008, a privately owned whitetail deer tested positive for chronic wasting disease (CWD). The 7-acre fenced facility was immediately quarantined along with four other facilities that had been exposed with the infected herd. All deer in the original facility were destroyed and tested. No other infected deer were found at that facility or any of the other facilities. Wild deer were once again killed and tested, and again, no other positive deer were found. The owner of original infected deer was arrested on the first night of the quarantine, after tranquilizing the offspring of the infected doe, and transporting it off the property with the admitted intention of releasing it into the wild. Since the time of detection, additional testing has been done on private deer herds and the wild deer. Restrictions on the placement of feed and bait have been enacted as have restrictions on the import of live private deer and hunter killed carcasses. To date no additional CWD has been detected in Michigan until several weeks ago.

As we battle the diseases that can move from domesticated animals to wild animals or from wild animals to domestic animals, the rights that we have enjoyed for centuries are being challenged. Farmers are frustrated with hunters who want to maintain robust deer populations. Hunters, who pay for state agency conservation work through hunting license fees and excise taxes, are frustrated and vocal when wild deer herds are killed. A successful century of wildlife conservation work is being undermined. Likewise, farmers who raise livestock are negatively impacted when restrictions are placed on the movement of animals and testing requirements.

As we look to the future, there will be even greater demands on our working landscapes to provide space for livestock and agriculture, wildlife habitat and recreation, and people and their domestic animals. Clearly, the rights we have all enjoyed in this past century will have to be curtailed, if we are going to be successful in managing disease. Will individual rights prevail over the public domain? What will happen to our rich wildlife populations or the robust economy that comes from outdoor wildlife recreation? It is time for a new model of shared landscapes that provides better biosecurity for man, livestock and wildlife.

**Key words:** North American model of wildlife conservation, wildlife disease, wildlife management
TOWARDS EVOLVING ONE HEALTH

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Abstract

Urbanization, human encroachment on wildlife habitat, intensive agricultural practices, global transportation, pollution, climate change, and other challenges characterizing the Anthropocene, are altering the epidemiology and incidence of disease.\textsuperscript{12} Newly evolved pathogen strains, first time infections in humans, or increased incidence due to environmental changes describe emerging infectious diseases,\textsuperscript{15} which have been increasing in incidence since 1940.\textsuperscript{8} Chaos theory studies the behavior of dynamic systems that are highly sensitive to initial conditions; aka the “butterfly effect” with many examples in nature.\textsuperscript{3} Populations need to be studied in relation to their interactions with ecological networks and biogeochemical processes, which are often highly complex.\textsuperscript{14} Awareness of the need for and how we go about conserving the Earth’s biosphere has changed through time. The North American Model of Wildlife Conservation and One Health have deep historic roots, and there is a need for them to continue to evolve. The current approach to One Health has been very top-down, coordinated internationally by three organizations, and the One Health Commission leads national efforts.\textsuperscript{11} Thought should be given to the potential value of bottom-up approaches, centralized versus de-centralized models of organization, and better ways to connect veterinarians and conservationists with public health agencies.\textsuperscript{4,11} Science should inform policy; however, public perception plays an important role in the implementation of new policy.\textsuperscript{1,4,7,13} Because ~70\% of zoonotic diseases are of wildlife origin,\textsuperscript{8} there is potential for decreased interest in wildlife conservation among the public.\textsuperscript{4} Strategies to address public perception of risk can be developed by deepening our understanding of perceived risks.\textsuperscript{2,6,10,16} With additional training, veterinarians can engage in a broad range of activities under the One Health umbrella,\textsuperscript{5,9} play key roles in communication among domestic animal, human health, and wildlife conservation communities, and positively affect public policy.\textsuperscript{2}

Key words: Anthropocene, emerging infectious diseases, One Health, risk perception

LITERATURE CITED


Batrachochytrium dendrobatidis IN EASTERN HELLBENDER (Cryptobranchus alleganiensis) POPULATIONS: WHAT WE KNOW AND IMPLICATIONS FOR THE FUTURE

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Abstract

The Eastern hellbender (Cryptobranchus alleganiensis alleganiensis) is a North American salamander species in decline throughout its range.⁷,⁸ Efforts to identify the causes of decline have included surveillance for the chytrid fungus Batrachochytrium dendrobatidis (Bd), which has been associated with global amphibian population losses.²⁵ Several studies have evaluated prevalence of Bd in various hellbender populations in New York, Pennsylvania, Virginia, Ohio, Indiana, Missouri, and Tennessee.¹,³,⁴,⁶

Wild hellbenders have not been reported to display clinical disease associated with Bd, however prevalence in the population is important information for evaluating reservoir status, risk to other species, and as a baseline for investigation in the face of an outbreak of clinical disease.

The importance of surveillance and ongoing research into the behavior of chytrid fungus in these populations is highlighted by the recent emergence of a second species of the fungus, Batrachochytrium salamandrivorans. Although it has not been detected in initial surveys of Eastern hellbenders it appears to have increased pathogenicity in salamander species and is another pathogen of concern when considering amphibian conservation.¹ Since many zoological facilities are active participants in ongoing hellbender conservation and reintroduction efforts the aim of this presentation is to provide clinicians with the most up to date information regarding chytrid in the species.

Key words: Batrachochytrium dendrobatidis, Batrachochytrium salamandrivorans, chytrid, Cryptobranchus alleganiensis alleganiensis, hellbender

LITERATURE CITED


CROSS-CONTINENT COMPREHENSIVE ASSESSMENT OF HEALTH, DISEASE, AND CONTAMINATES IN THE COMMON LOON (Gavia immer)

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Abstract

The summer of 2014 began a 4-yr collaborative common loon (Gavia immer) health assessment across North America involving multiple non-profit organizations, state fish and wildlife agencies, and universities. Samples were collected from 170 loons from four key regions across the continent, including New England (Maine, Massachusetts, New Hampshire, and New York), Midwest (Minnesota), and West (Wyoming, Montana, British Columbia, and Saskatchewan). The goal of the study is to establish a comprehensive health assessment of the common loon populations across these regions. Selected health parameters were chosen to provide an understanding of (1) the overall general health condition of the birds, (2) exposure to contaminants, and (3) disease presence in each region. The health parameters were investigated by analyzing loon blood, feathers, down, and oral and cloacal swabs. The general health parameter analyses included complete blood count, plasma chemistries, packed cell volume, blood lactate, stable isotopes, and genetic profiling. The health parameters for disease presence included Aspergillus panel, hemoparasites, avian influenza virus, bornavirus, and tick diseases. Toxicology analyses included heavy metals such as mercury, lead, and cyanotoxins. The results of this study will 1) provide vital baseline health data on common loons across North America, 2) quantify exposure to environmental contaminants and biotoxins, and 3) measure exposure and shedding of important viral diseases of conservation and public health concern. This information will help guide and prioritize loon conservation efforts across the continent, and provide published loon health parameters for wildlife veterinarians and rehabilitators.

Key words: Aspergillus, avian influenza virus, common loon, cyanotoxins, Gavia immer, health parameters, lead, mercury

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The North American Common Loon health assessment study is a component of Biodiversity Research Institute's "Restore the Call" National Loon Restoration project supported by the Ricketts Conservation Foundation.
THE USE OF KITTY CAMS TO UNDERSTAND THE EFFECTS OF FREE-ROAMING CATS ON WILDLIFE

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Abstract

Wildlife management professionals consider cat predation to be one of the most significant anthropogenic causes of wildlife mortality. Domestic cats are efficient predators that hunt despite food subsidies, yet there is much controversy about their predation rate, their effect on populations of wildlife, and their management. We have been utilizing Kitty Cams (point-of-view camera designed by National Geographic) to quantify the interactions of both free-roaming pet cats in Athens, GA and un-owned cats managed in trap-neuter-return colonies on Jekyll Island, GA, and wildlife. We also utilized mail surveys to elucidate public opinion about feral cat management and factors that influence perceptions. We obtained a minimum of 30 hr of video per cat in order to designate each cat as a hunter or a non-hunter. In the urban environment, 42% of pet cats hunted, primarily herpetofauna, leaving more than 25% of their prey uneaten. On Jekyll Island, 62% of cats monitored hunt, killing invertebrates, herpetofauna, small mammals and birds in decreasing order of frequency. Further work is ongoing and each hunter cat will be monitored for an additional 70 hr to focus on frequency, seasonality and target prey species. The surveys illustrated that perceptions of people about free-roaming pet cats at both sites are not as polarized as represented by vocal minorities on either side of the spectrum. In fact, respondents support cat management, including trap and removal. However, the surveys identified significant knowledge gaps about cats and their role in the environment that should be addressed with public education campaigns. Our study will quantify the impact that free-roaming cats pose to native and migratory wildlife while producing powerful images that can be used for public education.

Key words: Feral cats, Felis catus, Kitty Cam, point-of-view cameras, wildlife predation
VETERINARIANS AND WILDLIFE: A COMPLICATED SET OF RELATIONSHIPS

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Abstract

At a side meeting during the 2014 American Association of Zoo Veterinarians annual conference, a spirited discussion arose concerning provision of medical care, including anesthesia, by non-veterinarians working for wildlife agencies. This paper attempts to explain the legal differences between free-ranging wildlife and captive/owned animals under U.S. and Canadian laws and the North American Model of wildlife management.

Veterinary Practice Acts generally specify that only veterinarians can provide a diagnosis or clinical medical, surgical treatment, anesthesia and/or dentistry to animals. Practice acts serve to protect the public from fraudulent professional service providers (doctors, lawyers, engineers, etc.) by non-licensed persons. They apply to commercial situations where a fee is charged for services. But commercial laws do not necessarily apply to situations where there is no fee for service and no doctor-client-patient (DCP) relationship. State and Federal wildlife laws may supersede commercial laws.

The DCP is fundamental to veterinary private practice. On corporate farms, or in zoos, there is a client that owns or has ownership authority for the animal. But clients can choose to treat (or not treat) their own animals, even do surgery (farmers commonly dehorn and castrate), and administer medicines, even anesthetics, if legally obtained.

In North America, native free-ranging wildlife are not owned, but an agency or agencies of government, (State and/or Federal depending on species and location), has management authority. This can be seen as a form of ownership and includes authority to ‘take…..kill, capture, approach, pursue or possess’ them. This is the basis for licensed hunting and fishing (legal forms of ‘take’). It is also what allows agencies to permit rehabilitators and private and zoo veterinarians to provide care for free-ranging wildlife. The agency is the ‘client’ in the DCP for free-ranging wildlife, as well as the regulatory agency.

Wildlife management agencies in North America have employed veterinarians to provide and supervise medical care and preventive medical services since the late 1960s. Currently about 75 veterinarians work for State, Provincial, Tribal or Federal agencies in North America. An additional ~80 veterinarians employed by private non-profits, universities, and cooperatives work primarily on wildlife under various permits and agreements. In 1979, when AAWV was founded, there were five State and two Federal wildlife vets. In terms of employment, wildlife veterinary medicine is paralleling the track of zoo veterinarians, with about a 20-yr lag time.

There is no requirement that agencies employ veterinarians under the same laws that govern commercial veterinary medicine. And, just as veterinarians in practice use technicians, and sometimes use owner/clients, to provide medical care, including medications and some
anesthetics, under their ‘supervision,’ so wildlife veterinarians often use biologists. There are also practical reasons for this. Wildlife veterinarians often have a ‘practice area’ one or two orders of magnitude larger than a typical large animal practice. California, for example, is 800 miles long and 300 miles wide. Immobilizing a deer in a furniture store in Redding, or a bear up a tree in Fresno can seldom wait for a veterinarian to get there. Shooting them is often the only alternative. As in large animal medicine or animal control, welfare of the patient may be better served if someone acts for the veterinarian.

Wildlife management agencies do not need veterinarians to obtain scheduled substances. Anesthetics from Schedules IIN through IV can be obtained on a ‘Research’ DEA license. But, for reasons of liability and professionalism, increasingly wildlife agencies prefer to have staff veterinarians supervise their use. Typically an agency staff veterinarian will supervise and/or provide training for biologists in wildlife immobilization, and prescribe Schedule III and IV or prescription drugs (Telazol, xylazine, yohimbine) for field use (indirect supervision) by biologists, while reserving access to Schedule II and IIN drugs for use under only their direct supervision.

Agencies of government generally manage wildlife as populations rather than individuals. Commonly sick animals may be collected (killed) for a post mortem examination under the concept that getting a quick and accurate diagnosis can lead to better informed and effective management of the remaining animal population. Para-clinical veterinary skills (pathology, microbiology, epidemiology) are often more applicable to management of populations of wildlife than clinical medicine and surgery. One clear exception to this is surgical implantation of telemetry devices. That veterinarians have clinical skills, as well as great paraclinical skills and training, may be seen as value added by government agencies when it comes to making personnel decisions. The legal, political and social value of having staff professionals (like veterinarians) is also not lost on agencies of government that, in the end, are directed by politicians.

In its earliest form the Animal Welfare Act (AWA) was not seen as applying to wildlife, either captive of free-ranging, unless held for commercial display or research. However, the breadth of species and situation under which AWA is applied now includes projects in which wildlife are to be handled in the field by any institutions (universities and non-profits) that receive Federal funding. Since AWA requires the involvement of veterinarian in Animal Care and Use Committee (ACUC) review, some level of veterinary input generally occurs for most wildlife projects. Most Federal, but relatively few State wildlife agencies, have their own ACUC’s.

There is no group like Association of Zoos and Aquariums (AZA) that oversees the quality of veterinary services provided by wildlife veterinarians. It should be remembered that, until the 1970’s, many medium to small zoos did not have on site veterinary staff, and veterinarians working in zoos could find themselves overruled on medical issues by curators and/or directors. As might be imagined the relationship between the agency/employers and veterinarians working on free-ranging wildlife can be challenging at times. Terms of employment, job titles and descriptions, levels of support vary widely between agency/employers. The bottom line is that free-ranging wildlife veterinarians have a complicated set of relationships with their clients and patients, and are still defining and redefining that relationship.

Key words: Doctor-client-patient relationship, wildlife management agency, wildlife veterinarian
ASSOCIATION BETWEEN *Treponema* spp. AND SEVERE HOOF DISEASE IN ELK (*Cervus elaphus*) FROM WASHINGTON STATE, USA

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Abstract

Reports of elk (*Cervus elaphus*) with lameness and severely deformed or missing hooves increased dramatically in southwest Washington State during the late winter and early spring of 2008. The geographic distribution of reports of the disease has continued to expand since then, and at this time is estimated to encompass a core area of approximately 10,500 km$^2$ (4,000 mi$^2$). A diagnostic investigation to determine the cause was initiated in 2009. Radiography, bacteriology, virology, serology, and trace mineral analysis failed to reveal a cause of the disease. Histopathology and silver staining of lesions from affected hooves demonstrated the presence of deeply invasive spirochetes accompanied by significant inflammation. Furthermore, *Treponema phagedenis*-like and *Treponema medium*-like spirochetes were isolated from diseased elk hooves. These isolated *Treponema* sp. represent two of the three phylotypes known to be highly associated with hoof diseases in domestic animals: bovine digital dermatitis in cattle and contagious ovine digital dermatitis in sheep. Based on findings to date, it appears that *Treponema* spp. may have a causal role in the emergence of a significant disease of free-ranging elk in the Pacific Northwest of North America.

Key words: *Cervus elaphus*, digital dermatitis, elk, hoof disease, *Treponema* sp., Washington

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LITERATURE CITED


SEA LION RESEARCH AND MANAGEMENT IN THE LOWER COLUMBIA RIVER BASIN

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Abstract

Following passage of the Marine Mammal Protection Act of 1972, pinniped populations along the west coast of North America began to increase, many to the point of recovery or even localized overabundance. A case in point is the migratory male population of California sea lions (Zalophus californianus) in the lower Columbia River, where they frequently cause property damage and depredate catch in sport and commercial fisheries. In addition to these negative human interactions, California sea lions also prey heavily on several species of fish listed under the Endangered Species Act, a fact that led the states of Oregon, Washington, and Idaho to apply for and receive lethal removal authority for this species in 2008. State and federal biologists have sought to better understand and manage this situation by conducting basic and applied research when possible, and lethal and non-lethal management when necessary. Research tools include branding animals for lifelong identification, attaching telemetry transmitters for monitoring movements and behavior, tissue sampling for health screenings and disease monitoring, relocation to zoos and aquaria, and in limited circumstances chemical euthanasia.

Key words: California sea lions, Columbia River, fish and wildlife management, Zalophus californianus

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WILDLIFE HEALTH AND THE NORTH AMERICAN MODEL

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Abstract

Veterinarians working in the field of wildlife and zoo health have similar goals: On a broad scale we identify animal health concerns impacting species management goals and communicate these findings to animal managers and other stakeholders. We also strive to improve animal health and welfare during animal handling and care through education, training and development of best management practices. Regulations, policy and protocols govern both wildlife and zoo veterinarians to ensure animal health and welfare needs are appropriate and standard. Where wildlife agency and zoo veterinarian’s jobs diverge is in the scope of responsibility and the impact of decisions. For agency wildlife professionals, this difference is driven by the tenets of the North American Model and the funding structure of the Wildlife Restoration Act.

The North American Model is based on the public trust doctrine principle that wildlife resources are owned by no one, to be held in trust by government for the benefit of present and future generations and that state and federal governments in the U.S. have regulatory authority over wildlife. Central to the North American Model is that every citizen is entitled to the opportunity to hunt and fish, and that ethical, regulated use of fish and wildlife resources insures the maintenance of abundant fish and wildlife through funding associated with hunting and fishing. The passing in 1937 of the Wildlife Restoration or Pittman-Robertson Act provided the mechanism of funding support for continued management of robust and healthy wildlife populations. The Act imposed an excise tax on the sale of all guns and ammunition which would be divided among the states to be used for wildlife restoration. This funding is returned to the states as a 3:1 match (the match generated by hunting tags and license fees) and is the primary state-related funding source along with money from the state legislatures for state wildlife management agencies.

Nevada is home to the largest population of bighorn sheep (Ovis canadensis) in the lower 48 states numbering approximately 11,000. This species suffered precipitous population declines as the west was settled from overhunting, overgrazing and the introduction of novel pathogens from domestic sheep and goats. Recovery of the species has been significantly impacted by respiratory disease and wildlife veterinarians are actively involved in ongoing conservation efforts. Management, conservation, and restoration of bighorn sheep is an excellent example of how the Wildlife Restoration Act turned a keystone species in peril into a recovered and robust population across western North America, enjoyed by many wildlife enthusiast and a plethora of shared habitat dependent species.

**Key words:** Bighorn sheep, North American model of wildlife conservation, Ovis canadensis, wildlife health
SALMONELLOSIS AS AN ASYMPTOMATIC CARRIER STATE OR AS ACUTE ENTERITIS IN THE PREHENSILE-TAILED PORCUPINE (Coendou prehensilis)

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Abstract

Enteric bacterial disease is a common ailment of zoo mammals, affecting a broad range of taxa. Pathogenic bacteria including Salmonella are of major zoonotic concern. In this report, salmonellosis is described in prehensile-tailed porcupines (Coendou prehensilis) as an asymptomatic carrier state and also as acute, potentially fatal enteritis. Salmonella was detected in four prehensile-tailed porcupines from the Albuquerque BioPark or from records from the receiving institution over the last 15 yr. Cases are described and treatment depended upon whether or not clinical signs were present. Acute salmonellosis should be treated with appropriate antibiotic therapy, but it is generally not recommended to treat asymptomatic animals due to the potential to create antibiotic resistant strains.

The prehensile-tailed porcupine is a nocturnal, herbivorous rodent that originates from South America. This species is frequently used as an education animal; therefore, this information is especially important as direct or indirect contact with the public is possible. Animals that have direct or indirect contact with the public should be routinely screened for zoonotic pathogens.

Key words: Coendou prehensilis, enteritis, prehensile-tailed porcupine, Salmonella, zoonotic

Introduction

Four cases of salmonellosis in prehensile-tailed porcupines (Coendou prehensilis) have been diagnosed at the Albuquerque (ABQ) BioPark or noted in records from the previous institution in the last 15 yr. Three of seven porcupines that died at the ABQ BioPark over the last 15 yr were positive for Salmonella at the time of death. Other causes of death in this species were pneumonia, neoplasia (round-cell tumor, unable to classify), stillborn, and undetermined. An informal survey of AZA institutions holding three or more prehensile-tailed porcupines identified no additional cases of positively diagnosed salmonellosis in this species, although diarrhea or other gastrointestinal symptoms were common.

Case Reports

Case 1: A hand-raised 9-yr-old female prehensile-tailed porcupine was discovered to be an asymptomatic I carrier. In February of 2012, it was diagnosed with Salmonella enterica Type 1, subspecies enterica, which was sensitive to most antibiotics. Treatment was not pursued since it is generally not recommended to treat an asymptomatic carrier. As an education/outreach animal, the animal’s use around the public became very limited due to the potential zoonotic transmission of Salmonella. It was found acutely lethargic on September 23, 2014 and had not eaten overnight which was unusual for her. The porcupine was then anesthetized for physical examination,
bloodwork, radiographs, and further treatment. Upon physical examination, mild dehydration was noted and moderate distension of the abdomen. Radiographs revealed a gas-filled stomach and cecum. Bloodwork revealed mild hyperglycemia. Despite supportive care and treatment with subcutaneous fluids and antibiotics, the porcupine was found dead 4 hr later. Diarrhea was noted only during anesthetic recovery. Necropsy confirmed moderate gas distension of the stomach and cecum and pink-purple discoloration of the stomach and small intestine. Histopathology confirmed gastritis with loss and dysplasia of gastric glands. No evidence of infectious organisms was noted upon routine staining, but the appearance was similar to that associated with *Helicobacter* species. There were no microscopic lesions in the small or large intestine typical of salmonellosis. The pathologist suggested that chronic gastritis and fibrosis in the stomach may have led to acute bloat, but this could not be confirmed. In addition, this porcupine also had arteriosclerosis.

Cases 2 and 3: Two 9-yr-old female porcupines housed in a mixed-species exhibit with golden lion tamarins (*Leontopithecus rosalia*) were anorexic with no other signs of illness 2 days prior to death. Case 2 was anesthetized for examination, bloodwork, and radiographs. Physical examination revealed a distended abdomen and muffled heart sounds. Radiographs of this animal showed gas distension of the colon and cecum. This porcupine died 1 hr after anesthetic recovery. Necropsy revealed a distended cecum containing bloody fluid. Bacterial cultures were not obtained from this animal, but symptoms were presumed to be due to bacterial enteritis from *Salmonella* C2, serovar Newport, *Clostridium perfringens*, and *Campylobacter* as these bacteria were isolated from Case 3. Case 3 was anesthetized on the same day as Case 2. This porcupine was also noted to have a gas distended cecum on radiographs, but the colon was not distended. Anesthetic recovery was uneventful, but the animal became agonal 1 hr after recovery and it was humanely euthanatized. Just prior to death, it passed some malodorous liquid diarrhea. *Salmonella* C2, serovar Newport, *Clostridium perfringens*, and *Campylobacter* were isolated from the cecum.

Case 4: A female prehensile-tailed porcupine presented with diarrhea and lethargy and was diagnosed with *Salmonella* group B at 1 yr of age. It was treated with sulfamethoxazole and trimethoprim (Tribrissen, Schering-Plough, Elkhorn NE 68022 USA) initially and then switched to gentamicin (brand information not available) after bacterial culture and sensitivities were reported. This animal was also treated with probiotics (brand information not available) and this porcupine survived. However, the porcupine died acutely at 10 yr of age. Upon necropsy, reddened small intestine was noted, but no significant lesions were noted on histopathology and a bacterial culture was negative for pathogens. A cause of death was not determined in this case.

**Discussion**

In each of the cases in which a porcupine died acutely, a gas-filled cecum and stomach or intestine was noted upon radiographs. In this species, anorexic animals with or without diarrhea and gas distension of the gastrointestinal tract should raise concern for salmonellosis. This presentation should be considered urgent due to very short time frame in which the animal may die. Diarrhea was noted in two of the four cases, one of which died a short time after the onset. Despite the fairly high occurrence of salmonellosis noted recently at the ABQ BioPark, this prevalence has not been reported at other institutions. One recent study found a low prevalence of *Salmonella* and STEC 0157 at AZA-accredited institutions; 0/10 rodents (porcupines included) were positive for *Salmonella enterica* or *Escherichia coli* 0157:H7.3
The zoonotic potential of *Salmonella* in prehensile-tailed porcupines is also of major concern. *Salmonella enterica* should is considered ubiquitous and may be shed by apparently healthy animals.\(^4\) Several studies have noted the asymptomatic shedding of *Salmonella* spp. in zoo carnivores and have suggested contaminated meat as a likely source.\(^1,5\) The source of *Salmonella* in the prehensile-tailed porcupines is unknown. The American Zoo and Aquarium Association Animal Health Committee have drafted guidelines to assist member institutions in decision-making regarding the use of animals for public contact, education, and outreach. One recent study found that 14% of domestically acquired illnesses in humans caused by enteric pathogens were attributed to animal contact. Nontyphoidal *Salmonella* spp. were the leading cause of hospitalization out of the seven groups of pathogens studied (*Campylobacter, Cryptosporidium, nontyphoidal Salmonella, Shiga-toxin-producing Escherichia coli 0157, Shiga toxin producing Escherichia coli non-0157, Listeria monocytogenes, and Yersinia enterocolitica*).\(^2\)

In prehensile-tailed porcupines, salmonellosis may present as either acute, potentially fatal enteritis, or as an asymptomatic carrier state. In cases of suspected enteritis, it is recommended that a fecal culture with antibiotic sensitivities obtained early in the course of illness to diagnose and accurately treat the illness. In cases of asymptomatic carrier state, treatment is generally not recommended in order to avoid antibiotic resistance from developing.

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**LITERATURE CITED**


SEROLOGIC SURVEY AND RESULTS OF URINARY PCR TESTING FOR LEPTOSPIROSIS IN CAPTIVE BLACK-TAILED PRAIRIE DOGS (Cynomys ludovicianus)

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Abstract

Leptospirosis is an important zoonotic disease occurring clinically and subclinically in humans and a wide variety of mammalian species worldwide.1,7 Rodents and wild animals have been identified as important reservoirs for Leptospira bacteria.2,3,5,8,10,12-16 Twenty-two captive black-tailed prairie dogs (Cynomys ludovicianus) housed within a zoo were examined as part of a routine census and preventive medicine program. During examinations, blood and urine were collected to test for evidence of infection by Leptospira. All animals were apparently healthy at the time of examination. Leptospira Microscopic Agglutination Test (MAT)6 identified twelve of 22 (54.5%) prairie dogs with antibody titer ≥1:100 against Leptospira interrogans serovar bratislava on initial serologic examination. All prairie dogs within this collection were serologically negative for Leptospira interrogans serovars canicola, hardjo, icterohemorrhagiae, pomona, and Leptospira kirschneri serovar grippotyphosa. Leptospira PCR11 testing of urine was negative in all animals tested. A recent serologic survey of wild black-tailed prairie dogs in Mexico determined that almost 80% of wild prairie dog sera were positive for at least one L. interrogans serovar.9 This report suggests that these captive prairie dogs may have been exposed to Leptospira, however, low MAT results, and lack of leptospire DNA detected by PCR indicate these animals are unlikely to be important reservoirs for the disease. We hypothesize the source of Leptospira exposure to be wild rodents.

Key words: Cynomys ludovicianus, Leptospira bratislava, Leptospira MAT, Leptospira, real-time PCR, prairie dog

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The authors thank Yuxuan Sun, Iowa State University College of Liberal Arts and Sciences Department of Statistics, for statistical analysis. Heartfelt gratitude is also extended to the Veterinary Support Team, Small Mammal Team, and Registrar of the Blank Park Zoo for excellent record keeping and tireless care for these wonderful animals.

LITERATURE CITED


DETERMINATION OF THE EFFICACY OF STRECK CELL PRESERVATIVE ADDED TO EDTA-TREATED WHOLE BLOOD FROM KOALAS (Phascolarctos cinereus) TO FACILITATE FIELD-DELAYED COMPLETE BLOOD COUNTS

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Abstract

Field health assessments of free-ranging koalas (Phascolarctos cinereus) in remote study sites may lead to delayed testing of whole blood for complete blood counts (CBC). Streck Cell Preservative is a proprietary liquid stabilization reagent that may potentially extend blood cell integrity and morphology, which could be beneficial when processing of blood is not possible in a timely manner. To determine if Streck Cell Preservative is an efficacious method for the preservation of EDTA-treated whole blood from koalas, a study involving 12 captive adult koalas was performed. During routine health assessments, blood from koalas was opportunistically collected into EDTA-coated tubes. Following collection, a sub-sample of EDTA-treated blood was mixed with Streck Cell Preservative at a 1:1 dilution. The paired samples of EDTA-treated blood with and without Streck Cell Preservative had serial CBCs performed on days 0, 1, 3, 7, 10, and 14 post-collection. Data was analyzed by mixed effects ANOVA and post-hoc paired sample t-tests. Over time, the Streck Cell Preservative treated blood samples showed less cellular lysis than untreated samples, particularly after 7 days. Therefore, Streck Cell Preservative extended the viability of the blood sample up to 14 days and provided greater accuracy and precision of cell counts compared to blood remaining in EDTA alone. In conclusion, Streck Cell Preservative represents an effective method to preserve EDTA-treated whole blood in koalas and may be used with confidence during field research.

Key words: Blood, complete blood count, koala, Phascolarctos cinereus, Streck cell preservative

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The authors thank Dr. Alan D. Marcus and Dr. Damien P. Higgins for providing the impetus for this study. Additionally, the authors are grateful to the veterinarians, veterinary technicians, laboratory technicians and animal care staff for their dedication to the care of the koalas at the San Diego Zoo and for their participation in this project. The opportunistic collection of blood for this study was approved by the San Diego Zoo Global Institutional Animal Care and Use Committee (12-023) and San Diego Zoo Global has an Animal Welfare Assurance (A3675-01) with the Office of Laboratory Animal Welfare.
Does Phylogeny Influence the Determination of Drug Dosages by Alometric Scaling?

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Abstract

When treating animals, zoo veterinarians often face the challenge that the correct dosage and dosage regimen has not been scientifically determined for the species in question. Therefore the clinician will either extrapolate dosages from other, typically domestic, species or refer to predictions by allometric scaling. Conventional allometric scaling shares the assumption that interspecies differences are clinically negligible. In the present study we tested the assumption about interspecies differences with respect to phylogenetic relationship in mammals. We collated data from studies that investigated intravenous application of enrofloxacin on steady state distribution volume, total body clearance and elimination half-life, and that also provided the body mass of the investigated animals. A total of 55 references involving 17 species were used to calculate species averages. These data were log-transformed and submitted to linear regression, first using ordinary least squares (without accounting for phylogeny), and, after linking to an established phylogenetic tree for mammals, to phylogenetic generalized least squares. The phylogenetic signal in the dataset was evaluated, and estimated to be not significantly different from zero (i.e., no detectable phylogenetic structure in the data). While half-life was not significantly correlated to body mass, both steady state volume and clearance scaled at body mass $^{0.80}$, with the metabolic exponent of 0.75 included in the 95% confidence interval in both cases. Even though species differences have been described beyond the influence of allometry, the data evaluation does not suggest a systematic effect of phylogenetic affiliation.

Key words: Allometric scaling, body weight, clearance, half-life, pharmacokinetic, phylogeny
A NEW APPROACH TO THE RADIOGRAPHIC EXAMINATION OF THE PECTORAL GIRDLE IN SPECIES OF GALLIFORMES, ANSERIFORMES, CICONIIFORMES AND ACCIPITRIFORMES

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Abstract

One of the most common reasons for the inability to fly in wild birds are injuries to the wings and pectoral girdle, including fractures and luxations. For the diagnosis of pectoral girdle injuries, radiography is frequently necessary.1,2 The complex anatomy of the pectoral girdle and the superimposition of bones and soft tissues make the visualization of fractures or luxations challenging. The objective of this study was to determine an optimal angle for an additional oblique radiographic projection of the pectoral girdle in order to enable better evaluation of the coracoid, clavicle and scapula in different birds. Ventrodorsal radiographs at the angles 0°, 10°, 15°, 20°, and 30° were taken of the pectoral girdle of a common peafowl (Pavo cristatus), domestic chicken (Gallus domesticus), domestic goose (Anser domesticus), white stork (Ciconia ciconia) and common buzzard (Buteo buteo). The radiographs were evaluated based on the delineation and visibility of the different joints of the pectoral girdle and measurements were made using a scoring system. The following angles received the highest scores: in the chicken and the peafowl the caudo 20° ventral-craniodorsal view (Cd20°V-CrDO) and in the goose and the common buzzard the Cd30°V-CrDO view. In contrast, in the stork the ventrodorsal (0°) and the Cd15°V-CrDO were graded with the same score. In conclusion, acquiring an oblique radiographic projection (30° in Anseriformes and raptors, 20° in Galliformes) in addition to standard projections can provide superior information about the pectoral girdle in Galliformes, Anseriformes, Ciconiiformes and Accipitriformes.

Key words: Avian, bird, diagnostic imaging, skeletal, surgery

LITERATURE CITED


PHARMACOKINETIC PROPERTIES OF A SINGLE ADMINISTRATION OF ORAL GABAPENTIN IN THE GREAT HORNED OWL (Bubo virginianus)

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Abstract

Persistent pain associated with neuropathic pain in raptor patients offers no advantage at preserving life and is often refractory to commonly utilized analgesics. Doses of common analgesics are often extrapolated from mammalian species or pharmacology studies from other avian species. The published pharmacokinetic and pharmacodynamic properties of analgesics vary considerably across avian species. Therefore, extrapolating clinical doses and dosing intervals from one species to another may be either ineffective or harmful.

Gabapentin (1-(aminomethyl) cyclohexane acetic acid) is a gamma-aminobutyric acid (GABA) analogue shown to be efficacious for neuropathic pain control in humans.1 Plasma gabapentin concentrations greater than 2 µg/ml are considered effective in treating epilepsy in humans and are suggested to provide analgesia for neuropathic pain.2 This study investigated the pharmacokinetics of a single oral (p.o.) dose of gabapentin suspension (11 mg/kg) in great horned owls (Bubo virginianus). Plasma gabapentin concentrations were determined in six healthy great horned owls over a 48-hr period using high-performance liquid chromatography (HPLC) with mass spectrometric detection. Plasma gabapentin concentrations were estimated by a non-compartmental pharmacokinetic analysis. The harmonic mean (± standard deviation) maximum concentration (Cmax), time to maximum concentration (Tmax), and elimination half-life (t1/2λZ) for gabapentin were 6.17 ± 0.83 µg/ml, 51.43 ± 5.66 min, and 264.60 ± 69.35 min, respectively. Plasma gabapentin concentrations were maintained above 2 µg/ml for 528 min (8.8 hr), suggesting that gabapentin administered at 11 mg/kg orally every 8 hr may be appropriate for neuropathic pain control in great horned owls.

Key words: Analgesia, gabapentin, great horned owl, Bubo virginianus, neuropathic pain, pharmacokinetics

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LITERATURE CITED

PHARMACOKINETICS OF A SINGLE DOSE OF ORAL AND SUBCUTANEOUS MELOXICAM IN CARIBBEAN FLAMINGOS (*Phoenicopterus ruber ruber*)

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Abstract

The purpose of this study was to determine the pharmacokinetics of meloxicam in Caribbean flamingos (*Phoenicopterus ruber ruber*). A pilot study was performed first, followed by a complete pharmacokinetic study. Four healthy birds were divided into two groups and administered either 1 mg/kg oral (*n* = 2) or subcutaneous (*n* = 2) meloxicam. Plasma meloxicam concentrations were determined with liquid chromatography/mass spectrometry. Based on the pilot study results, 12 healthy birds were assigned into two groups and administered either a 3 mg/kg oral dose (*n* = 6) or 1.5 mg/kg subcutaneous dose (*n* = 6) of meloxicam. Blood samples were collected at baseline and at nine time intervals after administration of meloxicam in all 12 flamingos. Plasma concentrations after administration of 3 mg/kg oral meloxicam reached a mean $C_{\text{max}}$ of 1.449 µg/ml at 2.35 hr with a terminal half-life of 1.832 hr. After administration of 1.5 mg/kg subcutaneous meloxicam, $C_{\text{max}}$ was 4.059 µg/ml at 0.91 hr with a terminal half-life of 1.104 hr. The plasma profile from the principal oral study (3 mg/kg) differed markedly from the pilot study (1 mg/kg), suggesting a delayed absorption with the higher dose and lack of dose proportionality. The different doses for subcutaneous administration resulted in a proportional change in plasma concentrations. Further studies are needed to evaluate the effects of the drug volume administered and fasting status when oral dosing is used. Future studies are also needed to investigate multiple dose pharmacokinetics of meloxicam and to determine the therapeutic meloxicam plasma concentration in Caribbean flamingos.

**Key words:** Avian, Caribbean flamingo, meloxicam, nonsteroidal anti-inflammatory drug, pharmacokinetics, *Phoenicopterus ruber ruber*

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This study was supported by a grant from the Department of Clinical Sciences, College of Veterinary Medicine, Kansas State University.
CYCLOSPORINE AS A PALLIATIVE TREATMENT FOR PROVENTRICULAR DILATATION DISEASE IN PSITTACINE BIRDS

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Abstract

Proventricular dilatation disease (PDD) is a neurologic syndrome of birds caused by the infectious agent avian bornavirus (ABV).4-5 Clinical disease is thought to be due to T-cell mediated immune response to the presence of ABV within the nervous system.2-3 Lymphoplasmacytic infiltrates can develop in the affected enteric ganglia, enteric nerve plexuses, brachial, vagus, optic, and sciatic nerves and/or the central nervous system. Treatment of PDD has thus far been unrewarding.3 Cyclosporine is an immunosuppressant drug that primarily decreases cell mediated immune responses by inhibiting T-cell proliferation via calcineurin inhibition of growth cycles and decreased cytokine production.6 In avian species, cyclosporine is a proven potent immunosuppressant with T-cell specific action and has been successfully used to induce immunosuppression in birds.1,7 In this series of eight clinical cases of psittacine birds (two *Ara chloropterus*, one *Ara ararauna*, one *Ara rubrogenys*, two *Cacatua alba*, one *Psittacus erithacus*, and one *Pionus*) affected with ABV, use of cyclosporine was successful in treating clinical signs and preventing progression of PDD in multiple birds without severe side effects. Furthermore, a pilot study performed in ABV-infected cockatiels showed increased weight gain and lack of morbidity and mortality associated with ABV infection and cyclosporine treatment during the study period (151-153 days). While clinical trials and/or prospective studies would be necessary to further scrutinize the use of cyclosporine in psittacine birds with PDD, initial results indicate that cyclosporine is a promising option for treatment of PDD in avian patients.

Key words: Avian bornavirus, cyclosporine, proventricular dilatation disease, psittacine

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LITERATURE CITED


OCULAR EFFECTS OF DISPERSANT EXPOSURE IN COMMON MURRES (*Uria aalge*): AN EXPERIMENTAL STUDY

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Abstract

Forty common murres (*Uria aalge*) were captured in Monterey Bay, CA over six nights for a dispersant exposure study. All birds were in good to excellent body condition and appeared healthy at the time of capture. On day 7, a veterinary ophthalmologist examined 31 birds using phenol red thread tests (PRTT), fluorescein staining, slit lamp biomicroscopy, and rebound tonometry. Twelve of 31 birds had corneal ulcers, some of which had evidence of chronicity. Ten of 31 birds had mild to moderate conjunctivitis which was bilateral in 80% of the cases. On day 8, birds were divided into seven treatment groups and a control group and underwent a 90 sec exposure to artificial seawater with either Prudhoe Bay Crude Oil, COREXIT 9500 dispersant, or a mixture of the two. On day 10, birds were reevaluated. Post-exposure tear production decreased in all birds, although not significantly. Intraocular pressure was unchanged. Six birds developed corneal ulcers after exposure. Eleven birds developed conjunctivitis. Birds exposed to oil were 11.3 times more likely to develop conjunctivitis than birds not exposed to oil (odds ratio, *P* = 0.0495). Birds exposed to dispersant were 15 times more likely to develop conjunctivitis (odds ratio, *P* = 0.0347). Due to the high prevalence of ocular lesions, these birds should have ophthalmic exams when presented for rehabilitation. Exposure to dispersant in artificial seawater resulted in conjunctivitis in many birds, indicating that dispersants are not innocuous. The use of dispersants in oil spill response should take into consideration the potential for adverse effects on seabirds.

**Key words:** Alcids, common murre, corneal scars, ocular lesions, seabirds, *Uria aalge*
CATARACTS IN MACARONI (Eudyptes chrysolophus) AND ROCKHOPPER PENGUINS (Eudyptes chrysocome): PREVALENCE, DESCRIPTION, AND RISK FACTORS

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Abstract

Ophthalmic examinations were performed on 160 macaroni penguins (Eudyptes chrysolophus) and 90 rockhopper penguins (Eudyptes chrysocome) at eight North American zoological institutions. Cataract prevalence was 46.5% (n = 74) in the macaroni population and 45.5% (n = 40) in the rockhopper population. Macaroni penguin eyes with cataracts had significantly lower intraocular pressure (IOP) than eyes without cataracts (P = 0.001): 36.4 ± 9.0 mmHg (n = 135) vs. 42.0 ± 9.7 mmHg (n = 179). Rockhopper IOP did not differ significantly between eyes with and without cataracts (P = 0.079): 31.2 ± 6.4 mmHg (n = 73) vs. 32.9 ± 6.2 mmHg (n = 101). Incipient and hypermature cataracts were the most prevalent in rockhopper and macaroni populations, respectively. Mean age of a macaroni and rockhopper with incipient cataracts was 13.1 ± 6.9 yr and 21.0 ± 5.6 yr, respectively. Husbandry, heredity, exhibit light intensity, and ultraviolet light measurements were evaluated as potential risk factors for cataracts. Major risk factors for macaroni penguins included age, smelt in diet, hand-feeding, increasing density of Eudyptes penguins, and fluorescent lighting. Major risk factors for rockhopper penguins included age, capelin in diet, increasing density of Eudyptes penguins, increasing minimum photoperiod, and decreasing light intensity. Protective factors for macaroni penguins included saltwater pools, water quality monitoring, pool filtration and sterilization systems, use of metal halide lights, increasing light intensity, and increasing UV light. Protective factors for rockhoppers included herring in diet, increasing terrestrial area, increasing maximum photoperiod, increasing light intensity, and increasing UV light.

Key words: Cataract, Eudyptes chrysocome, Eudyptes chrysolophus, macaroni penguin, risk factor, rockhopper penguin

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THE ANATOMY AND DIGESTIVE MECHANISMS OF CAPTIVE AFRICAN PENGUINS (Spheniscus demersus)

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Abstract

Reference material specific to the digestive tract of piscivores is scant, and knowledge of the gastrointestinal tract of a normal penguin is based on information from other fish-eating birds. The purpose of this study is to determine the normal gross anatomy, transit time, and histopathologic structures of the penguin gastrointestinal tract.

Twelve clinically normal penguins were selected from the colony at the Maryland Zoo in Baltimore, which on average consists of 55 birds. Complete blood work, malaria screening, and fecal pathogen screening were performed to ensure a healthy population. All birds underwent a barium contrast study, and radiographic images were obtained until the entire gastrointestinal tract was empty. Approximately 2 wk later, each penguin was anesthetized using isoflurane, and an endoscopic evaluation of the anterior gastrointestinal tract was performed. Fluid from the ventriculus was collected for pH determination and parasite evaluation, and three representative biopsy samples from the ventriculus, proventriculus, and esophagus (for a total of nine samples) were obtained for histopathology, koilin thickness determination, and electron microscopy. Time from barium ingestion to defecation ranged from 17-70 min, and most penguins required 24-30 hr for the barium to clear the gastrointestinal tract completely. During endoscopy, koilin was not observed grossly in several birds; however, it was present on biopsy samples. Fluid from the ventriculus had an average pH of 2.75 and contained a mixed bacterial population. Several birds also had yeast or pollen present. The results of this study provide a comparative baseline to use during diagnostic workups and help guide treatment decisions.

Key words: African penguin, barium, endoscopy, koilin, Spheniscus demersus

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The authors thank the animal care and veterinary technician staff at the Maryland Zoo in Baltimore for their assistance in gathering historical and research data.
REPRODUCTIVE MANAGEMENT OF THE PANAMANIAN GOLDEN FROG
(Atelopus zeteki)

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Abstract

A breeding program for the critically endangered Panamanian golden frog (Atelopus zeteki) was established in 2001 with the goal of forming a genetically sustainable reassurance population. Breeding in select AZA institutions has been increasingly successful; however, the prolonged amplexus that is observed in this species can result in decreasing condition and higher morbidity and mortality during the breeding season in both sexes. Therefore, assisted reproductive technology was employed to aid in the release of ova and sperm in order to decrease mortality, produce eggs from genetically valuable females experiencing dystocia, and identify methods for the collection of ova and sperm for future in vitro fertilization and gamete banking studies.

Females (n = 154) in the study were administered 4 µg luteinizing hormone releasing hormone (LHRH) intracoelomically every 2 days for a maximum of four doses. During the 6 yr of the study, 66.9% of the female frogs that received LHRH successfully laid eggs. The highest success of ovipositioning was noted in November-December of each year and in frogs > 3 yr. The majority of frogs laid eggs after one dose of LHRH (63.2%), with 28.3% laying after two doses.

In the second part of the study, male frogs were administered LHRH intracoelomically, and urine was collected for semen analysis. Frogs that received 1 µg or 4 µg LHRH yielded spermic urine at 3 and 6 hr, with the highest sperm concentrations and highest yield of spermic urine noted with administration of 4 µg LHRH and urine collection 3 hr later.

Key words: Atelopus zeteki, dystocia, luteinizing hormone releasing hormone, oviposition, Panamanian golden frog, spermiation
OPTIMIZATION OF HORMONE PROTOCOLS IN FEMALE TIGER SALAMANDERS (Ambystoma tigrinum) BY USING ULTRASOUND TO MONITOR FOLLICULAR DEVELOPMENT

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Abstract

Due to frequent failure of amphibian captive assurance colonies associated with poor reproduction, it is critical that assisted reproductive technologies be developed as conservation tools for threatened amphibians. We hypothesized that ultrasound could be utilized to monitor follicular development of female salamanders such that hormone protocols could be optimally timed to stimulate oviposition. Using Ambystoma tigrinum (Eastern tiger salamander) as a model, female animals were observed via ultrasound throughout their follicular cycle. An ultrasound grading scale was developed for follicular stages, based on size (verified with imageJ software) and echogenicity (0 = little/no development; 1 = minor development; 2 = moderate development; 3 = extensive development).

To test ultrasound management with existing hormone protocols for salamanders in our lab, animals graded 1 (n = 9) were treated with a priming dose of 1 IU/g human chorionic gonadotropin (hCG) 1 wk prior to the start of our full ovulatory protocol (1 IU/g hCG; 168 hr later 2 IU/g hCG; 24 hr later 4 IU/g hCG + 0.1 µg/g luteinizing hormone releasing hormone [LHRH]). Animals graded a level 2 (n = 9) were treated with the full ovulatory protocol above, while animals graded a level 3 (n = 9) were given a modified ovulatory protocol of the 4 IU/g hCG + 0.1 µg/g LHRH only. Control animals (n = 15) were given the full ovulatory protocol; however, they were blindly chosen for treatment and did not receive ultrasonic analysis. In our preliminary trials, 33.3% of animals graded level 1, 83.3% of animals graded 2, and 100% of animals graded 3 oviposited within 18 hr of hormone treatment. In contrast, only 33.3 % of control animals oviposited, and time to oviposition was longer (within 72 hr). These preliminary results suggest that ultrasound grading of follicular development can help adaptively manage hormone techniques for salamander species by modifying protocols so they are more efficient based on the physiologic state of the animal.

*ImageJ/Image Processing and Analysis is freeware developed by the National Institutes of Health, Bethesda, Maryland (direct questions to wsr@nih.gov).

Key words: Ambystoma, artificial fertilization, follicle development, hormone treatment, salamander, ultrasound
DEVELOPMENT OF QUANTITATIVE PCR ASSAYS FOR INVESTIGATION OF IMMUNE FUNCTION IN THE FLORIDA MANATEE (Trichechus manatus latirostris)

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Abstract

Trichechid herpesvirus 1 (TrHV1) is found in both healthy and diseased Florida manatees (Trichechus manatus latirostris). Herpesvirus reactivation has been detected in experimental situations even when cortisol elevation was not, making the virus a potential biomarker of stress. Cytokines function as signaling molecules to mediate an immune response. This study addressed the need for sensitive, species specific assays to measure TrHV1 and cytokines in Florida manatees. Whole blood samples were collected from 42 free-ranging Florida manatees. DNA and RNA were extracted from the buffy coat for use in quantitative, real-time PCR (qPCR) assays. Primer/probe sets were designed for analysis of TrHV1, IFN-γ, IL-2, and IL-10, as well as GAPDH and β-actin as housekeeping targets. Using these assays, preliminary baseline buffy coat ranges of these targets from manatees in the Crystal River and Brevard overwintering sites were established.

TrHV1 copy numbers ranged between <10 (limit of detection) and 74.2 counts/100 ng DNA, with an average of 40.9 ± 21.2 counts/100ng. The average β-actin value for the healthy Florida manatee population sampled was 1.44 × 10^5 copies/100 ng cDNA, and for GAPDH the value was 2.08 × 10^4 copies/100 ng cDNA. Copy values of IFN-γ, IL-2, and IL-10 were normalized to GAPDH values. The final normalized count value averages were as follows: IFN-γ = 0.055, IL-2 = 0.126, and IL-10 = 0.031 (values in # copies/100 ng cDNA).

Future investigations of manatees from these overwintering sites now have a baseline value for comparison. In addition, these assays may ultimately provide the ability to monitor manatee immunologic processes.

Key words: Cytokine, Florida manatee, quantitative real-time PCR, Trichechid herpesvirus 1, Trichechus manatus latirostris

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LITERATURE CITED

IDENTIFYING DISSEMINATED INTRAVASCULAR COAGULATION IN THE FLORIDA MANATEE (Trichechus manatus latirostris) AND UNDERSTANDING ITS CLINICAL IMPLICATIONS

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Abstract

Disseminated intravascular coagulopathy (DIC) is an acquired disorder of hemostasis resulting in activation of the coagulation and fibrinolytic pathways. It is reported secondary to multiple disease processes and can be associated with increased mortality.2,3 Previous research at Lowry Park Zoo (LPZ) demonstrated that Florida manatees (Trichechus manatus latirostris) with cold stress syndrome (CSS) demonstrated thromboembolic disease.1 The object of this retrospective study was to establish the presence and clinical relevance of DIC in Florida manatees admitted to LPZ for rehabilitation from March 7th 2010 to February 9th 2015. A coagulation panel including prothrombin time (PT), partial thromboplastin time (PTT), platelet count, fibrinogen level, and D-dimer level was used to diagnose DIC. Prolonged PT, PTT, increased D-dimer and fibrinogen and reduced platelet count were considered consistent with DIC. There were 90 cases identified in the study period; 33 trauma, 31 CSS, 16 secondary to harmful algae bloom (HAB), and 10 other. Trauma and CSS cases had the highest incidence of DIC at 64% and 61% respectively; DIC was not identified in HAB cases. In CSS cases, 98% resolved. Manatees that developed DIC during rehabilitation or where DIC progressed did not survive. D-dimer level was a valuable prognostic indicator with a poor prognosis at levels > 1,500 ng/ml and 100% mortality at levels > 3,200 ng/ml. Due to the clinical implications of DIC, identifying its presence and recognising its severity could improve clinical outcomes by enabling more intensive treatment protocols.

Key words: Coagulation, D-dimer, disseminated intravascular coagulation, manatee, rehabilitation, Trichechus manatus latirostris

ACKNOWLEDGMENTS

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LITERATURE CITED


ABSENCE OF ACUTE TOXICITY OF A SINGLE INTRAMUSCULAR INJECTION OF MELOXICAM IN GOLDFISH (Carassius auratus auratus)

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Abstract

Meloxicam is a nonsteroidal anti-inflammatory drug with preferential cyclooxygenase-2 inhibitory activity frequently used in veterinary medicine, including in fish species. However, the efficacy and safety of meloxicam has not yet been reported in adult fish. The purpose of this study was to evaluate if a single intramuscular injection of meloxicam in goldfish (Carassius auratus auratus) was associated with acute toxicity. After 3 wk of acclimation, 32 goldfish were randomly assigned into two groups of 16 individuals. Fish in the treatment group received a single intramuscular injection of 5 mg/kg of meloxicam (Metacam® 5 mg/ml, Boehringer Ingelheim Canada Ltée, Burlington, ON L7L5H4 Canada). Fish in the control group received a single intramuscular injection of NaCl 0.9% using a similar volume (1 ml/kg). Fish were monitored for external lesions, mortality, level of activity and position in the water column. No lesions, mortality or modification in the behavior or position were noted. Fish were euthanized with an overdose of tricaine methanesulfonate (Aqualife TMS, Syndel Laboratories Ltd, Nanaimo, BC V9S4M9 Canada) three days after the initial injection. A complete macroscopic and microscopic examination was performed on each fish. Hemorrhage and necrosis were identified at the injection sites in fish from the treatment and the control groups. Multi-organs granulomas of undetermined etiology were detected in fish from both groups. No statistically significant differences were detected in regards to the lesions observed in the two groups. This study indicates that a single intramuscular injection of meloxicam at 5 mg/kg do not induce acute toxicity in goldfish.

Key words: Carassius auratus auratus, goldfish, injection, meloxicam, pathology, toxicity

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COMPARISON OF TOTAL LEUKOCYTE QUANTIFICATION METHODS IN WILD GALAPAGOS TORTOISES (Chelonoidis nigra)

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Abstract

Reptile hematologic data are important for conservation efforts of vulnerable wildlife species such as the Galapagos tortoise (Chelonoidis nigra), yet difficult to attain due to lack of automated cell counters and reported discrepancies between leukocyte quantification methods. 1 Two manual leukocyte quantification methods commonly used in reptiles, the Natt-Herricks (NH) a and the Eopette (EO) b, were compared to the white blood cell (WBC) estimate from blood film evaluation. 3 Total leukocyte counts were performed using these three methods on blood samples collected from 42 adult free-living female Galapagos tortoises. Additionally, total leukocyte counts and differentials were performed on blood films prepared both upon collection in the field and 18-23 hr later in the laboratory to investigate the significance of delay in sample processing. Passing-Bablok method-comparison analyses revealed that the NH was in agreement with the WBC estimate (regression slope = 0.925), while the EO was not (regression slope = 2.65). 2 The WBC estimates obtained from field and laboratory-prepared blood films were in agreement (regression slope = 0.82), while differential results were not. Additionally, blood film quality and cell morphology were superior in field-prepared blood films. In conclusion, the NH method, which stains all blood cell types and relies on differentiation of morphologically similar cells, was superior to the EO method, which stains only granulocytes and relies on an accurate differential to calculate total leukocytes. Our study indicates that immediate sample processing in field studies and use of the NH leukocyte quantification method with a confirmatory WBC estimate provides the highest quality reptile hematologic data.

a Natt-Herricks-TIC®1:200 plus (Bioanalytic GmbH, Waldmatten 10-13, D-79224, Umkirch/Freiburg, Germany).
b Eopette™ (Exotic Animal Solutions, Inc, 3516 Sharon Lane, Hueytown, Alabama, 35223).

Key words: Chelonoidis nigra, Eopette, Galapagos tortoise, Natt-Herricks, total leukocyte count, reptile hematology

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material support, Freddy Villamar and Walter Ernest for assisting in the field, Bioanalytic GmbH for donating the Natt-Herricks-TIC® kits, and the National Science Foundation for funding the Galapagos Tortoise Movement Ecology Programme. The authors also thank Phillip Kass BS, DVM, MPVM, MS, PhD for statistical assistance.

LITERATURE CITED


BILATERAL HEMIPENECTOMIZATION USING LOCAL ANESTHESIA IN INVASIVE GREEN IGUANAS (Iguana iguana) ON GRAND CAYMAN ISLAND

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Abstract

Fourteen subadult and adult free-ranging male invasive green iguanas (Iguana iguana) were captured via pole-noosing from trees on Grand Cayman Island in November 2014 to evaluate proof of concept of performing bilateral hemipenectomies in field conditions. The iguanas had eyes hooded and were held in dorsal recumbency. Sterile saline was injected caudal to the cloacal opening to completely evert a hemipene. The hemipene base was infused with lidocaine. After 2 min, a hemostat was placed across the entire base of the hemipene, distal to the local block site. A 3-0 monofilament was used to ligate via a transfixation/circumferential suture between the hemostat and local block site. The hemipene stump was cut. The amputation site was cauterized with silver nitrate, then the stump gently replaced into the cloaca. This was repeated with the second hemipene. A one centimeter hole was punched through the dewlap with the edges cauterized with silver nitrate to assist with visual identification of the iguana upon return to its habitat. One more cloacal hemorrhage assessment was performed, and the iguana was then released. Survival of altered iguanas was visually confirmed for several days post-release. This technique appears to show promise as an ethical, cost-effective, non-lethal, simple, and able to be performed in the field method. Evaluation of effectiveness on curbing population growth is unknown at this time but should be considered as the natural progression to investigate proof of concept further.

Key words: Green iguana, hemipene, Iguana iguana, lidocaine, population control
EFFECTS OF PARENTERAL EPINEPHRINE AND GV-26 STIMULATION ON INHALANT ANESTHESIA RECOVERY TIME IN TWO ORDERS OF REPTILES

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Abstract

Inhalant anesthetics are frequently used in reptiles and are associated with extended recovery periods.⁵ Reptiles in the orders Crocodylia and Testudines have unique cardiovascular anatomy, as well as adaptations that allow them to submerge for hours. Their ability to shunt blood away from their lungs presumably results in prolonged induction and recovery times.⁷ Studies have shown that the pulmonary-systemic shunt in crocodiles can be inhibited with the use of beta-adrenergic stimulation.³ Additionally, adrenergic control of the cardiovascular system in the turtle has also been demonstrated.⁴ In our two-part crossover study, using American alligators (Alligator mississippiensis) and common snapping turtles (Chelydra serpentina), individuals were anesthetized with inhalant isoflurane⁷ for 90 min and then given an intramuscular injection of saline⁶ or epinephrine⁷. C. serpentina were also given a third treatment, electrical stimulation of GV-26. GV-26 is an acupuncture point purported to aid in the treatment of shock and cardiopulmonary arrest.⁶ While the efficacy of this point in reducing anesthetic recovery times has not been investigated, an anatomic location for the point has been suggested and employed in sea turtles to help manage apnea.¹⁻² Reptiles given epinephrine, on average, recovered twice as fast as those given saline. Recovery times between GV-26 and epinephrine were similar. While this was not a safety study, no adverse effects were noted in the study animals. Results from this study were statistically and clinically significant. The use of parenteral epinephrine and/or GV-26 stimulation in the immediate post-anesthetic period may substantially improve our current management of these species.

aIsoflurane® USP, Piramal Healthcare Limited, Andhra Pradesh, India.
b0.9% Sodium Chloride Injection USP, Baxter Healthcare Corporation, Deerfield, IL 60015, U.S.A., 0.1 ml/kg i.m.
cEpinephrine Injection USP, 1 mg/ml solution, IMS Limited, SO. El Monte, CA 91733, U.S.A., 0.1 ml/kg i.m.

Key words: Alligator mississipiensis, American alligator, anesthesia, Chelydra serpentina, common snapping turtle, GV-26

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LITERATURE CITED


EVALUATION OF VITAMIN A STATUS AND DIAGNOSIS OF HYPOVITAMINOSIS A IN AMPHIBIANS

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Abstract

Without supplementation, insect-based diets for amphibians and reptiles are known to be deficient in nutrients such as calcium and vitamin A.5 In the last decade, hypovitaminosis A has been recognized as a limiting factor for amphibian conservation programs that must successfully maintain and breed endangered species for ex situ rescue, survival assurance, and reintroduction programs.6,7 Empirical treatments, new approaches to dietary supplementation of insects (especially carotenoids and techniques for more effective gut-loading), and experimental studies have been useful for improving our understanding of this condition.2,4-6 However, research and clinical management have been hampered by practical considerations (e.g., it is difficult to get sufficient samples from very small frogs), limited basic information on vitamin A metabolism in amphibians, and a lack of standardization in diagnostic methods.3,7 A presumptive diagnosis of hypovitaminosis A in amphibians will often be made by a pathologist observing squamous metaplasia (SM) in a normally mucus-producing or ciliated epithelium.6,7 Although the tongue is the most common anatomic site for SM (i.e., short tongue syndrome), it is also recognized in the oropharynx, esophagus, ureter, reproductive tract, and cloaca. It is important to note that SM is not observed in every vitamin A-deficient animal, nor is it consistently observed in every anatomic site.7 Collection and histologic examination of a range of different tissues is suggested for every amphibian necropsy. Measurement of vitamin A levels in serum or liver is encouraged to confirm a diagnosis of hypovitaminosis A, but there are important pitfalls including awareness of what is measured and reported by different laboratories (retinol+retinyl esters or simply retinol) and the need for proper collection of samples (autolysis and light exposure influences results).3,7 Interpretation of vitamin A levels can be frustrating because of a lack of validated reference ranges in amphibians, wide variation in “normal” upper levels between individuals and species, and physiologic maintenance of serum retinol levels until deficiencies are advanced (serum retinol is not linear in relation to deficiency).1,3,7,8 However, low vitamin A levels (e.g., < 5-10 µg/g retinol in liver) should always raise suspicion of deficiency.

Key words: Amphibians, hypovitaminosis A, retinol, short tongue syndrome, vitamin A

LITERATURE CITED


UNDERSTANDING THE INTERACTIONS OF DIET AND LIGHTING ON FROGS AND THEIR SYMBIOTIC BACTERIA TO IMPROVE EX SITU HUSBANDRY OF AMPHIBIANS

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Abstract

Amphibians are undergoing massive population declines in the wild, in part due to infectious diseases including chytridiomycosis, caused by the fungal pathogen Batrachochytrium dendrobatidis (Bd). In response, amphibian populations are being maintained in ex situ breeding programs while viable treatments for chytridiomycosis are developed. One potential action involves the use of symbiotic bacteria from the skin of amphibians; however multiple factors likely affect the success of such probiotic applications. Disturbances in the natural microbiota of amphibians may alter individual susceptibility to pathogens and disrupt any probiotic treatments that may have previously been applied. Studies have found wild populations of amphibians show large variation in bacterial communities according to host species and location, thus conservation efforts may require baseline data for specific species and populations. The bacterial community of an individual is influenced by its biotic and abiotic environment, and amphibians in the wild receive relatively high exposure to bacteria through environmental and conspecific interactions. Conversely, the captive environment likely provides lower environmental heterogeneity and reduced conspecific interactions, potentially resulting in lower exposure to bacteria. Therefore there may be species- and institution-specific responses of the amphibian microbiota to the captive environment. Varying dietary and environmental conditions provided in captivity may also lead to differences in the microbial community, potentially leaving captive amphibians with compromised immunity to infectious diseases, such as the fungal pathogen Batrachochytrium dendrobatidis (Bd), which could be particularly significant for populations intended for reintroduction. The development of treatments against Bd will need to consider a range of complexities regarding the microbial ecology of symbiotic bacterial communities on the skin of amphibians, particularly in the context host-microbe-environment interactions. The purpose of this research was to determine the impact of husbandry practices on symbiotic bacterial communities of frogs maintained at Chester Zoo and the University of Manchester. Specifically, the research aimed to:

1) investigate the effect of a carotenoid-rich diet on symbiotic bacterial communities of red-eyed tree frogs, and

2) assess the effects of varying ultraviolet light provision and calcium diets on growth, body condition and symbiotic bacterial communities of red-eyed tree frogs.
No effects of either UV treatment or calcium diet on growth or body condition of frogs were found. Specific dietary conditions (carotenoid availability) in captivity were found to alter the symbiotic bacterial communities associated with the frogs’ skin, whereas others (UV and calcium availability) have no effect although subsequent to the UV boost, frogs had a significantly greater fungal load in comparison to frogs that were not UV-boosted.\textsuperscript{1,2} Thus, feeding and UV provision may influence the successful establishment of probiotics and affect the suitability of captive populations for reintroduction into the wild. In summary, host-microbe-environment interactions were identified pertinent to developing treatments for Bd and chytridiomycosis. At Chester Zoo, by gut-loading their cricket prey items, frogs are fed a carotenoid-enriched diet to enhance the skin colour and promote species richness and abundance of cutaneous bacterial community. Boosting baseline UV light provision had no effect on growth, breeding success or symbiotic bacterial communities in these two species, and this costly addition to husbandry protocols has been stopped. Whether these bacterial changes increase susceptibility of amphibians to infectious disease is unknown and warrants further study.

**Key words:** Agalychnis callidryas, Agalychnis moreletti, amphibians, Batrachochytrium dendrobatidis, health, Morelet’s tree frogs, red-eyed tree frogs

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**LITERATURE CITED**


CONSIDERATIONS TO MAXIMIZE NUTRIENT SUPPLEMENTATION OF FEEDER INSECTS

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Abstract

Providing a nutritionally appropriate diet to amphibians and other insectivores under human care has long proved challenging. The number of available insect species is limited and typically deficient in key nutrients such as calcium and vitamin A. Until more nutritionally balanced options are available, actions should be undertaken to improve the nutritional quality of feeder insects such as the domestic cricket (Acheta domestica), commonly used to feed amphibians and other insectivores. Common practices involve gut loading and dusting.\textsuperscript{3,4} Gut loading utilizes a nutrient dense diet to feed the insect with hopes of improving its nutrient content through retention of the diet. Dusting involves coating the live insect in a powdered supplement prior to offering to the insectivore. Both methods of supplementation have been studied with regards to certain nutrients, specifically calcium and vitamin A/carotenoids, with inconsistent results reported in the literature.\textsuperscript{3} Maximizing the efficacy of gut loading would require additional husbandry modifications for species like the domestic cricket. Utilization of recommendations involving temperature, supplementation regimen, water provisions, storage and preparation of vitamin supplements, particle size, and growth stage of the cricket, may to help maximize the effect of gut loading and supplementation of crickets.\textsuperscript{1,3} Although considering factors such as the growth stage of crickets would help to optimize delivery, in practical systems this level of detail can be challenging, leading to a call for more streamlined and reliable products that deliver the most impact with the least labor intensity. There are a multitude of products available for gut loading and dusting, the reliability of which can vary significantly. One study previously reported that of four dry cricket gut loading diets tested, only three provided guaranteed calcium content and only two of those met their minimum guarantee.\textsuperscript{2} Some products are designed to provide only a specific nutrient or group of nutrients, and may be lacking other key nutrients. For example, insects raised to have enhanced vitamin content had calcium to phosphorus ratios ranging from 0.07-0.14 (unpublished), instead of the desired 1-2, and thus would still require gut loading or dusting to improve their overall nutritive value for the insectivore. When evaluating nutrient content and product efficacy, as is done at regularly at Disney’s Animal Kingdom, often a gap exists between guaranteed analysis and reality. By evaluating current differences between product claims and analyzed values, we aim to demonstrate the need for scrutiny and consumer awareness to ensure delivery of proper nutrition to amphibians and other insectivores under human care. A multi-faceted approach to cricket care and feeding is necessary to ensure a nutritionally adequate diet for amphibians and other strict insectivores.

Key words: Amphibians, crickets, cricket husbandry, gut loading, nutrition, supplementation
LITERATURE CITED


NON-HEALING SUBCUTANEOUS HEMORRHAGE IN A COLONY OF VAMPIRE BATS (*Desmodus rotundus*) DUE TO SUSPECTED VITAMIN C DEFICIENCY

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Abstract

The Milwaukee County Zoo has housed vampire bats (*Desmodus rotundus*) since 1973. The bats are fed defibrinated cow’s blood with a liquid pediatric multivitamin supplement. In November 2013, one bat developed a non-healing left wing hematoma. An August 2014 post-mortem examination revealed multifocal extensive necrohemorrhagic and suppurative ulcerative dermatitis with no underlying cause determined. From July to December 2014, five of nine bats in the colony developed similar hematomas along with gingival bleeding. Biopsies showed chronic histiocytic dermatitis with fibrosis and hemorrhage. One bat euthanized in December 2014 had a serum ascorbic acid level of 0.08 mg/dl and marked generalized subcutaneous hemorrhage. A nutritional imbalance was suspected, so a therapeutic trial was initiated in which two bats received defibrinated cow’s blood supplemented with only oral vitamin C, 100 mg/kg p.o. × 3 days, and then 50 mg/kg p.o. daily. Two other bats received non-supplemented defibrinated cow’s blood but were given vitamin K 3.3 mg/kg s.c. b.i.d. × 3 days, and then 3.3 mg/kg s.c. b.i.d. × 7 days. The bats supplemented with vitamin C improved, so all bats were then supplemented with vitamin C. All subcutaneous hemorrhages resolved within 10 days to 2 mo. Vitamin C is necessary for collagen synthesis, which is required for proper wound healing and capillary strength.1 Many animals, including several bat species, cannot synthesize vitamin C and require a dietary source.1 This is the first report of suspected vitamin C deficiency in a colony of vampire bats leading, to severe chronic subcutaneous hemorrhage.

Key words: Case series, *Desmodus rotundus*, subcutaneous hemorrhage, therapeutic trial, vampire bats, vitamin C deficiency

LITERATURE CITED

BODY WEIGHT CHANGES OF LEOPARD TORTOISES (*Stigmochelys pardalis*) FED TWO ISOCALORIC DIETS

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Abstract

Growth patterns of captive leopard tortoises (*Stigmochelys pardalis*) have been compared with those of free-ranging individuals.\(^2\,^4\)-\(^5\) Although useful comparative references for captive animal management, the lack of quantified food intake and opportunistic morphometric sampling associated with wild specimens limits their application. Average daily gain (ADG) of 17 female leopard tortoises born of the same clutch, was analyzed over two 12-mo periods: Period A was January through December 2012 (ages 2650-3015 days) and Period B was January through December 2014 (ages 3380-3745 days). Food offered supplied 50% of herbivorous reptile field metabolic rate (FMR, kJ ME/day) based on weekly body weight throughout both periods.\(^3\) Daily food intake was quantified as the difference between food offered and orts remaining after 10 hr. On a dry matter basis, calculated metabolizable energy (ME) (12.93, 13.78 kJ/g), crude protein (CP) (13.7%, 16.3%), crude fat (CFat) (3.8%, 6.8%), and structural carbohydrates (crude fiber [CF]) (22.3%, 17.7%), differed for commercial diet blends consumed during Period A and B, respectively. The contributions (%) of CP and CF to consumed ME were consistent with previous recommendations.\(^1\) NDF content was 51.4% and 40.7%, respectively. Absolute amount of ADG was significantly greater during Period A (\(P < 0.05\)) (Figure 1). Periods reported here represent ages beyond those for which growth has been previously described.\(^4\) Lower Period B growth rates may 1) be a result of reduced energy utilization associated with the nutrient profile consumed over that time and/or 2) coincide with a species typical, age-related decline associated with maturity.

Key words: Average daily gain, growth, leopard tortoise, metabolizable energy, *Stigmochelys pardalis*

LITERATURE CITED


Figure 1. Mean average daily gain (ADG) (±SD) of female leopard tortoises (*Stigmochelys pardalis*) (*n* = 17) fed isoenergetic diets over two 12-mo periods (Jan-Dec 2012 and Jan-Dec 2014).
EVALUATION OF THE NUTRITIONAL STATUS OF REHABILITATED GREEN SEA TURTLES (Chelonia mydas) UTILIZING NUTRITIONAL MARKERS, STABLE ISOTOPES, AND METAGENOMICS

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Abstract

Green sea turtles (Chelonia mydas) are unique because hatchlings and pelagic juveniles are carnivorous, while later life history stages are primarily herbivorous. Dietary requirements at each life stage are poorly understood, making diet selection during rehabilitation of injured and sick animals challenging. Although turtles are typically transitioned to an herbivorous diet before release, food items high in animal protein (e.g., fish, shrimp, and squid) are often offered/consumed early in rehabilitation to combat poor appetite and emaciation. This may result in gastrointestinal pathologies and potential obesity.

To understand the impact of diet on health and recovery, nutritional parameters in green turtles undergoing rehabilitation at the Georgia Sea Turtle Center are being compared to those of healthy, free-ranging turtles captured during an ongoing monitoring project in St. Lucie County, Florida. Analyses include: (1) a suite of blood nutritional parameters (e.g., biochemical enzymes), (2) carbon and nitrogen stable isotopes in skin tissue, and (3) metagenomics of bacterial fecal flora. Rehabilitated turtles are monitored at admission, mid-rehab, and release. Preliminary analyses of blood nutritional parameters was completed on 13 rehabilitated turtles that were initially fed primarily carnivorous diets and then transitioned to primarily herbivorous diets pre-release. Turtles at the release time point had higher mean total protein ($P < 0.001$), mean triglyceride ($P < 0.001$), and mean ionized calcium ($P < 0.001$), and lower mean uric acid ($P < 0.05$) compared to the entry time point. Ultimately, information gained from this study will enable rehabilitation centers to make dietary modifications and develop gel-based diets that will enhance the recovery process for these endangered animals.

Key words: Chelonia mydas, green sea turtle, metagenomics, nutrition, rehabilitation, stable isotopes

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EX SITU AMPHIBIAN NUTRITION: RECENT FINDINGS AND FUTURE DIRECTIONS

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Abstract

In 2013 a workshop was hosted to evaluate the current understanding of amphibian medicine and nutrition, in order to further our progress in establishment of successful breeding programs to promote amphibian conservation.1 The Nutrition Working Group identified a number of challenges and opportunities for advancement in this field.2 First, an overarching theme of all Working Groups was the need for standardization of protocols and processes to allow for objective evaluation of nutritional and health status of amphibians. Second, an overview of current knowledge in amphibian nutrition was conducted. Finally, specific areas of concern in nutrition were highlighted for vitamin A status (determination of status, preventive and therapeutic options), multifactorial issues contributing to metabolic bone disease, the role of water quality in amphibian nutrition, establishment of appropriate research models to further define nutrient requirements of amphibians, and the need for evaluation of a wider range of wild-type diet items and enhancement of captive diet items.

Key words: Amphibian, conservation, nutrition

LITERATURE CITED


THE HAIRY LIZARD: FACTORING IN HETEROTHERMY IN ANESTHETIC MANAGEMENT OF ARABIAN ORYX (Oryx leucoryx)

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Abstract

The core body temperature (Tb) of mammals is generally expected to be constant, and is usually not factored in when selecting anesthetic dosages. However, several mammals show heterothermy to save energy and water. For example, the daily Tb of the Arabian oryx (Oryx leucoryx) fluctuates by as much as 5°C.1,2 Such variation in Tb might affect metabolic rate and thus anesthesia. We investigated the effect of Tb on the anesthetic dosage required in 68 anesthetic events of semi-free ranging Arabian oryx. Anesthesia was induced by remote injection of a set amount of ketamine (25 mg), midazolam (10 mg), and medetomidine (0.5 mg) combined with a variable amount of etorphine (target dosage: 20 µg/kg). If an animal did not become recumbent within 15 min after darting, or was insufficiently anesthetized, it was given a supplementary injection of etorphine (0.2-0.4 mg i.v.) depending on anesthetic depth. The Tb was measured immediately upon handling of the animal. Forty two animals (62%) became recumbent following the initial dose. The remaining animals could be handled, but needed 0.3 ± 0.14 mg etorphine i.v. to reach the desired level of anesthesia. There was a significant positive correlation between Tb and the total etorphine dosage needed (r² = 0.4677, P < 0.0001); at low Tb (<37°C), as little as 16-20 µg/kg was sufficient, whereas above 41°C twice that amount was required. In eight animals, basic metabolic rate was assessed based on oxygen consumption at two different Tbs: a 30-40% reduction in oxygen uptake with a decrease in Tb of 4-5°C was demonstrated, supporting the notion that Tb must be considered when anesthetizing heterothermic animals.

Key words: Adaptive heterothermy, anesthesia, Arabian oryx, etorphine, Oryx leucoryx

LITERATURE CITED


EFFICACY AND SAFETY OF MEDETOMIDINE-AZAPERONE-ALFAXALONE COMBINATION IN CAPTIVE WHITE-TAILED DEER (*Odocoileus virginianus*).

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**Abstract**

Alfaxalone is a neurosteroid drug that interacts with GABA$_A$ receptors in the brain. It has the potential to improve the efficacy of existing alpha-2-adrenergic agonist-based wildlife anesthesia combinations but there are few studies of its use in wild mammals.1,2 The objective of this study was to determine the efficacy and safety of a medetomidine-azaperone-alfaxalone (MAA) drug combination used to anesthetize captive white-tailed deer (*Odocoileus virginianus*). Eight captive adult white-tailed deer were hand-injected intramuscularly with 0.15 mg/kg medetomidine, 0.2 mg/kg azaperone, and 0.5 mg/kg alfaxalone. Once anesthetized deer were maintained in lateral recumbency and monitored for 60 min. Heart and respiratory rate, rectal temperature, and direct systolic, mean, and diastolic blood pressures were recorded every 5 min. Blood gas analysis was done on arterial blood every 15 min. The level of sedation and quality of recovery from anesthesia after reversal with 0.75 mg/kg of atipamezole were scored. Analysis of variance and descriptive statistics (significance of $P < 0.05$) was used to analyze data. Induction (time to lateral recumbency, 7.1 ± 2.4 min [mean ± SD]) and recovery times (time to standing, 9.1 ± 3.1 min) were comparable to current medetomidine-based combinations in white-tailed deer.3-5 Cardiopulmonary effects observed at 15 min post injection of immobilizing drugs were hypoxemia (PaO$_2$ 54 ± 9 mmHg), hypoventilation (PaCO$_2$ 55 ± 3 mmHg), and mixed acid-base disturbances (pH 7.22 ± 0.04). Blood pressure was in normotensive range (mean BP 99 ± 8 mmHg) and recovery was consistently smooth with minimal struggling or ataxia. MAA produced a satisfactory and safe level of deep sedation for handling and minor procedures in captive white-tailed deer.

**Key words:** Alfaxalone, anesthesia, azaperone, medetomidine, *Odocoileus virginianus*, white-tailed deer

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**LITERATURE CITED**


NEAR-INFRARED SPECTROSCOPY: APPLICATIONS TO ANESTHETIC MONITORING OF IMPALA (Aepyceros melampus)

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Abstract

Indirect monitoring methods are used to ensure adequate oxygen delivery to vital organs during anesthesia.2 Technologies not common-place in veterinary medicine can provide additional information. One such technology is near-infrared spectroscopy (NIRS), a non-invasive method of assessing regional tissue perfusion.1 In a randomized cross-over design, nine impala (Aepyceros melampus) were anesthetized twice each with protocol EA [15 μg/kg etorphine (Captivon 98, Wildlife Phamaceuticals Ltd, White River, South Africa) and 0.15 mg/kg acepromazine (Calmivet Solution injectable, Vétoquinol, Magny-Vernois 70200, Lure, France)] and protocol MK [110 μg/kg medetomidine (Zalopine 30 mg/ml, Orion Pharma, Espoo, Finland) and 4.3 mg/kg ketamine (Ketaminol Vet, MSD Animal Health, AN Boxmeer, Holland)]. As anticipated, EA animals had lower mean arterial blood pressures (EA 72 ± 21, MK 118 ± 8 mmHg) and respiratory rates (EA 8 ± 3, MK 27 ± 23 bpm) but higher heart rates (EA 107 ± 11, MK 47 ± 18 bpm) at 20 min post-darting. NIRS values, reflecting muscle oxygenation, were consistently higher for EA than for MK animals. Mean values at 20 min were EA 70.8% and MK 56.0% and at 40 min EA 66.3% and MK 60.4%. The lower muscle oxygenation levels seen with MK animals at 20 min were likely a result of reduced perfusion caused by medetomidine. Further work is required to establish the relationship between perfusion/oxygenation of muscle and that of vital organs. However, NIRS uniquely allows assessment of tissue oxygenation reflecting perfusion, and in this case demonstrated better muscle oxygenation with EA than with MK.

Key words: Acepromazine, Aepyceros melampus, etorphine, impala, medetomidine, near infra-red spectroscopy

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LITERATURE CITED


UNGULATE POPULATION SUSTAINABILITY: VETERINARY CHALLENGES ASSOCIATED WITH BIG HERD MANAGEMENT

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Abstract

According to a 2011 report by the Association of Zoos and Aquariums (AZA) Task Force on the Sustainability of Zoo-based Populations, many ungulate species managed through AZA institutions are not sustainable at their current population levels. Some of the reasons cited for this included: low numbers of animals in individual populations and a lack of exhibit and breeding space sufficient to maintain a population capable reaching long-term sustainability. In order to combat this, larger populations of these threatened and endangered species are needed in AZA facilities.

One of the largest challenges facing AZA institutions in trying to meet this goal is a lack of holding space for maintenance of normal herd structure. One solution is to create breeding centers away from heavily populated areas where significant acreage can be devoted to the maintenance and breeding of large herds of ungulate species. Although this method shows significant promise, it does bring several unique challenges to the institution in regards to veterinary medicine.

Fossil Rim Wildlife Center is an 1800-acre facility outside of Dallas, Texas devoted to the care and breeding of endangered species. Currently, Fossil Rim’s Veterinary Staff manages the health of more than 1000 animals representing 50 different species. The majority of these animals are large hoofstock species that have been managed for an extended period of time in herds located on large pastures.

Over its 30-yr history, veterinary procedures and protocols have had to be developed and / or altered in order to accommodate the unique environment of Fossil Rim. Many of these protocols have been documented on film and / or video for later review. Some of these include alterations to darting methodology, routine vaccination and deworming protocols, chute work, body condition scoring to assess herds over time, and herd management via the use of vasectomized males.

Darting is a common component of most zoo medicine programs. Typically this involves the keeper staff shifting an animal into a smaller space where darting on foot from outside the enclosure is possible. In large herd situations on open pasture, the methodology for darting changes dramatically, particularly in regards to chemical immobilizations. Not only are the distances often much further, the darting typically occurs from a vehicle. Once darted, a significant amount of vehicle work needs to be performed in order to maintain an appropriate darting situation. Having experienced drivers, vehicles capable of handling rough terrain, and excellent communication becomes essential.

Routine vaccination protocols have their own challenges when considering a large herd of animals. Added complications also occur when a large number of animals from the same herd need
to be immobilized in relatively close proximity, as may happen with a shipment of multiple animals during a small window. In these situations, the herd may become hypersensitive to the darting vehicles and may scatter immediately when approached. Over the years various methods have been used to overcome these challenges including: the use of different darting vehicles, using a pole syringe from the back of a tour van, as well as posting a veterinarian in a tree with the dart gun and using the vehicles to push the herd past the tree to facilitate darting.

Chute work becomes extremely useful when dealing with large herds of hoofstock. It allows the veterinary team the ability to get hands on animals in very rapid succession and it avoids the complications associated with multiple anesthetic events. In order for chute work to go smoothly, communication and delineation of task responsibility is essential and should be confirmed among the team members prior to starting the procedures.

Body condition scoring is used frequently in zoo medicine to track an individual animal’s condition over time, but is rarely utilized on the larger scale. In large herds, it is assumed that some animals will be below adequate condition, some animals above, but the goal is to maintain the average body condition of the herd at an ideal level. At Fossil Rim, body condition scoring is done routinely on the various herds as a whole and used at a population level to manage the overall herd condition.

Contraception becomes more difficult when dealing with herds in open pasture. Many of the hormonal methods become less feasible when dealing with large herds and mixed species pastures. Vasectomy as a method of contraception has been used at Fossil Rim to control populations that are no longer desired as part of the collection. Most notably, a breeding herd of red deer (Cervus elaphus) is in the process of being phased out after successfully vasectomizing 37 males.

Even in herds that are intended to be maintained as breeding herds, there may be reasons why regulating the number of offspring would be useful. A common concern is weather, as winter is not an ideal time for calves to be on the ground. One method around this is to pull the bull from the herd in order to avoid parturition occurring during the winter months. However, the lack of a bull in the herd can affect the herd dynamics. In order to avoid this complication, Fossil Rim uses a vasectomized bull that is exchanged for the intact bull during the ideal “off” season. This maintains the influence of a bull in the herd without having the complications associated with a year-long calving season.

Thirty years of large herd management at Fossil Rim has created a unique environment for the development of solutions to the challenges routinely faced by large acreage breeding centers. These problems are often unique to institutions that house large herds, but the solutions may be applicable to other areas of zoo medicine as well. Whether it is at an institution that already has large herds in open pasture, an institution that is considering adding an offsite breeding center, or an institution that is interested in recreating some of the herd dynamics in their smaller herds, many of the alterations that have been developed at Fossil Rim are applicable and adaptable to other facilities.
**Key words:** Body condition scoring, darting protocols, large herd management, ungulates, vasectomy

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**LITERATURE CITED**

USING URINARY HORMONE ANALYSIS TO PREDICT GENDER AND ASSESS FETAL VIABILITY IN THE INDIAN RHINOCEROS (*Rhinoceros unicornis*)

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Abstract

The high incidence of stillbirth (16% of all births) within the global captive propagation program for Indian rhinoceros (*Rhinoceros unicornis*) has been a major impediment to achieving a sustainable population.2 Many factors have been linked to stillbirth incidence in domestic livestock including: parity, sex of offspring and gestation length. Recent analysis of studbook data indicates primiparous Indian rhinoceros dams experience less perinatal death and stillbirths compared to pluriparous dams.2,3 While sex ratio at birth remains fairly equal in this species (54% male), the majority of stillbirths (67%) have been associated with male calves.2

As fetal gender may be a contributing factor in stillbirth in the Indian rhinoceros, knowledge of the sex of calves in utero could help identify those dams at a potentially higher risk. Knowing the gender of an expected calf would provide institutions and the rhinoceros taxon advisory group (TAG) more lead time to plan for housing requirements and subsequent breeding recommendations if viable births occur. Developing a non-invasive means to determine sex of an Indian rhinoceros fetus could potentially benefit this species and the zoo community.

In this study, we examined if urinary hormone analysis of maternal testosterone (T), cortisol (C) and corticosterone (C₁) could be used to establish physiologic markers to predict gender, parturition date and potentially assess fetal viability during pregnancy in the Indian rhinoceros. While urinary C has been validated for Indian rhinoceros,1 it has not yet been examined during gestation, and the pattern of excretion as it relates to timing of parturition and birth outcome is unknown. To validate urinary C₁, samples collected during a previously conducted adrenocorticotropic hormone (ACTH) stimulation test were utilized.1

Longitudinal urine samples were collected starting on day of breeding (3 dams) or AI (3 dams), continued throughout gestation and for 1 wk post parturition. Of the six pregnancies monitored, three resulted in live births of female calves at 477.67 ± 6.96 days (range 465-489 days) post-breeding (n = 2) or AI (n = 1); two resulted in live births of male calves at 481 ± 1 days post-breeding (n = 1) or AI (n = 1); and one resulted in birth of a male calf at 490 d post-AI that exhibited signs of respiratory distress and died ~12 hr post-parturition. Although sample size was low, we found no difference (P = 0.452) in gestation length between dams carrying female versus male calves.
Significantly higher concentrations of urinary T were excreted from dams carrying male versus female calves during all months of gestation, with the largest difference observed during month 11 of gestation. Similarly, glucocorticoids C and C₁ were excreted in higher concentrations during all months of gestation in dams pregnant with male calves when compared to those pregnant with female calves \( (P < 0.05) \). Peak urinary C was measured during the 30 days prior to parturition in dams carrying a female calf, whereas dams pregnant with male calves excreted peak C during the 60 days prior to birth.

As urinary C₁ has the potential to signal independently of C, and because in some species the fetus preferentially secretes C₁ versus C, we also sought to validate urinary C₁ in this species and determine its utility as a prognostic tool for fetal viability. Pharmacologic validation of C₁ was shown via a 12-fold increase in urinary C₁ concentrations (baseline 3.45 ± 0.50 ng/mg vs. peak 44.17 ng/mg corticosterone) measured 16 hr after ACTH injection in a 32-yr-old Indian rhinoceros bull.

The data from this study provided useful information showing that urinary hormone excretion can be used to determine the sex of the fetus in Indian rhinoceros. However, as none of the pregnancies evaluated in this study resulted in stillbirth and only one birth was associated with perinatal death, sex of the calf could not be shown to be associated with an increased risk of stillbirth in this study. Evaluation of hormonal data, fetal sex and calf viability from additional pregnancies is warranted to determine key factors associated with reproductive success in Indian rhinoceros.

**Key words:** Fetal gender, glucocorticoids, pregnancy, *Rhinoceros unicornis*, testosterone, urinary hormones

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The authors thank the animal care staff at the participating zoos (Buffalo Zoo, Cincinnati Zoo & Botanical Garden, Fort Worth Zoo, Oklahoma Zoo, Montgomery Zoo) for collection of urine samples. Appreciation is extended to Katherine MacKinnon and Patricia Hermes for endocrine assistance. This study was supported by the P&G Wildlife Conservation Scholarship, Proctor & Gamble Pet Care, Cincinnati, OH.

**LITERATURE CITED**


THROMBOELASTOGRAPHY-GUIDED DIAGNOSIS AND THERAPY IN A CASE OF ELEPHANT ENDOTHELIOTROPIC HERPESVIRUS HEMORRHAGIC DISEASE

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Abstract

Elephant endotheliotropic herpesviruses can lead to a devastating hemorrhagic syndrome (EEHV HD) in sub-adult elephants with an extremely high mortality rate. Clinical symptoms result from reduced endothelial integrity leading to widespread edema, hemorrhage and presumptive consumption of platelets and clotting factors. These hemostatic abnormalities have not yet been characterized. Thromboelastography (TEG) measures the dynamic process of coagulation and fibrinolysis1 and has numerous applications in veterinary species.2

A 20-mo-old Asian elephant (Elephas maximus) presented with non-specific signs. TEG performed on citrated whole blood revealed a hypocoagulable state (Figure 1, line 2) which supported suspicions regarding EEHV HD. Aggressive treatment included whole blood and plasma transfusions, antiviral medications (Ganciclovir and Famciclovir), synthetic factor VII (NovoSeven, NovoNordisk Scandinavia AB, Region Denmark, DK-2300, Denmark, approximately 70 µg/kg i.v.) and supportive care. Repeat TEG showed some improvement (Figure 1, line 3). Initially the R value, indicating time to initial fibrin formation, was greater than 119 min, but decreased to 43.3 min after treatment. R in normal elephants is 3-4 min. Despite treatment, the calf deteriorated and was euthanized. Pathology and PCR confirmed a diagnosis of EEHV-1A.

In-vitro analyses were performed to assess the potential effect of 20 and 40 ml/kg plasma therapy (Figure 1, lines 3 and 4 respectively). However in-vivo, this would require administration of 15-30 L of plasma. As less than 1200 ml of plasma were successfully given, it is believed that the improvement seen on TEG was associated with administration of synthetic factor VII.

TEG shows potential to characterize and assess the pathogenesis and potential treatment options in elephants with EEHV HD.

Key words: Elephant endotheliotropic herpesvirus, Elephas maximus, factor VII, hemorrhagic disease, thromboelastography, transfusion

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LITERATURE CITED


Figure 1. Thromboelastography (TEG) curve from a 17-yr-old healthy dam (1); EEHV HD calf pre-treatment (2 = straight line); in-vitro addition of 50µl (3) and 100µl (4) plasma from dam to calf sample; calf sample after synthetic factor VII treatment (5).
SUBCLINICAL ELEPHANT ENDOTHELIO TROPIC HERPESVIRUS (EEHV) SHEDDING SURVEILLANCE AND NOVEL CLINICAL INFECTION WITH EEHV4 IN ASIAN ELEPHANTS (Elephas maximus) AT THE HOUSTON ZOO

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Abstract

Elephant endotheliotropic herpesviruses (EEHV) can cause fatal hemorrhagic disease in elephants. EEHV1 is the most common and lethal species globally, while EEHV4 has only been described in two fatalities on postmortem examination.1,3 Surveillance for EEHV was conducted on samples from various anatomic sites. EEHV4 shedding was reliably detected in trunk washes and hard palate swabs, which were used to document the transmission of EEHV4 between herdmates. EEHV1 shedding was optimally detected in trunk washes; however, conjunctival and distal trunk swabs also produced positive detections. These findings suggest that EEHV1 and EEHV4 may be sampled in various anatomic sites, which may be applicable to epidemiologic and clinical studies in situ where trunk washes are less feasible.2,4 During the study, the first non-fatal EEHV4 clinical infections were confirmed in two captive-born Asian elephants (Elephas maximus). These were characterized by viremic episodes, initial leuko- and thrombocytopenia followed by leuko- and thrombocytosis, and clinical signs consistent with other EEHV infections. Early detection and administration of the antiviral famciclovir (15 mg/kg rectally TID, Novopharm Limited, Toronto, M1b2K9, Canada) starting on day 4 of viremia helped to successfully resolve these cases, along with supportive fluid and plasma therapy. As has been documented in previous EEHV viremias, viral shedding was detected with quantitative polymerase chain reaction shortly after clinical infection and continued for several months, peaking after approximately 2 mo. The sequential course of clinical infection, treatment, and resolution was carefully documented in these cases, which may be a useful tool to manage future EEHV4 cases.

Key words: Asian elephant, elephant endotheliotropic herpesvirus, Elephas maximus, famciclovir, qPCR, swab sampling

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LITERATURE CITED


ASSOCIATION OF ZOOS AND AQUARIUMS ENVIRONMENTAL DISASTER RESPONSE INITIATIVE

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Abstract

Whether hurricanes, oil-spills, or forest fires, animal populations are directly affected by both natural and man-made disasters. The current response network for man-made environmental disasters involving wildlife, the largest and most prominent of which are oil spills, is comprised of a well-established coalition of players, including federal and state agencies, large corporations, NGOs and companies that specialize in response, rescue and remediation. Following the Deepwater Horizon disaster in the Gulf of Mexico, this coalition of responders faced the challenge of being better prepared to respond to future disasters and, in particular, to reduce the damage these disasters cause to wildlife and the environment.

Currently, the Association of Zoos and Aquarium’s (AZA) network of accredited zoos and aquariums provides a diverse talent pool that can be tapped into for increased, additive effectiveness during an oil spill event. AZA-accredited zoos and aquariums have the experienced animal-care professionals—including zoologists, biologists, aquarists, veterinarians, vet techs, animal data-entry specialists and many other animal professionals—who are desperately needed to respond to animal-related issues in disaster situations and who are uniquely suited for augmenting wildlife triage, recovery, rehabilitation and release activities. AZA-accredited zoos and aquariums also have the resources including capture equipment, horse-trailers, boats, nets, filtration equipment, pop-up pools and animal medical supplies that most disaster responders simply do not have. However, despite its willingness to play a role, AZA is not currently included in any formal response framework. This provides the clear opportunity for AZA accredited zoos and aquariums to become more involved and more coordinated when future environmental disasters arise.

AZA is creating an association-wide environmental disaster response prototype. Conceptually, this prototype will focus on identifying and coordinating AZA animal care professionals who are fully trained, motivated and able to respond to a wide-variety of environmental disasters anywhere in the United States and possibly beyond. In order to accomplish this, the first order of business is to make sure that potential AZA responders have the requisite training certifications required by Occupational Safety and Health Administration (OSHA) to work with hazardous materials such as oil. This would require AZA zoo and aquarium professionals to be trained in Incident Command System (ICS 100/200/700) and Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) training protocols. These are essential training protocols, which must be completed before getting near an oil spill site….or working with oiled wildlife.

AZA’s goal is to create and sustain a large, well-funded network of fully trained and certified zoo and aquarium professionals—including zoo and aquarium veterinarians—to respond to oil spills
and other environmental disasters that affect wildlife in all regions of the United States and possibly beyond. This network will work to maximize the number of animals, especially threatened and endangered species that are rescued, rehabilitated and released.

AZA is immediately pursuing the following next steps:

- Develop inventory of resources and requisite training of AZA community for disasters in offshore, freshwater and terrestrial environments.

- Establish ICS and HAZWOPER training schedule for interested zoo and aquarium staff.

- Ensure zoo and aquarium staff attendance at Regional Response Team and Area/Subarea Committee meetings across the country.

**Key words:** Aquariums, disaster response, hazardous waste, incident command systems, training, zoos
THE TIME HAS COME FOR SECURE ZOO

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Abstract

The managed wildlife community is a diverse mix of licensed exhibitors, sanctuaries, game ranches, and other facilities. While business models differ, all operators and owners would be impacted should a Foreign Animal Disease (FAD) outbreak occur within their institution. The emergence of several strains of Highly Pathogenic Avian Influenza in North America in 2014 is a recent example of how business operations must change to protect collections and, for licensed exhibitors, to remain “open for business.”

The Secure Zoo program is a joint effort between United States Department of Agriculture, The Association of Zoos and Aquariums (AZA) and the Zoo and Aquarium All Hazards Preparedness Response and Recovery Fusion Center (“ZAAHP” Fusion Center). The Secure Zoo program is based upon the successful producer-driven Secure Milk, Secure Pork and Secure Egg programs. These industries understand that traditional FAD mitigation strategies would essentially put them out of business. Secure Zoo has adopted the framework for these models, which stress biosecurity, animal movement and recovery in the face of disease outbreaks. Secure Zoo addresses similar concerns, but at its core, stresses animal preservation and visitation. Pork producers and poultry farmers prevent visitation as a way to prevent disease transmission, but many managed wildlife facilities depend upon visitation for their very existence.

The Secure Zoo program is an opportunity to combine the expertise of many members of American Association of Zoo Veterinarians, AZA, USDA, State Veterinarians and other stakeholders to produce guidance to address reasonable alternatives to antiquated mitigation strategies for our industry in the event of an FAD or other hazard.

Key words: All hazards, Foreign Animal Disease, preparedness
The Great Ape Heart Project has worked over the last several years to develop a database that will be available on-line for veterinarians and cardiac advisors. Cardiovascular disease (CVD) has been identified as a major cause of death in captive great apes. The Great Ape Heart Project (GAHP) based at Zoo Atlanta (USA), (www.greatapeheartproject.org) has designed an innovative and coordinated program to investigate ape CVD and establish uniform, state of the art, cardiac diagnostics, therapeutic, and prevention strategies for great ape CVD. Understanding, managing and researching diseases that affect species where only a few individuals are housed in multiple zoological institutions has historically been a challenge. The Great Ape Heart Project, based at Zoo Atlanta, is an example of the zoo community recognizing the need to better understand what causes cardiovascular disease in great apes and to improve monitoring techniques and treatment options in their collections. A 2010 Institute of Museum and Library Services National Leadership Collaborative Planning Grant (IMLS-NLG) funded a planning workshop that brought together a targeted audience of cardiac and ape specialists from varied disciplines within the USA. This meeting assessed currently available resources, identified needs and impediments to progress, and agreed on specific actions to be taken in four areas of ape CVD: clinical diagnosis/treatment, pathology, identifying etiologies, and communication.

A top priority identified at the 2011 planning meeting was for the GAHP to develop a database ensuring all archived and prospective CVD-relevant clinical and pathology data are compiled into a confidential yet searchable resource. This effort was awarded a 2012 IMLS National Leadership Grant for Museums that funded the design and implementation of the software platform needed, and this database is currently operational in several zoological institutions within the USA. This tool was developed through extensive collaboration between the GAHP subject matter experts (SME) and the software developer, Prelude Dynamics based in Austin, TX (www.preludedynamics.com). Prelude Dynamics has provided the GAHP with a customized, online, multi-institutional database program. The GAHP VISION™ database facilitates best practices for collection and management of CVD-relevant data.

The database supports statistically robust retrospective and prospective studies, involving numerous subject matter experts (SME’s), to encourage discovery of potential causes of ape CVD, and to evaluate the efficacy of different treatment regimens. All retrospectively collected data has been migrated into this database, along with ape studbook and relatedness information. This information is currently being used to identify disease trends and current gaps in data collected.
during ape examinations. The GAHP serves as a resource and communication hub between veterinarians charged with the care of individual apes and SME’s from various disciplines, including veterinary and human cardiologists, pathologists, and ape keepers. Ape cardiac necropsy protocols are being standardized and the database will allow for comparison between clinically relevant information and pathologic information at necropsy.

Utilizing a centralized database improves clinical management of apes affected with CVD by allowing more targeted and timely reports to individual institutions regarding their animals. The GAHP VISION™ Database currently contains historical studbook data for all four great ape taxa housed in AZA institutions. The program allows users to map out familial relationships from the studbooks with the potential for determining genetic links to CVD. The database contains cardiac exam records dating back to 1992. The database is only accessible with a unique login and password that is assigned by the GAHP. User access to records is limited based on customized settings within VISION™. Individual animal identifiers are blinded through an ID generated by the software, thus preserving confidentiality while providing a way for researchers with layered permissions to access information needed for research analysis. In addition to customized data fields for cardiac exam measurements, the database stores echocardiograms and EKG files. Storing large, digitized files on Prelude Dynamics’ dedicated server not only allows the GAHP to preserve the files for research integrity purposes but also creates a secure online access point for SMEs to review exams and provide report feedback within VISION™. This eliminates the need to mail hard copies of exams or give direct access to a zoo’s server to view digital files. When an ape moves to a new institution, the new institution receives the complete cardiac records of that ape and can begin adding to the records. The prior institution reserves the ability to view the historical data up to the date of transfer, but they will not have access to future data.

By generating and collecting CVD-relevant data in a coordinated and cohesive manner for analysis and coordinated action, the GAHP overcomes previous obstacles among zoo veterinarians wanting to better understand and treat CVD in great ape collections and serves as a national and international model for disease investigation. Development of the GAHP VISION™ Database shows how zoos can pair with software developers to initiate more in-depth disease investigations that can span multiple institutions, record keeping systems, privacy concerns, and also incorporate multiple SMEs to evaluate data real-time as it is entered into the system. This system serves as a model for any disease investigation project including field-based conservation programs. VISION has a digital paper solution that allows information to be collected in areas where there is no internet available using tablets and then uploaded at a later time. VISION allows for multi-language integration and translation capability for international institutions. Researchers of any species wishing to track health trends in order to improve health and conservation outcomes and increase lifespan could take advantage of VISION™.

**Key words:** Database management, disease investigation, disease management, great apes, heart disease
FULMINANT DISSEMINATED TUBERCULOSIS (*Mycobacterium tuberculosis*) IN A CHIMPANZEE (*Pan troglodytes*) AND TREATMENT OF SIX OTHERS WITH SUSPECTED LATENT INFECTION

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Abstract

A 15-yr-old male chimpanzee (*Pan troglodytes*) had a 5-mo history of intermittent lethargy, discharging inguinal wound, loss of body condition and recent cough. Examination revealed multifocal purulent lymphadenitis, radiographic unilateral pulmonary interstitial alveolar infiltrate, neutrophilia, circulating myelocytes, metamyelocytes and promyelocytes and acid fast bacilli (AFB) on lymph node fine needle aspirates (FNA). TB Stat-Pak® (SP, Chembio) and Dual Path Platform Vet®-TB test™ (DPP, Chembio) (retrospective) were reactive. PCR on FNA was positive for *Mycobacterium tuberculosis* complex DNA prompting euthanasia. Necropsy revealed pyogranulomatous pneumonia, pleuritis, lymphadenitis, splenitis, nephritis, peritonitis, enteritis and hepatitis. Interferon gamma release assay (IGRA, Primagam®, Asure Quality) was positive. Culture confirmed *M. tuberculosis*. The genotype was identical to that from an Asian elephant (*Elephas maximus*) diagnosed with tuberculosis (TB) 12 mo earlier, suggesting an epidemiologic link between the two cases.1,2

Seventeen chimpanzee cohorts were screened for TB using comparative tuberculin skin test (TST), IGRA, thoracic radiographs, SP and tracheobronchial lavage (AFB smear, PCR, culture). Three of six TST positive animals were also IGRA positive. None had radiographic lesions consistent with TB; all were non-reactive on SP and negative on tracheobronchial testing. All commenced treatment with isoniazid and rifampicin. Rifampicin was successfully replaced with rifabutin where compliance was poor. Screening was repeated after 4 mo. Six animals were considered latently infected (positive TST and/or IGRA) and remained on treatment for 9 mo. After completion of treatment, the six animals were retested. All tests were negative, apart from a young male that remained IGRA positive. All 17 animals were rescreened in 2013 and 2014. The young male remained IGRA positive; all other tests were negative and there was no evidence of TB disease in any animal.

Key words: Chimpanzee, latent tuberculosis infection, *Mycobacterium tuberculosis*, *Pan troglodytes*, tuberculosis

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LITERATURE CITED


SURGICAL MANAGEMENT OF RETAINED PLACENTA IN TWO NONHUMAN PRIMATES

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Abstract

Two primates were successfully treated for retained placenta, despite distinctly different presentations and management. The first case of retained placenta was a 35-yr-old multiparous female Western lowland gorilla (Gorilla gorilla gorilla). Three weeks after an apparently normal parturition, the gorilla developed profuse vaginal bleeding with no other clinical abnormalities. Emergency examination revealed severe anemia and ongoing intrauterine hemorrhage. A uterine dilation and suction curettage was performed, and blood clots and pieces of tissue were extracted from the uterus. Histopathology confirmed that the tissue fragments were retained placental tissue. Intra-operative intrauterine hemorrhage was managed with anesthetic manipulation, administration of uterotonic agents, and placement of an intrauterine foley catheter. Following medical and surgical intervention, the gorilla remains clinically normal. The second case of retained placenta involved a 10-yr-old multiparous silvered leaf langur (Trachypithecus cristatus) that presented acutely for dystocia. A dead fetus was manually extracted under anesthesia. Over the next 24 hr the langur failed to pass the placenta, became anorexic and lethargic, and demonstrated signs of early sepsis on blood work. An ultrasound-guided removal of the placenta using tissue forceps was performed under anesthesia. The intact placenta was removed successfully with minimal hemorrhage. Following placental extraction, the langur remains clinically normal. These cases represent different presentations of retained placentas in nonhuman primates, one acute and one chronic (which has not been reported), and offer clinicians various methods for case management. Retained placenta is a potentially life-threatening condition that is rarely reported in primate literature, but must be dealt with aggressively when encountered.1,2

Key words: Gorilla gorilla gorilla, nonhuman primate, retained placenta, silvered leaf langur, Trachypithecus cristatus, Western lowland gorilla

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LITERATURE CITED


CARDIOVASCULAR DISEASE IN CAPTIVE ORANGUTANS (*Pongo* sp.): WHERE WE ARE NOW

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Abstract

Cardiovascular disease is a significant cause of morbidity and mortality in captive orangutans.5 Knowledge of heart disease in orangutans lags behind other ape species. Peer-reviewed publications on orangutan cardiac disease are limited to case reports, mostly focusing on congenital conditions and post-mortem diagnoses.1-2,6-7,9,11 Orangutans have evolutionary differences and specialized physiologic adaptations that may make comparison of cardiac parameters between orangutans, other apes, and humans potentially problematic.3-4,8,10

In a 2012 health survey of captive U.S. orangutans, 15% of zoos housing orangutans reported diagnosing cardiac disease pre-mortem (Orangutan Species Survival Plan, unpubl. data). A systematic review of medical records from participating institutions has shown that of the eight orangutans diagnosed with cardiac disease pre-mortem, five were asymptomatic when diagnosed during routine examination. Seven out of the eight cases were diagnosed via echocardiogram. Echocardiograms are integral in the diagnosis of this disease process and should be included in all routine exams. Collaboration with human cardiologists to obtain precise images and the Great Ape Heart Project (GAHP) in the accurate interpretation of these images is crucial.

The science of treating orangutans with cardiac drugs is still in its infancy. In conjunction with the GAHP, a treatment using ACE inhibitors and beta-blockers has been used to manage cardiovascular disease in orangutans, but more information is needed to ensure a beneficial impact on management and survival. It is vital for institutions housing orangutans to collaborate with the GAHP to help assemble this information and develop a database of normal parameters for orangutans.

**Key words:** cardiovascular disease, cardiac, heart, orangutan, *Pongo pygmaeus, Pongo abelii*

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The authors thank the Orangutan Species Survival Plan (http://orangutanssp.org) and the Great Ape Heart Project (http://greatapeheartproject.org), as well as cooperating zoological institutions, for the support provided in the successful completion of this project.

LITERATURE CITED


LONG-TERM MANAGEMENT OF DIABETES MELLITUS IN TWO GUINEA BABOONS (Papio papio) WITH ORAL HYPOGLYCEMIC AND INSULIN THERAPY

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Abstract

The Kansas City Zoo has housed a population of Guinea baboons (Papio papio) since 1995. Baboons are a popular but non-endangered exhibit animal in zoos. Guinea baboons range across the countries of Guinea, Senegal, Gambia and southern Mauritania.

Diabetes mellitus is common in baboon species and pancreatic amyloidosis had been previously documented in one adult baboon at the zoo with diabetes mellitus. Two additional cases subsequently occurred in two females contracepted with melengestrol acetate implants. At the time of implant removal, both animals were noted as being significantly underweight, hyperglycemic, hypoinsulinemic, glycosuric, with demonstrated elevated fructosamine serum concentrations. Both animals were subsequently diagnosed with diabetes mellitus. Both animals were initially managed with dietary adjustment, the oral hypoglycemic agent glipizide (Patheon Pharmaceuticals Inc, Cincinnati, OH 45237 USA) and one animal also received roziglitazone (Avandia, GlaxoSmithKline, Philadelphia, PA 19101 USA), until they were behaviorally conditioned to accept blood sampling, twice daily urine sampling and insulin therapy. Each keeper was specifically trained in the usage of insulin, and a protocol including acceptable glucose parameters was implemented. Porcine insulin zinc (Vetsulin, Intervet Inc., Merck Animal Health, Summit, NJ 07901 USA) was initially utilized in conjunction with glipizide and roziglitasone to control and subsequently regulate diabetes. When Vetsulin became no longer available, both baboons were transitioned to NPH human insulin (Humilin N, Eli Lilly & Co., Indianapolis, IN 46285 USA).

Both animals were managed with twice daily insulin therapy for more than 8 yr, at which time one animal deteriorated with uncontrolled hyperglycemic and hypoglycemic events and was subsequently euthanized. Histopathologic evaluation of the pancreas demonstrated 100% effacement with amyloid.

The success in controlling and regulating diabetes mellitus in these two animals was directly due to unique and specific behavioral conditioning by staff. Consensus meetings between animal and animal health staff, training and communication were critical to the long term management of these two animals. These may serve as a model when attempting to treat baboons with diabetes.

Key words: Amyloidosis, baboon, diabetes mellitus, insulin, Papio papio, training
UTILITY OF FINGER BLOOD PRESSURE MEASUREMENT IN AWAKE BONOBOS (*Pan paniscus*) FOR THE DIAGNOSIS AND TREATMENT OF HYPERTENSION AND CARDIOVASCULAR DISEASE

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Abstract

Like other species of captive great apes, cardiovascular disease (including sudden death, myocardial fibrosis, hypertension, aortic dissection and stroke) is a major cause of mortality in adult bonobos.1 The ability to measure indirect blood pressure in non-anesthetized animals is critical in order to identify hypertension, institute timely anti-hypertensive treatment, and monitor response to anti-hypertensive and cardiac medications in bonobos with heart disease in order to optimize dosages. The Milwaukee County Zoo has been successful in obtaining indirect blood pressure measurements using finger cuffs and a dual channel oscillometric hand-held device on awake bonobos trained to participate through positive reward operant conditioning, and is collecting data to develop normal reference ranges for bonobos. This technique has already identified bonobos with apparent hypertension and documented reduction in finger blood pressure measurements after treatment with ACE inhibitors or beta-blockers. Most importantly, this technique allows clinicians to modulate medication dosages based on a measurable therapeutic endpoint. The effective dose of these drugs appears to vary between bonobos, as it does in humans.2 Echocardiography in both awake and anesthetized bonobos has documented reduction in left ventricular size after treatment with ACE inhibitors. The ability to measure blood pressure in awake bonobos will help define critical points for therapeutic intervention, and develop effective dosage ranges of anti-hypertensive and cardiac medications in bonobos.

Key words: Blood pressure, bonobo, cardiovascular disease, great ape, hypertension, *Pan paniscus*

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LITERATURE CITED


MORTALITY REVIEW WITHIN A POPULATION OF MANAGED PRIMATES AT TAMPA’S LOWRY PARK ZOO, 2000-2014

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Abstract

Analysis of 64 cases of primate mortality from Tampa’s Lowry Park Zoo (TLPZ) from January 2000-December 2014 revealed that approximately 20% of the cases presented with severe cardiovascular disease (CVD) at necropsy or subsequent histologic review of cardiovascular tissue. The remaining cases revealed liver (15.63%), pulmonary (14.06%), renal (7.81%), neoplastic (7.81%) and gastrointestinal (6.25%) diseases as ranking significantly lower in occurrence as related to the primary cause of death. Among the most common CVD diagnoses were fibrosing cardiomyopathy (FCM) and myocarditis. Typical ante-mortem diagnostics may be useful in cardiovascular health concerns but anesthesia had precipitated mortality in some of these cases. Although CVD, especially FCM has been recognized and monitored within the managed ape populations, our analysis will outline a growing recognition of FCM among several primate species including black and white colobus (Colobus angolensis palliates), siamang (Symphalangus syndactylus), and mandrill (Mandrillus sphinx) in managed care. These findings suggest FCM is perhaps more prevalent than suspected in the smaller primate species. Looking at common predisposing factors between great apes and other primates may prove useful at identifying an underlying etiology. Nutrition is believed to be the underlying cause in the cases at TLPZ. As we advance our husbandry and veterinary care proficiency within zoological settings we are obligated to take on a whole health approach toward individual care. Identifying common trends in mortality within and across taxa will outline the steps necessary to improve both management and veterinary care.

Key words: Cardiovascular disease, fibrosing cardiomyopathy, mortality, non-human primate

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SO, WHAT DO YOU MAKE? RESULTS OF THE 2014 AMERICAN ASSOCIATION OF ZOO VETERINARIANS SALARY SURVEY

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Abstract

In 2014 a salary survey was sent out to membership of the American Association of Zoo Veterinarians (AAZV). Out of 899 AAZV members, 122 members participated (13.5%). The last survey of this kind was completed in 2007.1

For comparison purposes, the mean starting salary of newly employed veterinary graduates was $67,136 in 2013 and mean educational debt was $162,113.2

Of the survey respondents, the majority were employed at institutions with an annual budget greater than $10 million dollars, with the second most common budget $3-$10 million. The majority of veterinary budgets (including employee salaries) were reported as greater than $200,000, with the second most common response being $100,000-$200,000. The most common institution collection size was between 500-999 animals, not including invertebrates. Most veterinarians were supervised directly by a director or CEO. The majority of institutions employed two full-time veterinarians. Only 1% of institutions employed an on-site pathologist. Twenty-one percent of institutions employed a contract veterinarian for either less than 10 hr or more than 20 hr/wk. Eighty-one percent of institutions employed a full-time licensed veterinary technician, with the majority employing two veterinary technicians. The most common salary for full-time veterinarians was $65,000-$79,999 (range of $50,000-$155,000+). The second most common salary was $80,000-$94,999. The majority of respondents had less than $50,000 student loan debt at graduation with the second most common debt load being $75,001-$100,000. Most full-time zoo veterinarians worked between 41-50 hr/wk; the next most common response was greater than 50 hr/wk.

Key words: AAZV, salary, staffing, veterinarian, veterinary technician, zoos

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LITERATURE CITED

FROM LED TO LEADER: MAKING THE TRANSITION FROM CLINICIAN TO DIRECTOR

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Abstract

Making the transition from clinician to director is challenging. For many zoos, the size or structure of the veterinary department results in no middle management positions for developing leaders to step up through. This results in a large leap as a clinician goes from the comfort zone of day-to-day management of animal health cases to a leadership role revolving around strategic planning, visions, missions, budgets, and often complex, demanding team dynamics. Great leadership is not about a change in title, but a change in you. Important factors in successfully making this change are mentorship, training, and self-belief tempered by self-awareness. As a clinician at San Diego Zoo, through mentor guidance, I changed and learned the importance of managing by influence and the power of servant leadership, which provided me with the confidence and ability to make the next step in my career. Going from an individual contributor to a leader managing a team of over 50 people was daunting. Thankfully, Disney recognizes that this transition can be difficult for any new leader and that it typically can take 12-24 mo. Disney aims to accelerate this process with training and mentorship. New leaders undergo a 6-wk “Transition to Disney Leadership” program with mentor support from their leaders and peers. The program’s goals include: defining what is expected of leaders at Disney; exploring and discussing how the company culture shapes those expectations; identifying the skills necessary to be successful and how to best use those skills within the culture; building relationships that start with trust and communication; developing others through coaching, feedback, and recognition; and making good business decisions that reflect safety, creativity, and innovation. The program provides a clearly defined pathway to developing the competencies expected of Disney leaders which include: thinking strategically, building relationships, communicating effectively, driving results, inspiring creativity and innovation, championing change, building teams, exhibiting professional excellence, embracing Disney heritage and values, promoting workforce diversity and workplace inclusion, delivering excellent service, and demonstrating technical and functional competence. While the support at Disney is overwhelmingly positive and has certainly eased the transition, it has been the mistakes that I have made that have provided the greatest learnings. In particular, I have learned a comment made as a clinician can have dramatic ripple effects when made by a director. Words meant to stimulate discussion suddenly turn into decrees. Simple statements are interpreted as new policies. Staff may need to be reassured about interpreted change and the effects on their job security and roles. The other big learning has been in regards to measuring success. As a clinician, it is easy to mark off the cases done; the successes and failures on a daily basis. As a director, it is not easy to mark off the successes on a daily basis; it may take months or years for visions and strategies to come to fruition. Making the transition from clinician to director is challenging, though with support, mentorship, and training and change in you, the challenge can be met with success.

Key words: Director, Disney training, education, leadership
DEVELOPING VETERINARY LEADERSHIP SKILLS: FINDING WAYS TO LEARN THESE SKILLS WHEN TIME AND RESOURCES ARE LACKING

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Abstract

Leadership and management skills are critical to developing trusting, team-based environments that foster optimal animal care. Veterinarians are frequently placed in formal leadership roles within institutions. Regardless of a formal role, all veterinarians should consider themselves leaders in the zoo environment as they interact directly with and influence nearly all members of the animal care staff, as well as those in other organizational groups (e.g., media relations, development, facilities, operations). When relationships are strong, optimal animal care decisions can be made more easily, resources may be more readily directed toward veterinary care, and staff morale can be improved.

Veterinarians spend years developing the technical skills needed for their role; skills related to what they do as clinicians (e.g., anesthetizing animals, interpreting diagnostics, evaluating the literature) or research (e.g., study execution, paper writing). However, many have had little opportunity to develop skills related to the technical aspects of effective management and leadership. This also applies to the so-called “soft skills,” such as those related to relationship building and communication.

Skills needed for these non-clinical aspects of the job can be learned. Increased ability in these areas can be critical to creating environments that are supportive of optimal animal care. In addition, they may allow veterinarians to more effectively contribute to the future development of professional animal care models and conservation actions and take on a greater role in executive level positions.

The Leadership and Management Forum within the Membership Services Committee was established to help develop transformational veterinary leaders within zoological and conservation areas. Many of us receive little or no training in management and leadership skills, but developing these skills is integral to increasing our relevance in the field and optimizing our ability to provide animal care. The group is providing various resources to members, such as quick “tips and tricks”, references lists, insights from knowledgeable colleagues, and full-length workshops. We are actively seeking interested members to help grow our resources and support each other in developing these skills.

Below are some prompts to help get you motivated to focus, at least occasionally, on leadership and management skills.
1. Identify a few personally meaningful reasons to develop the skills. Learning new skills takes time and energy. Personal reasons help increase motivation to engage in that learning. Some ideas might include improving animal care, saving time, reducing your stress, and career advancement. 
   Ask yourself: What will I get out of this that is meaningful to me?

2. Acknowledge it has to start with you. Even if your institutional environment is not healthy or highly functional, you can still develop new skills that improve your ability to care for the animals and increase trust within teams. 
   Ask yourself: How can I be part of improving these relationships?

3. Envision a future with those skills in place.
   Ask yourself: What would it look and feel like if it was easier to get my work accomplished?

4. Identify one or two learning methods that work best for you in your current environment (e.g., reading blogs on the computer, reading books, listening to podcasts, watching online training videos, listening to cd’s in your car) and how much time you might be able to devote to exploring these topics. 
   Ask yourself: What will be easiest to fit into my current schedule and match my preferred learning method?

5. Identify one or two short-term goals that are realistic given your current environment. These can be very simple, such as spending 5 min/wk reading a blog post about communication skills. 
   Ask yourself: What can I start doing right away?

Key words: Career development, leadership skills, management skills, professional development, veterinary profession
THE POWER OF A STRATEGIC PLAN FOR YOUR ZOO TEAM

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Abstract

Great leaders proactively lead their organization (team) and define criteria to ensure current and future success. One of the most important tools in the leadership toolbox is the strategic plan. The strategic plan is a roadmap for an organization to move from today to an envisioned future. If done well, the strategic plan should not only inspire change and improvement in the organization for the future, but should also aid in day-to-day decision making/priority setting in the current state. There are probably as many strategic plan formats as there are books on strategic planning, but the base expectations for a strategic plan are: a vision and mission statement; definition of strategic objectives; definition of specific goals, action plans, and criteria for success.

- A vision statement is an aspirational (and often inspirational) statement that defines where your organization wants to be in 5-10 yr. A mission statement is more practical and describes the purpose of your organization today (i.e., why did I come to work today?).
- Strategic objectives are long-term continuous areas that align your mission to your vision. Strategic priorities identify the key areas where an organization needs to focus to get from the current state to the future state. A SWOT analysis (strengths, weaknesses, opportunities, and threats) can be a useful tool/process to guide creation of strategic priorities.
- Specific goals should be set for each strategic priority and actions plans should be created with a champion(s) identified for each goal. Goals should be short-term in duration (2 yr maximum) and criteria for success should be clearly defined. The SMART model (goals should be specific, measurable, achievable, relevant, and timely) is a useful tool for goal definition.

“If you fail to plan, you are planning to fail.” – Benjamin Franklin

One of the most daunting things about strategic planning is the process itself. Countless books and websites describe detailed plans and processes for complex strategic plans. The process doesn’t need to be that complex. In fact, depending on the size of the team, the base expectations described above can be accomplished in as little as a half-day or 1-day work session. The use of a trained human resource (HR) facilitator or outside consultant makes the process easier, but is not mandatory. A dedicated leader or team of leaders can accomplish the strategic planning process and create a useful plan with some readily available resources, a dedicated team, and a relatively small investment in time. Some tips for this process include:

- Get full commitment and support from leadership. The hospital director should have commitment from the Zoo Director or hierarchical leadership that the strategic plan will be supported.
- Pull together a diverse group of team members from all levels of your organization. For a veterinary team, keepers; vet techs; vets; leaders; key animal husbandry, research, or zoo operations partners could be included.
• Try to go off-site or to a remote location for the planning day to minimize distractions (this may be difficult for small medical practices).
• Facilitate free and open discussion regardless of position. Use a facilitator if possible to minimize introduced bias from the “boss.”
• Identify strengths and weaknesses and plan according to both. Don’t just plan around the things that suck, also plan around those things that your team excels at already. Use the SWOT model to identify key strengths, weaknesses, opportunities, and threats.
• Communicate the results of planning to all applicable parties (leaders, partners, team members, etc.). Communication is key to success.
• Don’t write your plan in stone. Good strategic plans allow you to adapt to a changing climate or needs.
• Make strategy a habit. Review strategies and goals at every one-on-one, team meeting, leadership meeting, performance evaluation, etc.
• Celebrate successes, big and small. Track, communicate, and celebrate key milestones/successes for goals created during the strategic planning process. Also track “failures” and learn from goals that did not pan out as expected.

It is easy to discount the value of strategic planning or think that it is a tool only for traditional retail businesses or large corporations. However, all organizations and teams need direction and purpose. Lack of direction results in decreased morale, decreased productivity, and increased anxiety, as the future is unpredictable and uncertain. A strategic plan provides a buffer against indifference and drives purpose and direction for any organization regardless of its size. Strategic planning can be as simple or as complex as the leader or organization desires, but the planning process does not have to be complex to be useful. A few key components and a clear planning process can result in a tool that is useful to any organization to drive success today and into the future.

**Key words:** Leadership, management, mission statement, strategic plan, vision statement
ANIMAL CARE DECISION-MAKING: GIVING UP CONTROL TO GAIN INFLUENCE

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Abstract

We can rightly assume that zoo professionals desire to make decisions which are in the best interest of animal health and welfare. Animal health and welfare may suffer, however, when unhealthy conflict exists between the key decision-makers. In most cases, this conflict originates from unclear decision-making roles and disputes over authority. In other words, there is often conflict over who has the ultimate authority to decide. In contrast, successful partnerships develop when it is clear who the ultimate decision-maker is and who is best suited to influence that decision. Successful partnerships are not based on equal and identical roles but rather thrive when roles are defined and distinct.1

The following is a model to help improve animal care decision-making by clarifying the roles of each party. This model focuses on the veterinarian-curator relationship since it is often the relationship that is strained the most when difficult and complex decisions about animal care must be made. A similar process, however, could be employed in other animal care decision-making relationships such as nutritionist-veterinarian, curator-nutritionist, veterinarian-technician, etc. In each of these relationships, working as allies is more effective than working as opponents.

This approach begins with the proposition that having influence may actually be more important (and require a higher degree of responsibility) than having full authority and control. The professional experience and expertise of the veterinarian, used with humility and integrity, can be a powerful source of influence. Furthermore, exerting that influence is entirely under the control of the veterinarian, whereas the final decision may not be. In other words, it is useful to give up control in order to gain influence. This approach can change a win-lose situation into a win-win and a distrusting relationship into a collaborative one. When applied with good intent, the relationship improves, trust mounts, and animal welfare ultimately benefits.

The first step in this model is to identify and define decision-making roles. For this purpose, two distinct roles can be identified: the “Decider” and the “Advisor.” The Decider’s role is that of the responsible party who has the ultimate decision-making authority. This person actively seeks input from those in the Advisor role. The Decider takes full responsibility for outcomes. The Advisor’s role is to influence the Decider by providing evidence, interpretation, and advice in a professional and respectful manner. The Advisor may actually initiate and drive the decision-making process. In the end, they support and respect the Decider’s decision.

The second step is to identify key decision areas where curators and veterinarians need to partner in decision-making. For each of those decision areas, the curator’s and veterinarian’s role is
determined and agreed upon. The following are suggested roles and corresponding example decision areas.

**Curator “Decider” role – Veterinarian “Advisor” role**

- Collection planning
- Acquisition and Disposition
- Animal welfare issues
- Husbandry and enclosure design
- Animal escape and recapture
- Regulatory issues (animal care related)
- Non-emergency euthanasia
- Health and disease management practices
- Medical case management affecting sustainability and welfare

**Veterinarian “Decider” role – Curator “Advisor” role**

- Quarantine and biosecurity
- Preventive medicine program
- Emergency medical care
- Basic and daily case management
- Egregious animal welfare issues (USDA role as veterinarian of record)
- Regulatory issues (health related)

These roles may seem straightforward at first glance. Conflict arises, however, during complex or high-stakes decision-making events when the roles seem to overlap. It is advisable in these situations to break these complex scenarios down into the individual decisions that need to be made and what roles each will play for each step. The end result is a decision that can be made with consensus and true partnership.

We all desire to see decisions made which are in the best interest of animal health and welfare. As professionals, we have knowledge and experience vital and necessary as a decision-making partner. Therefore, our goal should be to develop healthy, solid relationships that give us strong influence and not simply the power and authority to make those decisions. This is a model that requires good communications and relationship skills. There are good resources in the veterinary literature\(^\text{2,4,5}\) and elsewhere\(^\text{3,6}\) that review communications skills around building trust and decision-making.

These are concepts and practices that have developed at our institution over many years. Other situations and styles may be entirely different and require a different approach. If, however, the decisions involving animal care are not what you would like them to be, you might consider trying some of these practices.

**Key words:** Animal welfare, decision-making, leadership
ACKNOWLEDGMENTS

The authors thank the Animal Health and Collection Husbandry Sciences departments of San Diego Zoo Global for their help in formulating this model and for their partnership in ensuring animal health and welfare.

LITERATURE CITED


RETHINKING CONFLICT: A CATALYST FOR CREATIVITY, CHANGE, AND DEEPER RELATIONSHIPS

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Abstract

A conflict, at its most basic, is nothing more than a difference in opinion, perspective, or feeling about a situation. What most people picture when they think of conflict is what happens so often when healthy conflict is not managed well and devolves into arguments with people digging in their heels on their positions. As a result, most people recoil at the concept of conflict, believing it to be something that should be tamped down as quickly as possible, if not avoided altogether.

What if we think about conflict differently? What if we think about the basis of the conflict, the difference of opinion, perspective, or feeling as a required catalyst for any change. As Stephen Covey says, “If two people have the same opinion, one is unnecessary.” So, the question becomes: How do we alter our paradigms and approaches to conflict situations to generate transformational improvements, while deepening our connections and relationships with those with whom we disagree?

We’ll explore some realistic and foundational concepts that could assist in building cultures where robust dialogue is not only encouraged, it is rewarded, and where disagreements launch new ideas, and lateral thinking is embraced. At a minimum, the utilization of these concepts will decrease stress levels when confronted with conflict-oriented situations.

Key words: Communication, conflict resolution, management
A NOVEL Chlamydophila SPECIES IN A FALSE GHARIAL (Tomistoma schlegelii) WITH CERVICO THORACIC SCOLIOSIS AND GRANULOMATOUS ENCEPHALOMYELITIS

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Abstract

A 5-yr-old, captive hatched female false gharial (Tomistoma schlegelii) was presented for a 1-mo history of cervical spinal curvature. Initial bloodwork was largely unremarkable, but a whole body CT scan confirmed severe scoliotic deviation of the cervicothoracic spine. Neurologic exam and electromyogram were within normal limits. Left cervical epaxial and left trapezius muscle biopsies revealed moderate myonecrosis, which in itself could not explain the severity of the spinal curvature. After 10 days of hospitalization and supportive care, no significant improvement was seen. MRI of the brain did not reveal any structural abnormality. The patient never recovered from anesthesia and was declared deceased the following day. Necropsy revealed extensive marked chronic granulomatous encephalomyelitis along with neuronal necrosis, rarefaction, gliosis and astrocytosis of the white and gray matter of the brain, brainstem and spinal cord. Samples of spinal cord and brain tested positive by pan-chlamydiae PCR and sequencing for both the 16S and ompA genes and a novel Chlamydophila species was identified. Infections by members of the phylum Chlamydiae have been reported in diverse vertebrates, including crocodilians.1-4 One study found 64% of tissues with granulomatous inflammation from reptiles were positive for Chlamydiales on PCR.5 Due to difficulties with culture and other diagnostics, they are underdiagnosed. This is the first case report of a novel Chlamydophila species associated with severe granulomatous encephalomyelitis in a false gharial.

Key words: Chlamydophila, encephalomyelitis, false gharial, Tomistoma schlegelii, scoliosis

LITERATURE CITED


EASTERN EQUINE ENCEPHALITIS VIRUS MORTALITY IN FOUR SOUTHERN CASSOWARY (Casuarius casuarius) AT THE VIRGINIA ZOO

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Abstract

Eastern equine encephalitis virus (EEEV) is an arbovirus that causes disease in horses, humans and a wide variety of avian species. Morbidity and mortality from EEE outbreaks have occurred in captively held birds including species in the orders Gruidae and Icteridae. Disease-related mortality and pathology appears to be highly species specific. Whooping cranes and emu appear to be particularly susceptible, while a colony of African penguins experienced morbidity but little mortality.

In the summer of 2014 the Virginia Zoo experienced acute mortality in four Southern cassowary (Casuarius casuarius) over a 2-wk period. The birds affected included three 27-day-old chicks and their 23-yr-old dam. Two of the chicks were found dead with no premonitory signs; the other two birds showed signs of dyspnea, mental obtundation, weakness, lethargy and anorexia. Both birds died shortly after initiation of intensive medical care. Clinicopathologic changes included leukocytosis, hyperuricemia and elevated liver enzymes indicative of systemic inflammation. Plasma protein electrophoresis revealed elevated beta globulins indicative of acute inflammation.

On postmortem examination, coelomitis and diarrhea were observed. Common histopathologic abnormalities were encephalitis, vasculitis, hepatitis, nephritis and splenitis. The diagnosis of EEEV was confirmed through the detection of viral RNA via PCR assay in the brain tissue of these cases. The EEEV in Southern cassowary has never been fully described and has different pathologic characteristics than those observed in other species. Vaccination of susceptible birds is recommended with a killed polyvalent equine product. Mosquito control should also be implemented to help prevent disease.

Key words: Arbovirus, cassowary, Eastern equine encephalitis, ratite, zoonoses
SURGICAL TREATMENT OF CHRONIC MULTIDRUG-RESISTANT BACTERIAL RHINITIS AND SINUSITIS IN A GREATER RHEA (Rhea americana)

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Abstract

Sinusitis is a common finding in a variety of avian species, however presents unique treatment challenges in ratites.¹ A 6-yr-old male greater rhea (Rhea americana) presented acutely with right periorbital swelling. Examination revealed chemosis and infraorbital sinus swelling. He was treated with oral antibiotics based on multiple cultures for the next 14 wk with variable improvement, however no resolution of clinical signs. Mycoplasma, mycobacterial, and fungal culture results were negative. Due to inability to resolve clinical signs, advanced imaging with a CT scan of the sinuses was performed which revealed a mixed density mass associated with extensive destruction of the right nasal bone, hard palate, maxilla and frontal bone. CT guidance was used to perform a fine needle aspirate of the mass through a frontal bone defect for aerobic, anaerobic, fungal, and mycobacterial culture and cytology. The sinus mass culture grew an E. coli which was only susceptible to imipenem and amikacin. Based on these results, surgical resection of the affected tissue was performed. A dorsal midline incision was made to access the right infraorbital sinus and nasal cavity. The mass was removed and submitted for culture and histopathology. Gentamicin was applied topically and amikacin was administered parenterally. Histopathology of the mass was consistent with inspissated necrotic tissue. Five months post-surgery, no further clinical signs have been noted. Advanced imaging and surgical therapy were considered instrumental in eventual resolution of this resistant bacterial sinusitis in a species that is not typically amenable to frequent handling and restraint.

Key words: Bacterial sinusitis, computed tomography, greater rhea, Rhea americana, rhinitis

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The authors thank Dr. Jeff Steurer and Dr. Dennis Keith for their assistance with this case, as well as the bird management and keeper staff at the Phoenix Zoo.

LITERATURE CITED

USE OF A STANDING COMPUTED TOMOGRAPHY SCAN TO AID IN THE DIAGNOSIS OF A PULMONARY ADENOCARCINOMA IN A SCARLET MACAW (Ara macao)

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Abstract

Primary respiratory neoplasia is a reported but uncommon finding in birds compared with other companion species. Computed tomography (CT) has been increasingly used in the diagnosis of intracoelomic disease in avian patients. However, a persistent drawback to performing CT exams is the need for general anesthesia, especially in compromised patients. A recent study experimentally showed the utility of sedated CT scans in birds. Another report detailed the use of non-sedated (standing) CT exams in mute swans to diagnose femoral fractures. The present case report is the first to describe the clinical use of a standing CT in a psittacine bird.

An adult female scarlet macaw (Ara macao) was referred for evaluation of pronounced respiratory noise. Previous treatment with antibiotics by the primary veterinarian did not improve clinical signs and standard whole body radiographs were non-diagnostic. When restrained, the patient would become severely tachypneic with increased respiratory effort. Because of the bird’s significant respiratory compromise and concerns over risks of general anesthesia, a standing CT scan was performed without sedation. The CT results showed the presence of a large intrathoracic soft tissue mass with bony invasion. After attempts at supportive care with nebulization, antibiotics, and antifungal agents, the bird declined and was euthanatized. Necropsy findings confirmed a 6.6 × 3.7 × 4 cm neoplasm with infiltration into the keel. Histologic examination led to the diagnosis of a pulmonary adenocarcinoma with local invasion and metastasis.

Key words: Adenocarcinoma, Ara macao, computed tomography, scarlet macaw

LITERATURE CITED


TREATMENT OF PULMONARY HYPERTENSION IN A MEALY AMAZON PARROT (Amazona farinose) USING SILDENAFIL CITRATE

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Abstract

In veterinary medicine right-to-left cardiac shunts are usually the result of pulmonary arterial hypertension that increases pressure in the right side of the heart leading to a reversal of blood flow through a congenital malformation.¹,² This case report describes the treatment of presumed pulmonary hypertension and a right-to-left cardiac shunt in a mealy Amazon parrot (Amazona farinose).

A 25-yr-old male mealy Amazon parrot with a history of polycythemia, hepatomegaly, and epistaxis was evaluated for progressive lethargy and anorexia. Clinical laboratory testing revealed severe polycythemia (71%), hypophosphatemia (1.6 mg/dl), and mild hypokalemia (2.8 mEq/L). Radiographs showed marked hepatomegaly and loss of air sac space. The bird tested negative for West Nile virus and Chlamydia psittaci via PCR. Despite supportive treatments, the bird’s condition deteriorated over the next 24 hr. The patient developed ataxia, had poor flying ability, and became oxygen dependent. An echocardiogram, including a bubble study, performed while the patient was hospitalized showed a right-to-left atrial shunt and presumed pulmonary hypertension. The bird was started on periodic phlebotomy (5-10 ml/kg every 6 wk) to reduce PCV and sildenafil citrate (2.5 mg/kg p.o. q8hr) to decrease pulmonary hypertension. One week later the patient was weaned off oxygen. Twenty-four days after initial presentation the parrot was returned to its outdoor exhibit. Intermittent periods of increased respiratory rate and effort have been reported but have resolved without additional treatments. Epistaxis, once common in this bird, has not been noted since initiating treatment with sildenafil citrate, which the bird continues to take well.

Key words: Amazona farinose, mealy Amazon Parrot, polycythemia, pulmonary hypertension, right-to-left shunt, sildenafil citrate

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LITERATURE CITED

FATAL INFECTION OF A BORNEAN ORANGUTAN (Pongo pygmaeus) WITH A Versteria sp. PARASITE: USE OF DEEP-SEQUENCING TECHNIQUES TO IDENTIFY AN UNKNOWN PATHOGEN AND ITS SOURCE

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Abstract

On 9 December 2012, a juvenile Bornean orangutan (Pongo pygmaeus) at the Milwaukee County Zoo was found dead after exhibiting an intermittent moist cough, partial loss of appetite, and lethargy for two days. Post-mortem examination and histologic analysis revealed that the orangutan died from an unknown disseminated parasitic infection. Through deep sequencing of DNA from infected tissues and gene-specific PCR and sequencing, it was discovered that the orangutan was infected with the larval (metacestode) form of a divergent species within the newly proposed tapeworm genus Versteria (Cestoda: Taeniidae).1 This study investigates the source of transmission of the cestodes responsible for the case. We performed DNA sequencing of mitochondrial genes from cestodes recovered in Wisconsin where the animal died and in Colorado where the animal was born. Preliminary results indicate that the animal was most likely infected in Colorado and that the source of infection was wild carnivores of the family Mustelidae, subfamily Mustelinae (e.g., weasels, mink and relatives). Our results demonstrate that movement of zoo animals can obscure the location of origin of diseases contracted from local wildlife.

Key words: Cestode, deep sequencing, DNA, orangutan, Pongo pygmaeus, Versteria

LITERATURE CITED

LONG-TERM MANAGEMENT OF TWO PALLAS CATS (Otocolobus manul) WITH BILATERAL POLYCYSTIC-LIKE RENAL DISEASE

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Abstract

Two 11-yr-old female sibling Pallas cats (Otocolobus manul) were diagnosed with bilateral polycystic-like renal disease. The first case presented in June 2013 with a history of anorexia and lethargy. On exam, the cat had bilaterally palpable renomegaly, with the right much larger than the left. Bloodwork and urinalysis were unremarkable, excepting a relative eosinophilia. Multiple bilateral renal cysts were noted on ultrasound, were drained, and were confirmed cytologically. The cat was treated supportively and improved clinically. The sibling was immobilized and confirmed to have cysts as well, with otherwise normal diagnostic and examination results, also excepting a mild relative eosinophilia. The SSP veterinary pathologist indicated that other Pallas cats had been reported with bilateral renal cysts (some related to these two cats), with none still alive. Over the course of the next 1.5 yr, both cats were routinely immobilized for monitoring and cyst drainage. In May 2014, the first cat had cytology consistent with cystic hematomas. Routine cystic drainage was stopped. In November 2014, the first cat presented clinically as in June 2013. A stomach full of pine needles was noted and a gastrotomy was performed. The right kidney was abscessed so a nephrectomy was also performed. Pathology confirmed hematoma and abscessation with secondary tubulointerstitial nephritis. The first cat improved dramatically, although now consistently has a mildly elevated blood urea nitrogen value. The initial relative eosinophilia was never repeated in either cat. The second cat has never shown clinical manifestations since diagnosis. Both cats continue to be regularly monitored.

Key words: Cyst, kidney, management, Otocolobus manul, Pallas cat, renal
GIRAFFE (Giraffa camelopardalis reticulata) ARTHROPATHY: POST-MORTEM COMPUTED TOMOGRAPHY, GROSS PATHOLOGY AND HISTOPATHOLOGIC FINDINGS

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Abstract

A 21-yr-old intact female reticulated giraffe (Giraffa camelopardalis reticulata) was euthanized for deteriorating quality of life following chronic intermittent lameness and tendonitis of the fetlock joint for several years. Although hoof overgrowth is frequently reported in captive giraffe,1,2 hoof pathology was not a feature in this animal’s clinical disease. Antemortem diagnostic testing included thermal imaging and digital radiography performed with operant training1. The giraffe had been medically managed for many years with oral chondroprotectants and intermittent non-steroidal pain medications; however, in the months prior to euthanasia, management also included husbandry modifications and daily multi-modal pain medications. Post-mortem computed tomography (CT) was performed on all four distal limbs to further characterize the joint lesions observed. CT revealed soft tissue and bony changes in multiple joints which had not been identified with antemortem testing. Complete necropsy and histopathology revealed severe tenosynovitis with erosive and ulcerative arthritis. Pyogranulomatous inflammation of the joints was an unexpected finding. Arthritis has been infrequently reported in giraffe.2,3 This investigation correlates clinical observations, antemortem diagnostic testing, post-mortem CT and pathologic findings to better characterize chronic arthropathy in an aged giraffe.

Key words: Arthritis, Giraffa camelopardalis reticulata, histopathology, imaging, reticulated giraffe

LITERATURE CITED


RHINOPLASTY: MANAGEMENT OF A FIBROMYXOSARCOMA IN THE HORN OF A SOUTHERN WHITE RHINOCEROS (Ceratotherium simum simum)

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Abstract

A 33-yr-old, 1600-kg captive-born female southern white rhino (Ceratotherium simum simum) at a safari park presented with an abscess at the base of her primary horn. There was minimal response to systemic antibiotic treatment and daily flushing. Approximately 6 wk after presentation the animal was anesthetized with etorphine (0.0019 mg/kg), azaperone (0.078 mg/kg) and butorphanol (0.06 mg/kg) i.m. for diagnostics and treatments.3 The distal third of the horn was removed, revealing a large necrotic mass extending from the base of the horn. Six additional anesthetic events were performed over the next 7 mo to debulk the mass and remove most of the horn. Histologic diagnosis was fibromyxosarcoma, based on the presence of neoplastic spindle cells with stromal mucin and collagen production. Open wound treatment included topical antiangiogenesis treatment and intralesional injections of Cisplatin SR™, a sustained release form of cisplatin used to treat equine sarcoids.1,4 Systemic therapy included antibiotics based on culture and sensitivity, gabapentin (1.0 mg/kg p.o. s.i.d.) for analgesia as well as oral piroxicam (0.1 mg/kg p.o. s.i.d.) for its anti-inflammatory and anti-tumor properties.2 Seventeen months after initial presentation, there was no evidence of neoplastic cells. At 20 mo, the horn wound is healed over, and horn regrowth is evident. However, there is a low-grade osteomyelitis in the horn base that is being treated with long-term oral antibiotics and monitored with monthly radiographs using operant conditioning.

Key words: Cancer, Ceratotherium simum, cisplatin, fibromyxosarcoma, neoplasia, rhinoceros

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LITERATURE CITED


SEMEN VITRIFICATION IN FELIDS: A SIMPLIFIED CRYOPRESERVATION METHOD FOR FIELD USE

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Abstract

Assisted reproductive technologies such as semen cryopreservation and artificial insemination (AI) are becoming increasingly important for genetic management and conservation of endangered felid species. However, current semen freezing methods for felids are not ‘field-friendly’, requiring advanced reproductive expertise and access to specialized equipment. One alternative to conventional semen freezing may be vitrification, using ultra rapid cooling in liquid nitrogen to form a glass-like state without ice crystal formation. With this approach, wildlife veterinarians and biologists could easily cryopreserve felid semen in the wild for subsequent AI and genetic augmentation of captive populations. In this study, our objectives were to 1) compare post-thaw sperm parameters for domestic cat and nondomestic cat semen preserved with vitrification vs. conventional freezing; and 2) investigate production of viable kittens using vitrified domestic cat sperm for in vitro fertilization (IVF)/embryo transfer and AI. Semen was collected from domestic cats (n = 2) and non-domestic felids (fishing cat, Prionailurus viverrinus, n = 1; ocelot, Leopardus pardalis, n = 1). Control samples were extended in a chemically-defined soy lecithin-based medium with 4% glycerol, slow cooled and frozen in straws over liquid nitrogen vapor. For vitrification, raw semen was diluted in soy lecithin medium (without glycerol) containing sucrose (0.1 M, Trt 1; 0.2 M, Trt 2; 0.3 M, Trt 3), held for 5 min and vitrified by pipetting (30 µl) directly into liquid nitrogen. After thawing, control and vitrified samples were evaluated for acrosome status, progressive motility and fertility in vitro. For IVF, oocytes collected laparoscopically from gonadotropin-treated domestic cats were inseminated with control or vitrified (Trt 2 only) semen and assessed for embryo cleavage. To evaluate in vivo viability, domestic cat embryos produced with vitrified sperm were transferred into three synchronized recipients, and three additional females were inseminated with vitrified sperm. In domestic cats, post-thaw sperm motility and acrosome status did not differ (P > 0.05) for control, Trt 1 or Trt 2, but values were reduced (P < 0.01) for Trt 3. IVF percentages were similar (P > 0.05) for control (16/53, 30.2%) vs. vitrified sperm (13/53, 24.5%). In the fishing cat and ocelot, post-thaw motility was slightly decreased for vitrified (20-25%) compared to control (~40%) sperm but acrosome status (43-48% intact, fishing cat; 26-27% intact, ocelot) was similar. IVF of domestic cat oocytes with vitrified sperm resulted in fertilization in both species (5/9, 55%, fishing cat; 2/9, 22%, ocelot). Domestic cat embryo transfer failed to produce any pregnancies; however, AI resulted in conception in all three females. Two pregnancies progressed to term, culminating in the birth of two healthy kittens - the first non-human offspring of any species ever produced from vitrified sperm AI. These findings suggest that vitrification may be a suitable option for cryopreservation of felid semen in a field situation, especially if combined with newer semen collection methods that do not require electroejaculation.
Key words: Artificial insemination, cryopreservation, embryo transfer, felids, in vitro fertilization, semen, vitrification

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LITERATURE CITED


SPECTACLED BEAR (Tremarctos ornatus) ALOPECIA SYNDROME: AN UPDATE

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Abstract

Spectacled bear alopecia syndrome is a disease of unknown etiology affecting spectacled bears (Tremarctos ornatus) in captivity. It has been reported in South America, North America, Japan and Europe.1-3,5,6 Initial symptoms consist of patches of decreased hair density that appear on both flanks. The animals generally become itchy and the disease progresses to complete alopecia of the lumbar region and, in the final stages, of the entire body. No treatment has proven to be efficient and some of them are likely to have worsened the condition.2,3

As nine (25%) females from the EEP were affected, a European Working Group was established in 2009, to try to better understand the disease and propose guidelines for the care of affected animals.2,3 Clinical surveys as well as tissue and blood sampling protocols were circulated to all EEP participants.

Epidemiology points to a sex-bias (females being predominantly affected) and pedigree analysis rules out simple inheritance patterns, although a genetic background factor cannot be excluded. Longitudinal fecal cortisol, estrone sulfate, and progesterone monitoring of affected and unaffected bears revealed no significant difference between the two groups.

Skin biopsies from 16 healthy bears enabled characterization of normal healthy spectacled bear skin, whereas samples from 15 alopecic bears revealed inflammatory lymphocytic infiltrates or giant cells directed against the isthmic portion of the hair follicles, resulting in follicular atrophy and destruction. These lesions are suggestive of an immune-mediated disease.4

The treatment of three alopecic bears with oclacitinib, a janus kinase inhibitor, shows promising results.

Key words: Alopecia, oclacitinib, spectacled bear, Tremarctos ornatus
ACKNOWLEDGMENTS

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LITERATURE CITED


THE EFFECT OF EXERCISE ON BEHAVIORAL AND PHYSIOLOGIC MEASURES OF STRESS IN CHEETAHS (Acinonyx jubatus) IN HUMAN CARE

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Abstract

In human care, cheetahs (Acinonyx jubatus) experience health and reproductive challenges which have been attributed in part to high stress levels.1 Studies have suggested that running and hunting behaviors may reduce stress, and zoological facilities are beginning to provide an outlet for these behaviors through exercise programs, in which cheetahs chase a moving lure on a designated course.2 The purpose of this study was to analyze the impact of this lure course exercise on physiologic and behavioral measures of stress in cheetahs from the Columbus Zoo and Aquarium (CZA), the Wilds, and Cleveland Metroparks Zoo (CMZ). Cheetahs were divided into treatment (exercised on a lure course; n = 4) and control (not exercised; n = 10) groups. Fecal samples were collected every other day from June through August. Fecal glucocorticoid metabolites (FGM) were measured by enzyme-immunoassay. Thirty 30-min focal observations, balanced between morning, midday, and afternoon time periods, were conducted for each cheetah when the animal was not participating in formal exercise. Behavioral observations indicated that cheetahs involved in exercise programs displayed significantly more mobile behaviors (P = 0.02) and non-stereotypic locomotion (P = 0.05) than did non-exercised animals. In exercised cheetahs, fecal glucocorticoid metabolites decreased between the first and second half of the study. These data, in conjunction with associated studies, lend insight into the impacts of exercise on the welfare of cheetahs in human care.

Key words: Acinonyx jubatus, behavior, cheetah, exercise, glucocorticoid, stress

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The authors thank Juston Wickham, Toni Hoepf, Suzi Rapp, Wouter Stellard, and the Animal Program Staff at the Columbus Zoo and Aquarium for their invaluable efforts to make this project possible, and the Ohio State University College of Veterinary Medicine and Cleveland Metroparks Zoo for financial support.

LITERATURE CITED


COMPARISON OF DIAGNOSTIC METHODS FOR IDENTIFYING FELINE CORONA VIRUS IN A CAPTIVE POPULATION OF CHEETAH (Acinonyx jubatus) AFFECTED BY FELINE INFECTIONOUS PERITONITIS

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Abstract

Cheetahs (Acinonyx jubatus) are susceptible to feline infectious peritonitis (FIP) caused by FIP-virus (FIPV), a mutation of feline enteric coronavirus (FECV), both strains of feline coronavirus (FCoV). Ante-mortem diagnosis remains challenging despite novel tests.

Three adult co-housed cheetah littermates became ill and were euthanized. Cases 1 and 2 had pyogranulomatous peritonitis and were positive for FCoV on immunohistochemistry (IHC). Case 3 had histologic lesions suggestive of FIP but IHC was negative. Samples from these and apparently healthy cheetahs were evaluated: 11 of 27 tested positive for FCoV by polymerase chain reaction (PCR) on fecal samples, including samples from the three littermates. Serum samples from 20 cheetahs were split and submitted for FCoV IFA at two or three laboratories. Results were consistent among all laboratories in 75% of the cases. No serum was submitted from Case 1. Case 2 had the highest serum titer at all three laboratories. Case 3 had the second highest titer at two laboratories, but was negative at the third laboratory.

A new commercial real time RT-PCR test claims to distinguish between FECV and FIPV. Liver samples were submitted from cases 1, 2, and 3, as well as from three cheetahs previously negative on serum and fecal samples. Cases 1, 2, and one of the presumed negative cheetahs were positive for FCoV, with no FIP biotypes detected. Case 3 and the last two cases tested negative. It is speculated that the biotype causing FIP in cheetah could differ from those detected in domestic cats.

aIDEXX Laboratories Inc., Westbrook, ME 04092, USA.

Key words: Acinonyx jubatus, cheetah, feline coronavirus, feline infectious peritonitis, immunofluorescence assay, polymerase chain reaction

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The authors thank Michelle Lovering at the Toronto Zoo for organizing samples and documents for export permits; Dr. Melissa A. Kennedy from University of Tennessee and Dr. Roxanne Chan from IDEXX Laboratories for advice and discussions; and Dr. Roxanne Chan for FCoV RT-PCR testing.
IS AMYLOIDOSIS IN CHEETAHS (*Acinonyx jubatus*) TRANSMISSIBLE?

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Abstract

Amyloidosis is a chronic, protein misfolding disease that causes pathology through the accumulation of misfolded amyloid A protein in visceral organs, often leading to death of the animal. The continued increase of amyloidosis in captive cheetahs (*Acinonyx jubatus*) is of grave concern for the species, yet nothing is definitively known about its mechanism of transmission. One hypothesis is that amyloidosis is transmissible, similar to prion diseases. Transmission models from other prion diseases such as scrapie and chronic wasting disease were used in conjunction with cheetah demographic and disease data collected from the cheetah species survival plan (SSP) pathologist and cheetah stud book, in order to determine the likelihood that amyloidosis is infectious based on past captive transfers and historical amyloidosis infections. The likelihood of infection transmitting between cheetahs housed together was quantified using odds ratios. Odds ratio for mid-level exposure was 0.603 ($P = 0.362$, CI: 0.199-1.787) and for low-level exposure was 0.695 ($P = 0.555$, CI: 0.203-2.320), so there was no significant effect of exposure to infected cheetahs on development of amyloidosis. To refine the comparison, metapopulation models were designed, populated with demographic and transfer data, and compared with infection data. While our analysis does not disprove the infectious transmission route, transmission is not supported based on our initial findings. This study utilized a subset of the captive population, and given that the results contradict previous reports, a broader population survey should be pursued.

Key words: *Acinonyx jubatus*, amyloidosis, cheetah, metapopulation, odds ratio, prion disease model

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EVALUATION OF TWO CANINE DISTEMPER VIRUS VACCINES IN CAPTIVE TIGERS (Panthera tigris)

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Abstract

Canine distemper virus (CDV) infections have occurred sporadically in captive tigers (Panthera tigris) over the past 25 yr, with outbreaks occurring recently at sanctuaries.1,2 Additionally, CDV infections have been documented in wild Amur tigers (P.t. altaica), which are critically endangered.3,4 To date, there has been no cogent study of the safety and efficacy of CDV vaccines in tigers. Seven tigers were vaccinated with a 1-ml dose of a recombinant canary pox-vectored CDV vaccine (Recombitek C3, Merial Limited, Duluth, GA 30096 USA). These tigers received a second 2-ml dose of the vaccine s.c. 4-6 wk later. CDV serology (serum neutralization) was performed at weeks 0, 4, and 9. No tigers had detectable antibodies at weeks 0 and 4, and only two tigers had low (1:16 & 1:32) antibody titers at week 9. Eight different tigers were then vaccinated with a modified-live CDV vaccine (Nobivac DP, Merck Animal Health, Madison, NJ 07940 USA) at time 0 and around 6 mo. Serology was performed on these tigers prior to vaccination and at 3 wk, and, also, prior to the 6-mo booster vaccination and 2-3 wk post-booster vaccination. Seven of eight tigers in the Nobivac group had no detectable titers prior to vaccination, and all at animals 3 wk post vaccination had titers >128. At 6 mo, all tigers still had detectable titers. All but two at 2 wk post booster showed an increase to >128. To date, no adverse effects have been observed following use of either vaccine.

Key words: Canine distemper virus, Nobivac, Panthera tigris, Recombitek, tiger, vaccine

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LITERATURE CITED


SAFETY AND IMMUNOGENICITY OF VACCINATION OF GRAY FOXES (Urocyon cinereoargenteus) WITH A MULTIVALENT RECOMBINANT CANINE DISTEMPER VACCINE AND MODIFIED LIVE PARVOVIRUS VACCINE

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Abstract

Canine distemper virus (CDV) is a significant threat to domestic and wildlife carnivore species worldwide. Vaccinations against CDV are routinely administered to wildlife species in captive and rehabilitative settings and are being more commonly used in free-ranging carnivores as a conservation tool. Because CDV is a major cause of mortality in gray foxes (Urocyon cinereoargenteus), we evaluated the safety and immunogenicity of a commercial canine multivalent vaccine that included canarypoxvirus recombinant CDV and modified live (MLV) canine parvovirus type-2 (CPV2) components for use in gray foxes. Six, healthy 2-wk-old gray fox kits were admitted to the Kentucky Wildlife Center in April 2014. Five kits negative for maternal antibodies to CDV were vaccinated 4 times (on admission and every 3 wk) subcutaneously (Recombitek®C3, Merial, Inc., Athens, GA 30601 USA). One served as a contact control, receiving injections of sterile diluent. None of the kits exhibited any adverse local or systemic reactions, and all remained clinically healthy throughout the trial. Although there was variability among individuals, all five kits seroconverted by serum neutralization after the first vaccination. Peak titer levels were not reached until after the third vaccination. The control remained seronegative throughout the first phase and was then vaccinated. Because all titers dropped after the fourth vaccination, a booster was administered to all six foxes in November 2014. An increase in titer was noted for all foxes. Our study showed that the multivalent vaccine was safe in gray foxes even when given as young as 2 wk of age. Titer levels peaked after the third vaccination, suggesting that foxes may benefit from additional boosters in the rehabilitation setting due to high risk of infection. To provide additional protection, it might be advantageous to administer an additional dose prior to release, especially since newly released foxes could come into contact with potential CDV hosts during home range establishment.

Key words: Canine distemper, gray fox, Urocyon cinereoargenteus, vaccine, vaccination, wildlife
INSERTION OF METALLIC DENTAL PROSTHESIS IN WILD CARNIVORES KEPT IN CAPTIVITY

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Abstract

Among the various oral diseases that affect captive carnivores, dental fractures are highly prevalent. These lesions need immediate treatment, which can range from extraction or endodontic treatment, to complex dental restorations. However, after treatment, the remaining dental elements become weakened, when compared to vital teeth. The dental restoration brings back form and function of the affected teeth, offering better quality of life. The objective of this study was to assess the efficiency of metallic prosthesis on fractured teeth of captive carnivores, and this way evaluate the viability of the technique and resistance of the prosthesis on these animals.

One cougar (Puma concolor), two jaguars (Panthera onca), one jaguarundi (Puma yagouaroundi) and one lion (Panthera onca) presented fractured canines with pulp exposure in one or more teeth. All teeth were endodontically treated, and then prepared and molded for metallic prosthesis confection. Different techniques were used for prosthetic insertion, and their efficiency evaluated over time. Form and function of the teeth were restored, remaining up to 20 mo without new veterinary intervention. The metallic prosthesis presents as a viable, resistant and of fast recovery alternative for fractured teeth treatment.

Key words: Animal dentistry, dental restoration, metallic dental prosthesis, wild carnivores
CLINICAL, GROSS, AND HISTOPATHOLOGIC FINDINGS IN A CLUSTER OF SIX CASES OF MALIGNANT PERIPHERAL NERVE SHEATH TUMORS IN SENEGAL BICHIRS (*Polypterus senegalensis*)

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**Abstract**

Bichirs (*Polypterus* spp.) are evolutionarily ancient freshwater fish native to central Africa. They are popular exhibit fish due to their strikingly primitive appearance and retained physiologic characteristics, including obligate air-breathing with true lungs. From 2011 through 2014, six of 19 adult Senegal bichirs (*Polypterus senegalensis*) in the Wildlife Conservation Society collection developed large, disfiguring tumors resulting in death or euthanasia. Tumors were located in the musculature of the dorsal or lateral body wall. The most advanced cases ruptured through the skin, exposing an exophytic, broad-based mass that was not amenable to resection. Observed clinical signs were limited to mildly decreased activity, though at necropsy some fish were in thin condition and most had empty digestive tracts. Necropsy findings included a second, earlier stage tumor in two cases, coelomic invasion in one case, and metastatic disease in one case. Histologically, these neoplasms were infiltrative into the epaxial muscles, and in one case invaded and effaced vertebrae. One fish had evidence of secondary bacterial sepsis. The histologic diagnosis in each case was malignant peripheral nerve sheath tumor or neurofibrosarcoma; tumor locations suggested an origin from the spinal nerves. Similar tumors occur spontaneously in a number of fish species, and an infectious etiology has been demonstrated in epizootic peripheral nerve sheath tumors of bicolor damselfish (*Stegastes partitus*). The high prevalence of the same neoplasm in this bichir colony is suggestive of an infectious etiology, though an agent has not yet been identified.

**Key words:** Malignant peripheral nerve sheath tumor, neoplasia, neurofibrosarcoma, *Polypterus senegalensis*, Senegal bichir

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**LITERATURE CITED**


EMPHYSEMATOUS INGLUVITIS IN RAINBOW LORIKEETS (*Trichoglossus haematodus haematodus*)

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Abstract

Eleven cases of emphysematous ingluvitis were identified following a review of 220 necropsy records for rainbow lorikeets (*Trichoglossus haematodus haematodus*) that died over an 18-yr period. Affected birds were part of a group of rainbow lorikeets which were housed in a large, walk-through aviary. The numbers of birds in the enclosure and population density changed over time. Affected birds were eight males, two females and one of undetermined sex. In two of these birds emphysematous ingluvitis was considered to be the cause of death. Gross lesions observed in the crop included tan mucosal nodules, mucosal gas-filled bubbles, and a thickened crop wall. Histologic lesions included clear spaces in the mucosa with variable amounts of mixed inflammatory cell infiltrates and ulceration. The underlying cause of the lesions is not known, but lesions resemble pneumatosis cystoides intestinalis and gastric pneumatosis (emphysematous gastritis) in humans and other animals.¹ ² Emphysematous ingluvitis has not previously been described in birds. Identifying and understanding the pathogenesis of this condition may be important for ensuring optimal care of affected birds.

Key words: Crop, emphysematous ingluvitis, rainbow lorikeet, *Trichoglossus haematodus*

LITERATURE CITED


HEPATIC TO PULMONARY EMBOLISM OF ABSORBABLE GELATIN HEMOSTATIC SPONGE IN TWO EGYPTIAN FRUIT BATS (*Rousettus aegyptiacus*): A COMPLICATION OF ITS USE IN HEPATIC BIOPSY PROCEDURES

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Abstract

Thirty-four adult Egyptian fruit bats (*Rousettus aegyptiacus*) were enrolled in a study on iron regulation during which liver biopsies were collected at two time-points. Absorbable gelatin hemostatic sponge (GS) was inserted at the biopsy sites as necessary for local hemostasis. Sixteen of the bats have subsequently died or been euthanized and examined histologically; intravascular GS was identified histologically in the lungs of two bats. The identification of GS was based on the presence of amphophilic amorphous flaky material that stained strongly positive with periodic acid-Schiff technique. The first case, which died 1 yr after biopsy, had hepatic abscessation and necrosis with intralesional budding yeast and GS at the initial biopsy site. Pulmonary lesions included: vascular thrombosis with intralesional yeast and/or GS, neutrophilic bronchopneumonia, and hemorrhage. The second case, which died 3 yr after biopsy, also showed hepatic abscessation with intralesional bacteria, pulmonary vascular thrombosis with intralesional GS and septic pneumonia. GS is used frequently in veterinary medicine; no complications were described in a recent retrospective study of its use in 50 domestic small animal cases.1 In contrast, foreign body reactions, nidus of infection/abscessation, anaphylaxis/hypersensitivity, granuloma formation and local tissue compression have been described in human patients.1 The finding of GS embolization in these two bats highlights a need for reconsideration of potential adverse effects related to its use.

1Spongostan Dental, Ethicon, Somerville, NJ 08876 USA.

**Key words:** Egyptian fruit bat, embolism, gelatin hemostatic sponge, *Rousettus aegyptiacus*

LITERATURE CITED

A RETROSPECTIVE STUDY OF MORTALITY IN CAPTIVE PYGMY HIPPOPOTAMUS (*Choeropsis liberiensis*)

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Abstract

The pygmy hippopotamus (*Choeropsis liberiensis*), an IUCN Red List Endangered species (CITES Appendix II), has been housed in zoological collections since 1912. Our study is the first comprehensive review of mortality in captive pygmy hippopotamus that has been conducted since 1982 and significantly expands on previous data. We solicited necropsy reports from 129/187 zoological institutions worldwide currently or previously holding pygmy hippopotamus. Cause of mortality was determined for a total of 404 animals; 177 male, 220 female, and 7 of unknown sex. Reports were grouped into three age categories: neonate (0-30 days); juvenile (30 days-3 yr); adult (3+ yr). Causes of mortality were grouped according to body system and etiology. Our data indicate that mortality in neonates is primarily due to perinatal causes (failure to thrive, weakness, poor sucking reflex, maternal neglect) or parent-inflicted trauma. Common causes of mortality or euthanasia in adult pygmy hippopotamus include cardiovascular disease, degenerative musculoskeletal conditions, and renal insufficiency, the latter frequently associated with advanced polycystic kidney disease (PKD). The prevalence of PKD in pygmy hippopotamus 10+ yr of age exceeds 30%, and the condition exhibits a familial inheritance pattern. Infectious diseases causing mortality in pygmy hippopotamus include leptospirosis and encephalomyocarditis virus (EMCV), the latter usually presenting as acute, unexpected death. Our data significantly expand on the first reports of PKD in this species and indicate that the condition is of possible concern for long-term viability of the captive population given the limited number of remaining founder genomes.

**Key words:** *Choeropsis liberiensis*, encephalomyocarditis virus (EMCV), mortality, pathology, polycystic kidney disease (PKD), pygmy hippopotamus

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LITERATURE CITED


BLOAT AND ENTEROTOXEMIA IN LARGE FELIDS

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Abstract

Bloat and gastric dilatation and volvulus have not been previously reported in large felids. The clinical management of bloat and enterotoxemia in a female juvenile Sumatran tiger (Panthera tigris sumatrae) and a male juvenile Malayan tiger (Panthera tigris jacksoni) is presented. Both animals developed acute gastric bloat at 6 mo of age and were successfully managed with surgical intervention and aggressive post-operative care, following life-threatening complications. The Sumatran tiger developed bloat again at 12 mo and died shortly after surgical decompression. The Malayan tiger has not had additional gastrointestinal problems in the 2 yr following his recovery. Clostridium perfringens type A was cultured from fecal or gastric material from both animals and enterotoxemia was hypothesized as a cause of the post-operative complications. A retrospective study was undertaken to determine if gastric bloat and enterotoxemia were health concerns for large felids. Two additional tiger cases were identified: an adult male Amur tiger (Panthera tigris altaica), which died from gastric bloat and rupture, and an adult male Sumatran tiger which died from gastric bloat and volvulus. Three African lions (Panthera leo) are also included, two of which presented for acute hemoptysis; one died of a gastric rupture (11 yr male), the second was euthanized with surgical findings of gastric necrosis (11 mo female). The third lion (5 yr male), presented with a 48-hr history of recurrent vomiting and died during a gastrotomy procedure to remove a trichobezoar. Histopathology was consistent with probable recent intestinal volvulus and sepsis. Clostridium perfringens type A was cultured from the Amur tiger while culture results were unavailable for the remainder. Improper meat handling practices were postulated to contribute to some cases.

Key words: Bloat, Clostridium perfringens, enterotoxemia, felid, gastric dilatation volvulus

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BILIARY CIRRHOSIS IN EIGHT GREEN IGUANAS (*Iguana iguana*)

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Abstract

Biliary cirrhosis was diagnosed in eight green iguanas (*Iguana iguana*) by liver biopsy or necropsy with histopathology. Age range was 3-10 yr; five iguanas were females and three were males. Affected iguanas presented with anorexia, weight loss, dehydration, vomiting, hemoptysis or a combination of several of these symptoms. Physical examination and ancillary diagnostic tests including x-rays, serum biochemistries, exploratory laparotomy, endoscopy, and cytologic examination of percutaneous liver aspirates revealed orange discoloration of skin, hepatomegaly, increased hepatic consistency, severe dilatation of the gall bladder, hydrocoelom, leukocytosis, elevated GOT, increased bile acids, hepatocellular lipidosis or a combination of several of these symptoms. Hepatic lesions consisted of severe biliary hyperplasia with fibrosis replacing most of the affected parenchyma, and was associated with severe dilatation of the gall bladder, cholelithiasis of intrahepatic and extrahepatic ducts (with obstruction of the common bile duct in one case), rupture of intrahepatic bile ducts with leakage of bile and ensuing granulomatous hepatitis, granulomatous or fibrinonecrotizing cholecystitis with inspissation and plugging of bile and intralesional bacteria, or a combination of several of these lesions. One iguana with hemoptysis had severe phlebectasia involving pulmonary veins, jugular veins and cranial cava vein. These findings suggest biliary cirrhosis associated with cholelithiasis, bacterial cholecystitis, bile plugs, and/or intrahepatic bile duct rupture with leakage of bile should be considered a top differential for green iguanas presenting with evidence of hepatobiliary disease. Obstruction of the biliary tree appears to be the underlying cause for this condition.

Key words: Biliary cirrhosis, cholecystitis, cholelithiasis, green iguana, *Iguana iguana*
RETROSPECTIVE REVIEW OF HISTOPATHOLOGIC FINDINGS IN EIGHT SPECIES OF GAZELLE

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Abstract

Identifying disease trends amongst different species has indisputable value to veterinary clinicians and zoo managers for improving the welfare and management of zoo species. There are no published cross-institutional, multi-species studies identifying mortality trends in captive gazelle species, with the exception of reports from Qatar and Saudi Arabia.2-4 The cause of death for eight different species (addra gazelle, Nanger dama; dorcas gazelle, Gazella dorcas; Grant’s gazelle, Nanger granti; sand gazelle, Gazella leptoceros; Saudi goitered gazelle, Gazella subgutturosa; Soemmerring’s gazelle, Nanger soemmerringii; Thomson’s gazelle, Eudorcas thomsonii; and Speke’s gazelle, Gazella spekei) are presented from a 16-yr period (1996-2012). The leading cause of death for all species was trauma, followed by bronchopneumonia, and failure to thrive/maternal neglect. Chronic nephritis and rumenitis/abomasitis/enteritis were common concurrent lesions across all species. On average, female gazelle lived twice as long as male gazelle, with an average overall survival time of 6.7 yr. Dorcas, Thomson’s and addra gazelle females had the longest average survival time (8-13 yr). Calves up to 6 mo of age died most frequently from failure of passive transfer or maternal neglect. Thyroid carcinoma was a trend in Thomson’s gazelle but not other species. Sand and Speke’s gazelle frequently died from systemic amyloidosis, while Saudi goitered gazelle also had a high prevalence of secondary amyloidosis. Hematuria syndrome1 was the second most common cause of death in Grant’s gazelle. The majority of lesions identified in this study may be preventable with appropriate management.

Key words: Bronchopneumonia, gazelle, mortality, trauma

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LITERATURE CITED


OVARIAN ADENOCARCINOMA IN CAPTIVE NORTH AMERICAN JAGUARS (*Panthera onca*): TUMOR CHARACTERIZATION AND INVESTIGATION OF BRCA1 MUTATIONS

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Abstract

High numbers of ovarian adenocarcinomas have been documented in captive jaguars, which are rare in other felids.1,4 Formalin fixed, paraffin embedded tissues from 55 captive, female jaguars between 1988-2014 were collected. Twenty-three jaguars (40%) had ovarian carcinoma (five with bilateral tumors), 14 had mammary carcinoma, and of these, five had both ovarian and mammary carcinoma. No association has been found between ovarian cancer and the use of exogenous progestins in zoo felids, and in these cases, only nine of 23 animals with ovarian adenocarcinoma had a history of exogenous progestin exposure.2,5 An inherited germline mutation is suspected, and candidate genes include those involved in the carcinogenesis of human ovarian and breast cancer, such as BRCA1 and BRCA2.3 These tumors most often occur in middle-aged, post-reproductive jaguars, though a homozygous germline mutation in BRCA1 could lead to embryonic lethality, impairing captive breeding. To further investigate the role of BRCA1 in tumorigenesis, jaguar genomic DNA was first extracted from whole blood. Primers were designed using the domestic cat BRCA1 genomic DNA sequence. Jaguar and domestic cat genomic DNA was amplified using PCR and Sanger sequencing. Multiple variations in the jaguar BRCA1 sequence were detected, including five nonsynonymous point mutations and one three base pair insertion. Any association between these sequence variations and tumor development or phenotype, as well as other candidate genes are being investigated. Knowledge of risk factors for the development of ovarian carcinoma in jaguars will assist with the medical management and breeding recommendations of this endangered species in captivity.

Key words: BRCA1, jaguar, ovarian adenocarcinoma, *Panthera onca*, PCR, Sanger sequencing

ACKNOWLEDGMENTS

The authors thank participating zoological institutions for providing tissue samples and medical histories that are critical for this ongoing study. We also appreciate the support of the AAZV and the AZA Wildlife Contraception Center in this and other reproductive disease investigations, and recognize the initial work performed by Dr. Linda Munson and those in her laboratory on this project over the last 25 years.

LITERATURE CITED


ZOO ANIMALS AS MUSEUM SPECIMENS: CONTINUING CONTRIBUTIONS TO RESEARCH AND EDUCATION

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Abstract

Zoos and aquariums have long been a source of specimens for natural history museums. The Burke Museum, at the University of Washington in Seattle, makes use of such specimens, most often from the Woodland Park Zoo and the Seattle Aquarium. As Collection Manager of the Burke's Mammalogy Collection, I have helped hundreds of mammals, reptiles and birds transition from life at the zoo to curation at the museum. As museum specimens, they contribute to research by the global scientific community and education programs for museum visitors and students in Washington State. This talk will describe some of the process involved in turning a deceased zoo animal into an archived museum specimen in the Burke's collections. I will discuss some of the challenges (technical, logistical, sometimes political) that can be involved in processing the remains of an animal that may be large, decomposing, and well-loved by a community that is just beginning to mourn its death. Using specimens, stories and images, I will discuss different ways that our museum uses zoo specimens in education and interpretive programs to help inspire and inform the public. I will also give examples of research that is being done with these specimens, to demonstrate how important they can be for scientists trying to better understand the evolution, natural history and conservation of the world's wildlife.

Key words: Biofacts, education, museum, research, specimens

ACKNOWLEDGMENTS

The author thanks the Woodland Park Zoo and the lab of Dr. Sharlene Santana for data and images used in this presentation.
GROSS LESION RECOGNITION IN ZOO BIRDS

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Abstract

Gross lesion recognition, like other imaging modalities, is a bit of an art form. Vast zones of grey may confront the investigator when considering what the lesion is, what it could be, and what to do with it. And nobody is good at all of it: A seasoned livestock pathologist could possibly clear an entire day’s necropsies without the help of a single histology slide. A bee keeper would recognize immediately the maggot stages that parasitize his colony. A dog-cat pathologist in a busy private laboratory or a companion animal clinician may not have a clue about gross lesions in livestock or bees. Historically, our attempts at accurately diagnosing disease by gross lesion recognition have been a humbling experience, and that has been the impetus for all further diagnostic specialties.

So now that we have put gross pathology in its proper place, why even bother with such an imperfect science? Obviously, gross lesions, or lack thereof, are the first visual indication of what may be wrong with the patient. These are the lumps, the effusions, the asymmetrical oddities, the discolorations, the odiferous clues to disease that (hopefully) stimulate a “scientific” thought process culminating in a list of differential diagnoses. The purpose of this workshop is to present images of common and not so common avian gross lesions in live and necropsy specimens, and in a participatory manner, establish a differential diagnosis and means for establishing a definitive diagnosis.

Key words: Avian, diagnosis, differential, gross, lesion, pathology
By definition, stem cells are capable of self-renewal, proliferation and differentiation. Stem cells can be categorized based on their tissue of origin and their differentiation potential (pluripotent or multipotent). Pluripotent stem cells are capable of differentiating into all cell types of the body whereas multipotent stem cells have a more limited differentiation. Pluripotent stem cells include embryonic stem cells and induced pluripotent stem cells. Multipotent stem cells include hematopoietic stem cells and mesenchymal stem cells (MSC). Most all tissues of the body also have a population of resident tissue stem cells ensuring tissue-specific cell replacement (ie gastrointestinal or hepatic). Current “stem cell products” include culture expanded, adult-derived MSCs, suspensions of embryonic-like cells as well as nucleated cells from tissues including fat (stromal vascular fraction [SVF]) or bone marrow mononuclear cells. In this talk, there will be a basic review of different stem cell types however the emphasis will be on MSCs as they are the most common stem cell being used in current medical clinical applications.

MSCs are defined by their ability to adhere to plastic and be induced to undergo tri-lineage differentiation in vitro, notably adipogenic, osteogenic and chondrogenic differentiation, and by a specific surface protein expression (Cluster of Differentiation [CD] CD90+, CD105+, CD29+, CD45-, CD34-). MSCs with these characteristics have been isolated from almost every tissue. Both in human and veterinary medicine, MSCs promote tissue regeneration and return to function by dampening the immune response, decreasing inflammation, increasing blood flow, secreting growth factors to support resident stem cell populations and decreasing local cell death. They promote normal healing rather than scarring mostly by secreting soluble mediators. In veterinary medicine, MSCs are harnessed primarily for their immunomodulatory functions (inflammatory and immune-mediated diseases) and their tissue reparative properties (orthopedic injuries, spinal cord repair)

MSCs have been shown to communicate with nearly all cells of the immune system. Once MSCs are activated by the inflammatory environment, they decrease proliferation and activation of pro-inflammatory immune cells and promote expansion of inhibitory and immunomodulatory cells. Depending on the animal species and tissue source of MSCs, MSCs secrete a variety of soluble mediators including prostaglandin E₂ (PGE₂), interleukin-6 (IL6), transforming growth factor beta (TGFβ), nitric oxide (NO), hepatocyte growth factor (HGF) and indoleamine 2,3-dioxygenase (IDO). Overall, the administration of MSCs inhibits T-cell proliferation, alters B-cell function, down-regulates MHC II and inhibits dendritic cell maturation and differentiation. These anti-inflammatory properties provide the rationale to use MSCs for clinical trials for diseases including osteoarthritis, and inflammatory bowel, liver and pulmonary diseases. Their immunomodulatory properties, notably their regulation of T cell activation and phenotype, drives the use of MSCs for
clinical trials involving autoimmune diseases or diseases that result from chronic antigenic stimulation including feline chronic gingivostomatitis and immune-mediated dermatologic diseases. The stimulation of local progenitor cells and the secretion of potent growth and anti-apoptotic factors are likely partially responsible for their role in tendon, cartilage and ligament healing. MSCs can also be activated by microbes, including a wide range of bacteria and viruses. Engagement with bacteria may prime or enhance MSC functions including stimulating neutrophil or macrophage phagocytic activity and priming MSCs to be even more potent immunomodulatory agents. This interaction with microbes suggests that MSCs may be indicated for infected as well as inflamed lesions (they have been investigated for the treatment of sepsis in rodent models). MSCs are also being used in neural repair in veterinary medicine including spinal cord injury. They are thought to enhance neural repair by decreasing T cell activation, increasing neural blood flow, enhancing remyelination, reducing local cell death, secreting neurotrophic factors and increasing neuronal differentiation.

Stem cells have also attracted significant interest for tissue engineering purposes due to their ability to differentiate into tissues of mesodermal lineage (bone, tendon, cartilage etc). For these tissue engineering applications, stem cells are generally administered within scaffolds and with additional growth factors. Mechanical cues, including pre-conditioning with mechanical stimulation, are increasingly considered for the generation of orthopedic tissues. Various scaffold printing technologies, including three-dimensional (3D) printing permit complex scaffold manufacturing applications.

A deeper understanding of how MSCs function in vitro and in vivo helps us design rational, focused clinical trials to improve outcome for veterinary patients and inform human clinical trials. During the session, I will provide an overview of some current clinical trials using MSCs in veterinary medicine and how we harness how MSCs function in vitro to target our trials towards naturally occurring diseases in veterinary patients. Some of the targeted disease processes could be very relevant and translatable to captive wild animals. Working in collaborative teams of research scientists and clinicians, we can begin to answer questions on appropriate cell dose (including the number of doses), route of administration (intravenous, intralvesional, regional), timing of cell administration (early, acute versus more delayed treatment) cell tissue source (product, autologous or allogenic), and cell distribution using in vivo cell labeling techniques. Ideally, cell products should meet minimal release criteria including cell phenotype, cell number, cell viability, product sterility and, ideally, some measure of cell function for the intended use (differentiation, suppression of lymphocyte proliferation etc).

**Key words:** Clinical trials, immunomodulation, mesenchymal stem cells, stem cells, veterinary medicine
SURGICAL ONCOLOGY: FUNDAMENTALS AND FUTURE DIRECTIONS

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Abstract

Despite advances in radiation planning and application as well as chemotherapeutic drugs and regimens, surgery remains fundamentally important in the treatment of locoregional neoplastic disease. Recent and ongoing technologic advances make surgical approaches to cancer a rapidly evolving aspect of veterinary medicine. While more individualized patient approaches are starting to be implemented or are at least on the near horizon in both human and veterinary medicine, in practice we often continue to rely primarily on historical data to inform patient decision making. However, historical, evidence-based practices and adherence to fundamental techniques can enhance patient outcomes across species. Fundamental approaches to the veterinary cancer patient, including biopsy techniques, surgical planning, margin marking, and management strategies to optimize outcomes that can be immediately applied, as well as novel technologies and techniques will be discussed.

Key words: Oncology, surgical oncology, technologies
DOCUMENTED CESSION OF MYCOBACTERIAL SHEDDING WITH ANTIBIOTIC TREATMENT IN A Mycobacteria-tuberculosis-POSITIVE ASIAN ELEPHANT (Elephas maximus) BY SERIAL CULTURE AND DIRECT REAL-TIME POLYMERASE CHAIN REACTION TESTING OF TRUNK WASH SAMPLES

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Abstract

Routine mycobacterial culture of trunk wash (TW) samples yielded Mycobacteria tuberculosis organisms from a 45-y-old female Asian elephant, Elephas maximus. The TW cultures (3-4 samples/wk) were used to monitor response to treatment once an antibiotic regimen commenced and verified cessation of mycobacterial shedding. In addition, the opportunity to compare and potentially validate a direct real-time polymerase chain reaction (qPCR) method to detect Mycobacterium tuberculosis (Mtb) DNA in TW samples with standard mycobacterial culture methods for TW samples was undertaken. The TW samples were collected by the standard method, frozen in a -20°C freezer and shipped overnight to the National Veterinary Services Laboratory (NVSL) for testing.2 The TW were processed and half of the centrifuged pellet was decontaminated with NVSL’s NaOH-NALC decontamination procedure and inoculated onto media for mycobacterial culture. The second half was subjected to a qPCR targeting IS1081 of the M. tuberculosis complex genome. Over 73 days, 39 TW samples were obtained and cultured and qPCR was performed 70 times on these same samples. M. tuberculosis was isolated prior to treatment by culture 10 times and DNA detected by qPCR 11 times however the two tests were not always in agreement. On day 34 Isoniazid was started rectally as the first of a four-drug regimen and within 7 days all detectable shedding of Mtb had ceased.1 In this case attempts were made to compare two diagnostic modalities and that recommended antibiotic doses were efficacious and not associated with signs of toxicity in the animal.3

Key words: Asian elephant, Elephas maximus, Mycobacteria tuberculosis, real-time polymerase chain reaction, trunk wash

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LITERATURE CITED


ESTABLISHING NORMAL THYROID HORMONE VALUES FOR THE MALE GIANT PANDA (Ailuropoda melanoleuca)

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Abstract

Although reproductive and adrenal endocrine patterns of the male giant panda (Ailuropoda melanoleuca) have been established, the metabolic changes that facilitate these activities are unknown. 1 Because thyroid hormones (triiodothyronine [T3]; thyroxine [T4]) regulate metabolism and reproduction, 4 understanding their activity in the giant panda would benefit species care and management. Additionally, a hypothyroid-like condition in nearly 15% of the captive population drives a need to understand thyroid activity in giant pandas. 2 By utilizing a novel non-invasive approach we sought to create a normative database of seasonal T3 and T4 in the male giant panda. Fresh fecal samples (~2000) were collected for 1 yr (three samples/wk) from eight male giant pandas (age 4-21 yr) at the Chengdu Breeding Base of the Giant Panda. Feces were freeze-dried, crushed, and frozen prior to storage. 3 Thyroid hormone metabolites were extracted in 70% ethyl alcohol (10 ml) and double-antibody enzyme immunoassay was used to quantify the T3 and T4 metabolites (L. Graham, University of Guelph). 5 Excreted T3 and T4 were greatest (P < 0.05) in the pre-breeding period (October 1-January 31), declined as the breeding season progressed (February 1-May 31), and increased again in the non-breeding period (June 1-September 30). These are the first thyroid hormone data on the male giant panda and most interestingly conform to the seasonal reproductive cycle of the species. These data lay a contextual foundation for veterinarians and animal care managers to appreciate thyroid hormone levels in clinical presentation and normal physiology.

Key words: Ailuropoda melanoleuca, giant panda, seasonal reproduction, thyroid endocrinology

ACKNOWLEDGMENTS

The authors thank Allison Rowland, Kristina Ridge, and the staff at the Chengdu Research Base of Giant Panda Breeding, specifically, Hou Rong, Luo Li, Wang Chengdong and Zhang Zhihe. Project funding was provided by Zoo Atlanta and student funding was provided by Merial Veterinary Scholars Program.

LITERATURE CITED


IDIOPATHIC GRANULOMATOUS VASCULITIS (SARCOIDOSIS) IN A BLACK RHINOCEROS (*Diceros bicornis minor*)

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Abstract

A 20-yr-old male captive-born black rhinoceros (*Diceros bicornis minor*) presented with a relatively acute onset of lethargy and profuse watery diarrhea following a 5-mo period of weight loss. Fecal parasitology and culture failed to reveal any pathogens, and repeated clinical assessment over the following month suggested a protein-losing enteropathy.

Treatment for suspected inflammatory bowel disease commenced including intravenous colloid and crystalloid fluid infusions, dietary manipulation, oral psyllium, bismuth subsalicylate, oral ranitidine and probiotics. After 1 mo with only slight improvement, dexamethasone (0.06-0.08 mg/kg i.m. s.i.d.) was given for 2 days followed by a prolonged tapering course of oral prednisolone (initially at 0.8 mg/kg s.i.d. tapered in 25% increments over a period of 6 wk to 0.2 mg/kg e.o.d.). There was a noticeable clinical response to corticosteroids with improvements in demeanor, fecal consistency, serum albumin levels and body weight. The medication was discontinued 3 mo after presentation and clinical signs recurred within 1 wk. Recommencement of the corticosteroid therapy led to a temporary clinical improvement. The rhinoceros was euthanized 6 mo after presentation due to an eventual waning of the response to treatment.

Post-mortem examination revealed multiple, large, firm, coalescing nodules in the lung, kidney, spleen and lymph nodes. Histological examination confirmed these nodules to represent granulomatous inflammation, typically focused on vascular structures. An extensive search for potential causative organisms was undertaken but none were found. Idiopathic granulomatous vasculitis (sarcoidosis) has not been reported before in a black rhinoceros but it is considered an emerging disease in domestic horses.1

Key words: Black rhinoceros, *Diceros bicornis*, idiopathic granulomatous vasculitis, sarcoidosis

LITERATURE CITED

ANATOMIC DESCRIPTION AND PATHOLOGIC FINDINGS OF CHRONIC FOOT ROT WITH SEVERE SECONDARY OSTEOMYELITIS IN A ROTHSCILD’S GIRAFFE (Giraffa camelopardalis rothschildi)

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Abstract

A 22-yr-old, male Rothschild's giraffe (Giraffa camelopardalis rothschildi) presented with chronic intermittent forelimb lameness. An ulcerative pododermatitis which was not responsive to topical treatment and periodic hoof trimming had progressed to chronic laminitis and foot rot. This was characterized by severe overgrowth with deformation and odorous bleeding ulcers of the left front foot (LF), as well as a soft hemorrhagic lesion on the palmar aspect of right front foot (RF). Monthly radiographs had documented a progressive bone lysis of the medial digit and changes in conformation of the distal phalanx of the LF. Euthanasia was elected due to the poor prognosis and concerns of quality of life. Computed tomography (CT) images of the disarticulated distal forelimbs revealed severe chronic osteolysis and deformation of the distal phalanx of the medial digit of the LF, severe subchondral lysis of distal and middle phalanx adjacent of the distal interphalangeal joint. Osseous remodeling of the navicular bone including the flexor surface was present with adjacent minimal thickening and alteration of the deep digital flexor tendon of the medial digit of the LF. Dissection confirmed CT findings, including extensive necrosis and bone loss of P3, multiple cavitations involving the margins of the second phalanx and the navicular bone, and fistulous tracts extending parallel to the sole of LF. Foot rot has not been extensively described in giraffes and represents a big challenge for diagnosis, prevention, and treatment.1-4 Future studies are needed to establish the inflammatory mechanisms involved in foot lesions in giraffes.

Key words: Computed tomography, foot rot, Giraffa camelopardalis rothschildi, lameness, osteomyelitis, pododermatitis, septic osteitis

ACKNOWLEDGMENTS

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LITERATURE CITED


MULTIHORMONAL PANCREATIC ISLET CELL CARCINOMAS IN THREE KOMODO DRAGONS (Varanus komodoensis)

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Abstract

Although once thought rare in reptiles, neoplastic diseases are now being recognized more frequently.1,2 Endocrine neoplasms in reptiles however are still rarely reported. We report multihormonal pancreatic islet cell carcinomas in three captive Komodo dragons (Varanus komodensis), a 15-yr-old female, a 16-yr-old male, and a 25-yr-old male. Two of the three cases were noted at post mortem to have a grossly abnormal pancreas. Histologically, the tumors were comprised of nests and cords of well-differentiated neoplastic islet cells with scant amounts of eosinophilic cytoplasm and round, euchromatic nuclei, with rare mitoses. Infiltration by the islet cell tumor into the surrounding acinar tissue was observed in all cases, but no metastatic foci were seen. Multi-hormone expression was observed in all tumors, which were immunohistochemically strongly positive for glucagon and somatostatin and focally positive for polypeptide. Interestingly, somatostatin expression has been previously reported in a series of intestinal neuroendocrine carcinomas in bearded dragons.3 While, the clinical impact of the islet cell carcinomas in the Komodo dragons is unknown, for animals presenting with weakness, lethargy, and poor appetite, pancreatic islet cell neoplasms should be considered as a differential.

Key words: Komodo dragon, pancreatic islet cell carcinoma, Varanus komodoensis

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LITERATURE CITED


ADENOVIRUS INFECTION AND SALMONELLOSIS IN A GROUP OF LABORATORY-HOUSED CORN SNAKES (Pantherophis guttatus)

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Abstract

A group of 18 juvenile captive-bred corn snakes (Pantherophis guttatus) was quarantined at the USGS-National Wildlife Health Center. Upon arrival, several of the snakes exhibited intermittent vomiting and anorexia. One individual with persistent vomiting was treated with oral metronidazole, oral electrolyte solution, nutritional support, and subcutaneous fluids. Cryptosporidium sp. was not detected by microscopy or PCR from gastric lavage samples. The snake died 1 mo later; necropsy findings included hepatic and intestinal necrosis, with basophilic to amphophilic intranuclear inclusions found within epithelial cells throughout the alimentary tract. PCR and sequencing confirmed the presence of snake adenovirus 2 within the liver. In the following month, two additional snakes had intermittent regurgitation and anorexia, poor growth, and died despite treatment with antibiotics, nutritional support, and subcutaneous fluids. On necropsy, both snakes were diagnosed with systemic salmonellosis, based upon histologic lesions and isolation of Salmonella from the liver. These snakes also had similar intranuclear inclusions within the gastrointestinal tract and adenovirus was confirmed by PCR. In the first of these three cases, snake adenovirus 2 was the only pathogen found and appeared to be a contributing factor in the death of the snake. Salmonellosis was the likely cause of death in the subsequent cases, but adenoviral infection may have increased susceptibility to this opportunistic pathogen. Adenoviral infection has been previously described in several species of snakes, including corn snakes.¹ This case report corroborates a retrospective study by Garner et. al., showing that snake adenovirus 2 has the potential to act as a primary pathogen or contribute to debilitation and secondary septicemia in colubrids.¹ Although it is commonly found in the gastrointestinal tract of healthy snakes, Salmonella may cause severe disease and death in the face of adenoviral co-infection.²³

Key words: Adenovirus, corn snake, Pantherophis guttatus, Salmonella

LITERATURE CITED


GASTROINTESTINAL PARASITE BURDEN OF CAPTIVE PRZEWALSKI'S HORSES 
(Equus przewalskii) IN NATURALLY VERSUS TRADITIONALLY MANAGED HERDS

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Abstract

There is a paucity of published literature available that addresses gastrointestinal parasite burden in Przewalski’s horses (Equus ferus przewalskii), and it is unknown whether current deworming protocols for Przewalski’s horses are superior to other management systems for minimizing their gastrointestinal parasite load. Fecal samples of 145 captive Przewalski’s horses were analyzed using the standard McMaster test to determine selective gastrointestinal parasite burden in eggs per gram between two different management systems. The sampled Przewalski’s horses were managed in either a natural management system (free-ranging, low stocking density and untreated with anthelmintics) in the Hortobagy National Park, Hungary (n = 126) or in a traditional management system (separate smaller pastures and treated quarterly by weight with rotating oral anthelmintics) in The Wilds, Ohio (n = 19). Results of the McMaster test for the two populations were analyzed and results showed species from the family Strongylidae as the primary helminth in both populations. No Parascaris equorum eggs were observed in either population. Three horses that died or were humanely euthanized during the study at Hortobagy National Park were necropsied to confirm the lack of other parasite species on gross and histologic evaluation. The Przewalski’s horses in the natural system had a significantly lower gastrointestinal parasite burden than those in the traditional system (1142 ± 77.77 versus 1968 ± 268.30 eggs per gram, respectively; P < 0.001). Perhaps, given enough acreage, coexistence between Przewalski’s horses and parasites is superior to, or as effective at, controlling parasite-induced health problems as regularly treating with anthelmintics.1,3

Key words: Equus ferus przewalskii, gastrointestinal parasites, McMaster test, Parascaris equorum, Przewalski’s horse, Strongylidae

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LITERATURE CITED


FIVE YEARS OF HORMONE-ASSISTED CAPTIVE PROPAGATION IN HOUSTON TOADS (Anaxyrus houstonensis): MEDICAL CHALLENGES AND LESSONS LEARNED

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Abstract

The Houston toad (Anaxyrus houstonensis) was the first amphibian to be protected by the Endangered Species Act and less than 300 toads are estimated to remain in the wild. In 2007 the Houston Zoo began a head start program involving over 500 captive assurance toads; however, natural breeding was poor and hormone assisted breeding became necessary to produce animals for reintroduction. Hormone-assisted propagation is accomplished in a 5-day sequence. Absolute intracoelomic doses of hormones are used with the median weights of females and males at 75 g and 55 g respectively. On days 1 and 4, females are primed with 100 IU of chorionic gonadotropin (hCG). On day five both sexes are treated. Females receive 500 IU hCG and 16 µg of luteinizing hormone-releasing hormone (LHRH) and males receive 300 IU hCG and 8 µg of LHRH. Pairs of toads are then placed in breeding tanks. In 2015 this protocol resulted in a fertility rate of 88% and the release of over 450,000 fertilized eggs. While not a significant cause of mortality, oviductal or bladder prolapses remain the most common reason for post-breeding hospital presentation. Refinement of this protocol has improved fertility and reduced post-breeding mortalities since 2010. Adjustments include changing hormone dosing and frequency and decreasing time in breeding tanks. The current protocol is under constant reevaluation. The next areas of investigation include exploring methods to evaluate fertility of individual matings and to determine efficacy of a shorter treatment interval with a different class of hormone.

a hCG, 5000 IU/ml, Chorulon, Intervet, Inc., Millsboro, DE.

b LHRH, 0.2 mg/ml, Sigma Aldrich, St. Louis, MO.

Key words: Amphibian, Anaxyrus houstonensis, breeding, hormone assisted, Houston toad
CUTANEOUS SQUAMOUS CELL CARCINOMA IN A PANTHER CHAMELEON (Furcifer pardalis) AND TREATMENT WITH CARBOPLATIN IMPLANTABLE BEADS

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Abstract

A 3-yr-old male panther chameleon (Furcifer pardalis) presented with two bilateral raised and crusted skin lesions on the thorax. These lesions were excised and submitted for histopathology with subsequent diagnoses of carcinoma in situ and squamous cell carcinoma. Despite incomplete excision of the squamous cell carcinoma, both excision sites healed; however, several more lesions with a similar appearance developed along both flanks and the tail. The incompletely excised squamous cell carcinoma was re-excised and a piece of implantable carboplatin bead (Wedgewood Pharmacy, Swedesboro, NJ 08085 USA) was placed in the excision site at 5 mg/kg to evaluate this animal’s tolerance of this therapy. Two of the new lesions were sampled for histopathology and viral polymerase chain reaction (PCR) due to the multifocal nature of the lesions. Histopathology confirmed squamous cell carcinoma in the new location and PCR was negative for both papillomaviruses and herpesviruses. Due to the significant skin loss that would result from attempting complete excision of all lesions, implantable carboplatin beads were placed in each lesion. A maximum carboplatin dosage of 10 mg/kg within a 3-wk period was not exceeded. The animal was monitored for response to therapy and no adverse effects of the carboplatin beads were observed. Tumor excision sites treated with beads healed with no tumor recurrence and lesions not excised and treated with beads decreased in size. This is the first report of cutaneous squamous cell carcinoma in a panther chameleon, as well as the first description of implantable carboplatin bead use in this species.

Key words: Carboplatin implantable bead, carcinoma in situ, Furcifer pardalis, panther chameleon, skin, squamous cell carcinoma

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We thank Dr. Heidi Phillips for her guidance in the use of the carboplatin beads, as well as the Animal Health and Fishes departments at the John G. Shedd Aquarium for their care of this patient.
CROP ACARIASIS IN TWO GREEN-WINGED MACAWS (*Ara chloropterus*)

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Abstract

Crop acariasis was diagnosed in two green-winged macaws (*Ara chloropterus*) by crop biopsy (Case 1) or postmortem (Case 2). Case 1 was a 3-yr-old macaw of unknown gender that presented with vomiting and crop and proventricular dilatation. Crop biopsies were obtained and submitted for histopathology to screen for ganglioneuritis/proventricular dilatation disease (PDD). After a diagnosis of mild lymphoplasmacytic inflammation presumably involving a nervous ganglion, three additional recuts of the four fragments of crop biopsy tissue processed revealed moderate chronic multifocal granulomatous serositis with intrallesional and perilesional encapsulated mites. In these recuts, lymphoplasmacytic ganglioneuritis was confirmed. This macaw was treated with ivermectin, and clinical signs resolved. Case 2 was a female presented for necropsy with a clinical suspicion of PDD, which was confirmed by histopathology (ganglioneuritis, leiomiositis, encephalitis, chromaffin adrenalitis). Concurrent diseases included severe biventricular dilated cardiomyopathy, severe fungal necrotizing pneumonia with fungal thromboembolism and crop acariasis. Mites were embedded in the serosa, which had fibrosis; inflammation in the crop was more intense around mites and included macrophages in these areas. Despite the ability of diverse mites to parasitize internal organs such as the trachea, pericardium, or subcutis in birds, crop acariasis has apparently been not reported in macaws or any other avian species. The findings in Case 1 indicate that crop acariasis should be included in the differential diagnosis of PDD-like disease in macaws. Recovery after treatment with ivermectin suggests acariasis may have caused or contributed to the clinical presentation in this animal. Interestingly, the other affected macaw, Case 2, died of PDD.

Key words: *Ara chloropterus*, crop acariasis, crop mites, granulomatous ingluvitis, green-winged macaw, PDD
EPIDEMIOLOGY OF TERRAPENE HERPESVIRUS 1 IN FREE-RANGING BOX TURTLES

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Abstract

Diseases that affect the upper respiratory tract in chelonians have been well described as a significant contributor to morbidity and mortality. Specifically, chelonian herpesvirus has been attributed to disease events in captive chelonians worldwide, but its importance on free-ranging populations is less well-known. Methods for the diagnosis of herpesvirus infections include histopathology, virus isolation, and conventional PCR. Real-time PCR has become an essential tool for nucleic acid quantitation. A quantitative real time TaqMan PCR assay was developed targeting the DNA polymerase gene of Terrapene herpesvirus 1 (TeHV1). This assay can detect as few as 10 viral copies per sample, which is over 100 times more sensitive than conventional PCR assays. Oral swabs from 396 free-ranging turtles from Tennessee and Illinois were collected and assayed for TeHV1. The overall prevalence of TeHV1 was 30.5% (n = 121). Prevalence was highest in July (53.4%) compared to fall (33.8%) and spring (12.8%) (P < 0.0001). The prevalence was found not to be variable across state (P = 0.222), sex (P = 0.380), or age class (P = 0.106). The majority of positive turtles were found in edge habitats (55.0%), compared to forest (43.7%) and field (33.3%), which was not significantly different. This assay and its application can be utilized in free-ranging and captive box turtles for disease surveillance and progression of herpesviruses, and will aid in the characterization of the epidemiology of this disease.

**Key words:** Box turtle, herpesvirus, Terrapene herpesvirus 1
CAPTIVE CARE AND TREATMENT OF BRODIFACOUM TOXICOSIS IN A VULNERABLE SHOREBIRD, THE BRISTLE-THIGHED CURLEW (*Numenius tahitiensis*), DURING A 2011 RAT ERADICATION PROJECT, PALMYRA ATOLL

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**Abstract**

During the 2011 Palmyra Atoll rat eradication project, a vulnerable shorebird, the bristle-thighed curlew (*Numenius tahitiensis*) (*n* = 16), was captured and held in captivity as an attempt to reduce non-target mortality. Blood values (PCV, TP, cholesterol, triglycerides, albumin, calcium, uric acid, non-esterified fatty acids, and beta-hydroxybutyrate) were analyzed at capture and at 2 wk post captivity to evaluate the physiologic response to capture/captivity related stress and no statistically significant differences were found between time points or birds (*P* < 0.05). A subset of birds were captured post bait application and with rodenticide (brodifacoum) bait in their crops and/or signs of bait stains around their cloaca. These birds were treated successfully with oral vitamin K during captivity and all were resighted > 3 mo post-release. A novel avian ophthalmic trematode fluke was also discovered which caused clinical disease in captive birds. To the authors knowledge this is the first successful capture and captive maintenance of a shorebird species to reduce non-target mortality during a rat eradication project. Additionally, this is the first documentation of long-term survival of an avian species post-exposure to brodifacoum.

**Key words:** Bristle-thighed curlew, brodifacoum, *Numenius tahitiensis*, rat eradication

**ACKNOWLEDGMENTS**

The authors thank Kate Stadler of The Nature Conservancy for her generous support of the researchers on this project.

**LITERATURE CITED**


INFLUENCE OF PERIOD OF COLLECTION ON THE LONGEVITY OF SPERM CELLS RETRIEVED BY POST MORTEM EPIDIDYMAL ASPIRATION IN WILD BOVIDS IN ZOO CONDITIONS: EXAMPLE OF TWO SEASONED SPECIES, THE SOUTHERN LECHWE (Kobus leche) AND SPRINGBOK (Antidorcas marsupialis)

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Abstract

The conservation of endangered wildlife species depends on the development of assisted reproductive technologies and has been focusing on epididymal sperm conservation for several years. Epididymides from sexually mature Southern lechwes (Kobus leche, n = 15 individuals) and springboks (Antidorcas marsupialis, n = 11 individuals) kept in captivity at the Réserve Africaine de Sigean (France) were collected soon after death and stored at +4°C. Epididymal sperm collection was performed using a 25-ga needle mounted on a 1-ml syringe previously filled with 0.5 ml of a sterile isotonic liquid, and by catheterizing the epididymal duct in the cauda epididymis, as previously described. Sperm motility, viability, and morphology were regularly examined at different time intervals. Individual motility was assessed subjectively by light microscopy at 100x magnification on at least five fields, with a minimum of 200 spermatozoa per examination, previously gradually warmed to 37°C. Morphology was evaluated under optic light microscopy at a 400x magnification, on at least five fields, with a minimum of 200 sperm per examination; the morphologic differences found were grouped as follows: normal spermatozoa, spermatozoa with a head abnormality, with an abnormal flagellum, tailless spermatozoa, sperm with a cytoplasmic droplet (proximal or distal). Epididymal sperm vitality was approached by assessing the percentage of live and dead gametes using an eosin-nigrosin staining.

In this managed collection, Southern lechwes and springboks are highly seasoned with respectively 58% and 87% of births taking place in a 4-mo period (respectively, April to July, and March to June). Sperm cell parameters were then compared between reproductive and non-reproductive periods.

Considering the peaks of births, and the length of gestation in these two species, reproductive season was considered from August to November in Southern lechwes, and from September to December in springboks. To compare the characteristics of epididymal sperm between reproductive and non reproductive seasons, a trend line, regression curve type, was obtained from the data collected, determining all the following parameters: mean expected longevity, mean expected vitality at death, mean expected motility at death, mean expected immobility of all sperm cells, mean expected percentage of normal morphology, mean decay in vitality over time, and mean decay of motility over time. There were no statistically significant differences (Chi square test, $P > 0.05$) for these parameters between reproductive and non reproductive periods in Southern lechwes and springboks, leading to the following conclusion: there is no statistically significant difference in the quality and longevity of sperm cells retrieved by post mortem epididymal aspiration in these two species, in the conditions of this study. As a result, this technique may be used year round for assisted reproduction technologies of these two species.
In a previous study conducted on wild bovids in the same conditions, no statistically significant difference was shown in the decrease in total sperm motility and vitality over time between two seasons: autumn/ winter, and spring/ summer; nevertheless, this work was conducted on several species, seasoned or not.4 The influence of season on sperm quality has been studied in Cervidae; motility and sperm without morphologic abnormality are maximal during the breeding season.1,2,5 Ghosh and Fischer found that most samples collected on fallow deers (Dama dama) by electro-ejaculation in June-July are azoospermic.3 In wild Bovidae, knowledge is more limited and sometimes contradictory between publications. The diameter of the seminiferous tubules or testes, sperm count per ejaculate and sperm motility appear lower outside the breeding season in free-ranging springboks, blesboks (Damaliscus pygargus), impalas (Aepyceros melampus), greater kudus (Tragelaphus strepsiceros), blue wildebeests (Connochaetes taurinus), hartebeests (Alcelaphus caama) and African buffaloes (Syncerus caffer), but the difference is not always statistically significant.6,7

**Key words:** Antidorcas marsupialis, epididymal sperm cell, Kobus leche, seasonality, Southern lechwe, springbok

**LITERATURE CITED**


SEMEN COLLECTION IN BLACK RHINOCEROS (Diceros bicornis) VIA URETHRAL CATHETERIZATION

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Abstract

Conservation in rhinoceros is becoming increasingly dependent on assisted reproductive techniques.1,2,4,5 Assisted reproductive techniques including hormone monitoring, semen cryopreservation and artificial insemination,1,2,5 have decreased the health risks associated with transport and introduction of animals, and in other taxa, have made it possible for animals to reproduce posthumously. Electroejaculation is one method of semen collection which can provide samples for both evaluation of reproductive potential and use in assisted reproduction. Logistics of electroejaculation are considerable, partly because of the specialized equipment and personnel needed. In contrast, urethral catheterization requires less specialized equipment, can be performed opportunistically, yet provides a sufficient sample to evaluate concentration, motility, viability and morphology.3 It is also possible to freeze a sample of semen obtained with this technique, albeit the sample is significantly smaller than with electroejaculation. Samples were successfully obtained from a black rhinoceros (Diceros bicornis) repeatedly anesthetized with an etorphine-ketamine-azaperone combination. A sterile 5Fr bullet tip catheter (Adept Vet LLC, Michigan, USA), with a small amount of non-spermicidal gel applied to the tip, was passed retrograde through the urethra to the prostate (~ 100-110cm), as confirmed by rectal ultrasound. Once in the area of the prostatic urethra, 1ml of negative pressure was applied, then the catheter was rotated without negative pressure, and slight negative pressure was then re-applied. The catheter was removed without negative pressure. The semen sample was placed in a conical vial, evaluated and cryopreserved as described.4 Except for volume and concentration, semen characteristics were comparable to those obtained via electroejaculation.

Key words: Assisted reproduction, conservation, cryopreservation, Diceros bicornis, semen collection

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LITERATURE CITED


CHEMICAL IMMOBILIZATION OF FREE-RANGING AND CAPTIVE SUNDA CLOUDED LEOPARDS (*Neofelis diardi*) WITH TWO COMBINATIONS: MEDETOMIDINE-KETAMINE AND TILETAMINE-ZOLAZEPAM

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Abstract

The Sunda clouded leopard (*Neofelis diardi*) is an elusive felid found only on the islands of Borneo and Sumatra. Considered one of the least known felids in the world, no information is available regarding the veterinary management of this species, either in or ex situ. The Bornean Wild Cats Veterinary Project gave veterinary assistance for the capture of free-ranging Sunda clouded leopards and performed physical examinations of captive individuals from different facilities in Malaysia and Indonesia. This study provided the first opportunity to investigate the responses of this species to immobilization protocols both in situ and ex situ.

Medetomidine (Dorbene®, 39-54 µg/kg) and ketamine (Imalgene 1000®, 3-4.39 mg/kg) were administered i.m. during six immobilizations, resulting in mean induction times of 7.5 ± 3.3 min. After a mean anesthesia time of 66 ± 14.9 min, 0.2 mg/kg of atipamezol (Alzane®) was injected i.m., observing effects of the reversal in 11.2 ± 1.4 min. Tiletamine-Zolazepam (Zoletil 100®, 6.8-10.8 mg/kg) was administered on seven occasions. Data were analyzed using the non-parametric statistic test Mann Whitney U test. Induction times observed with this combination were shorter (5.7 ± 3 min; \( P < 0.05 \)) and anesthesia and recovery times were statistically longer (347 ± 162.9 min and 30.3 ± 5.4 min respectively; \( P < 0.05 \)). Respiratory rate, heart rate, body temperature and partial saturation of arterial oxygenation (Nellcor®) were measured during the immobilizations.

Both combinations resulted in safe and reliable immobilizations, although given the favorable anesthesia and recovery times of medetomidine-ketamine, this combination is recommended for the procedures performed here.

aDorbene®, Pfizer, Madrid, Spain.
bImalgene 1000®, Rhone Merieux, Lyon, France.
cAlzane®, Pfizer, Madrid, Spain.
dZoletil 100®, Virbac SA, Carros, France.
cNellcor® Oximax N-65, Nellcor Inc., Pleasanton, California, USA.

**Key words:** Anesthesia, ketamine, *Neofelis diardi*, medetomidine, Sunda clouded leopard, tiletamine-zolazepam

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The authors thank Sime Darby Foundation, Robertson Foundation, Panthera, the Recanati-Kaplan family, Zoo Atlanta, Point Defiance Zoo and Aquarium, Houston Zoo, The Rufford Foundation and Idea Wild for supporting our research on Sunda clouded leopards in Sabah.

**LITERATURE CITED**

DIATOMACEOUS EARTH AS AN ADJUNCT TO CONTROL INTESTINAL PARASITES IN BARBARY SHEEP (*Ammotragus lervia*)

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**Abstract**

Haemonchosis is a common parasitic disease causing significant morbidity and mortality in ruminants. Antiparasitic drugs have been employed to control *Haemonchus contortus* and *H. placei* infections but parasite resistance to anthelmintics remains a significant concern. Alternative strategies to control abomasal parasites have been proposed and include using copper oxide wire particles (COWP) and feeding tannin-rich forage such as sericea lespedeza. Diatomaceous earth (DE) can be an effective treatment to control intestinal parasites in free-range layer hens. However, there is a lack of scientific evidence to support its use in ruminants. DE is the fossilized remains of diatom shells ground into a fine mineral-rich dust. The abrasive properties of this dust are thought to traumatize the cuticle of invertebrates leading to their dehydration and death. An advantage of DE over COWP is that DE should be effective against parasites throughout the gastrointestinal tract. COWP are only effective against abomasal worms. A 16-day pilot study was initiated during which Sudan Barbary sheep (*Ammotragus lervia*, n = 16) were fed DE to assess effectiveness in reducing fecal egg counts. One pound of DE was mixed with 40 pounds of a pelleted ration using Karo syrup as a binder and fed as lib. Blood and fecal samples were obtained pre- and post-treatment. Nine out of the 16 individuals showed a lower egg count post-treatment. A comparative study was done using a control group to prove statistical value. Additional studies are needed to determine effective strategies for the use of DE in ruminants.

**Key words:** *Ammotragus lervia*, diatomaceous earth, *Haemonchus*, intestinal parasites, Sudan Barbary sheep

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The authors thank the San Diego Zoo Safari Park veterinarians, veterinary technicians, laboratory technicians, nutritionists, and keepers for their assistance with this project.

**LITERATURE CITED**


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INTESTINAL Encephalitozoon hellem INFECTION IN AVIARY BIRDS

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Abstract

Microsporidiosis has been sporadically documented in birds.1,2 Intestinal microsporidiosis was diagnosed in a European goldfinch (Carduelis carduelis), a lovebird (Agapornis roseicollis), and a canary (Serinus canaria) from different aviaries and concurrently affected with mycobacteriosis, macrorhabdiosis and a chlamydial-like infection of enterocytes, and poxviral glossitis, respectively. All birds presented with weakness, weight loss, and/or ruffled feathers. Enterocytes in the small intestine contained colonies of gram- and stamp-positive, oval to elliptical microorganisms measuring 2 × 1-1.5 µm and located within parasitophorous vacuoles in the apical cytoplasm that were reminiscent of microsporidia. The cloaca was also affected in the canary. The results of PCR and sequencing in all three birds were consistent with microsporidiosis due to Encephalitozoon hellem infection. Although concurrent infections were the main disease processes, microsporidiosis likely contributed to exacerbated catabolism and possibly to death. Encephalitozoonosis has been rarely reported in passerine birds.1 The occurrence of microsporidiosis with one or more viral, bacterial or fungal infections suggests underlying immunosuppression.

Key words: Carduelis carduelis, Encephalitozoon hellem, European goldfinch, fringilline birds, microsporidiosis

LITERATURE CITED


PHARMACOKINETICS OF A SINGLE DOSE OF METRONIDAZOLE IN CAPTIVE ASIAN ELEPHANTS (Elephas maximus)

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Abstract

Metronidazole is a nitroimidazole drug with bacteriocidal activity against a broad range of anaerobic bacteria.1,3 It is a recognized treatment for elephants exhibiting signs of colonic impaction, diarrhea, colic, protozoal disease, or anaerobic bacterial infection.1 The purpose of this study was to evaluate the pharmacokinetics of rectally administered metronidazole4 (15 mg/kg) in adult female Asian elephants (Elephas maximus, n = 6). Serum samples were collected from each animal at the following times: 0, 0.25, 0.5, 0.75, 1, 1.5, 2, 4, 6, 8, 12, 16, 24, 36, 48, 60, 72, 84 and 96 hr post rectal administration of metronidazole. Serum concentrations of metronidazole and its primary metabolite hydroxymetronidazole were measured via ultra performance liquid chromatography. Data were analyzed via a noncompartmental pharmacokinetic approach. Results indicated that serum levels of metronidazole were quantifiable at 0.25 hr and absent by the 96-hr time point in all elephants. The serum peak concentration (mean ± SD 13.15 ± 2.59 µg/ml) and mean area under the curve from time 0 to infinity (mean ± SD was 108.79 ± 24.77 hr * µg/ml) were higher than that reported in horses after rectal administration of metronidazole at similar doses.2,4 Concurrently, the time of maximum serum concentration (mean ± SD 1.2 ± 0.45 hr) and terminal elimination half life (harmonic mean ± pseudo-SD 7.85 ± 0.93 hr) were longer when compared to equine reports.2,4 Rectal administration of metronidazole was well tolerated and rapidly absorbed in Asian elephants. Dosing recommendations will depend on the mean inhibitory concentration of metronidazole for each pathogen.

4Metronidazole, Watson Pharma, Parsippany, NJ 07054 USA.

Key words: Asian elephant, Elephas maximus, Metronidazole, pharmacokinetic, rectal

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LITERATURE CITED


CALCINOSIS CIRCUMSCRIPTA IN THREE JUVENILE AFRICAN LIONS (*Panthera leo*)

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Abstract

Three juvenile, genetically related African lions (*Panthera leo*) were evaluated for discrete dome-shaped subcutaneous masses present over the proximal metatarsus. The lesions measured 4-8 cm diameter, were fluctuant to firm, non-ulcerated, and attached to underlying structures. On radiographic evaluation, the lesions were characterized by well-circumscribed punctate mineralizations in the soft tissue lateral to the proximal fifth metatarsus with no evidence of bony involvement. On cut surface, the lesions consisted of numerous loculi containing 2-5 mm, white, round to ovoid firm structures interspersed with fibrous tissue and pockets of serosanguinous fluid. Hematology, serum biochemistry, baseline cortisol, serum thyroid screening (including total thyroxine, total triiodothyronine, free thyroxine, and free triiodothyronine), and serum vitamin D panels (including parathyroid hormone, ionized calcium, and 25-hydroxyvitamin D) were unremarkable. Aerobic culture of the lesions revealed no growth. Histopathologic evaluation of the lesions was consistent with calcinosis circumscripta with fibroplasia and associated granulomatous inflammation. Calcinosis circumscripta is an uncommon syndrome of the ectopic deposition of calcium salts in soft tissue structures.\(^1\) In veterinary medicine, these lesions occur most commonly on the footpads of the hind feet or under the tongue of large breed dogs less than 2 yr of age.\(^1\) Etiology is poorly understood, though repetitive trauma, insect bites, chronic renal failure, hereditary, and iatrogenic (especially excessive dietary vitamin D or calcium supplementation and vaccinations) causes have been implicated.\(^1\) To the authors’ knowledge, this is the first report of calcinosis circumscripta in a lion.

**Key words:** Calcinosis circumscripta, lion, *Panthera leo*, skin

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The authors thank the animal care staff at the National Zoological Park for their diligent work on this project and their unrelenting care for the lions in this study.

LITERATURE CITED

THE GASTROINTESTINAL MICROBIOME: A BIOINDICATOR OF NUTRITIONAL STATUS IN POPULATIONS OF WILD NORTH AMERICAN MOOSE (Alces alces)

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Abstract

North American moose (Alces alces) are experiencing dramatic population declines in the southern portions of their range in the United States. Recent surveys of northeast Minnesota suggest a 52% population decline from 2006 to present. Researchers have suggested the declines in Minnesota’s moose are health-related, including diseases, parasites, and undernutrition. Moose in captivity are also experiencing nutritional problems including weight loss, gastritis, and diarrhea. Despite the vital role the rumen microbial community plays in host nutrition, few studies have examined microbial colonization along the entire gastrointestinal tract (GIT) in these sensitive populations. To characterize the microbiomes of wild Minnesota moose, we opportunistically collected samples (rumen, reticulum, omasum, abomasum, small intestine, colon, feces) from each of 12 moose that died in 2014, four of which were cachectic. The microbial community membership and diversity was analyzed with Illumina amplicon sequencing of the V4 region of the 16S rRNA gene. These samples were compared to the entire GIT microbiome from three Columbus Zoo moose calves experiencing gastritis and diarrhea prior to death. Our preliminary data suggest that the rumen microbiome of both wild and captive moose in poor nutritional condition is distinct from that of healthy moose in a normal weight range. The microbial community colonizing the rumen tissue of both wild and captive cachectic moose from different regions share the dominance of a single bacterial taxon (Neisseriales). This taxon is found in low proportions in the healthy moose rumen, and may represent a microbial bioindicator for assessing nutritional status of wild and captive moose.

**Key words:** Alces alces, microbiome, North American moose, nutrition, rumen
RADIOANATOMY OF THE GREEN TURTLE (Chelonia mydas)

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Abstract

Injured or diseased marine turtles are frequently presented for evaluation and treatment. Diagnosis and treatment of injury and disease in marine turtles present unique challenges. Digital radiology is a useful diagnostic tool in marine turtle medicine. It is generally readily available and provides high quality images that can be viewed almost instantly. Interpretation of images however can be difficult. The unique skeletal structures of the carapace and plastron create multiple areas of superimposition, obscuring other skeletal and soft tissue structures. Apart from air filled structures within the coelom, lack of contrast makes distinction of individual viscera difficult.

Radiology requires the recognition and description of abnormal findings and the interpretation of these findings. In order to recognise abnormalities, knowledge of normal radioanatomy is required. One option for increasing confidence in distinguishing normal from abnormal is to consult reference material on normal radioanatomy. The aim of this study was to produce a guide to normal radioanatomy of the green turtle (Chelonia mydas), aiding localisation of coelomic viscera, and defining appendicular and axial skeletal structures. The study used archived digital radiographs of wild green turtles at Taronga Zoo and computed tomography (CT) scans of two green turtles at Sydney University Diagnostic Imaging Department. Illustrated anatomic overlays were produced using these radiographs and CT images, together with contrast studies, anatomic references and necropsy specimen photographs. Digital radiographs were imported into design software (Adobe Illustrator) and used to produce 13 illustrated overlays. DICOM software (OsiriX) was used to produce 12 rendered CT images. This guide will provide a valuable resource for interpretation of radiographs of green turtles with potential extrapolation to other marine turtle species.

Key words: Chelonia mydas, green turtle, guide, illustrated overlay, radioanatomy, radiology
PITUITARY-DEPENDENT HYPERADRENOCORTICISM IN A GOLDEN LION TAMARIN (Leontopithecus rosalia)

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Abstract

There is a scarcity of information regarding endocrine disease in New World primates (NWP). While diabetes mellitus has been described,1 there is little other published information about endocrinopathies in NWP.1 Hyperadrenocorticism (Cushing’s Disease) is a syndrome of persistent inappropriate hypercortisolemia which can be caused by pituitary overproduction of adrenocorticotropic hormone, functional adrenocortical neoplasms and iatrogenic steroid administration. Although Cushing’s Disease is one of the most common endocrinopathies in domestic dogs,2 this syndrome has not been reported in NWP. A 15-yr-old, intact, female golden lion tamarin (Leontopithecus rosalia) with a history of cholelithiasis was evaluated for slowly progressive bilaterally symmetric alopecia and weight loss of 3-yr duration. Basal serum cortisol concentration and results from a low-dose dexamethasone suppression test were greater than the upper detectable limit of the assay. Abdominal ultrasonographic examination identified bilateral adrenomegaly. Computed tomography exam pre and post contrast was performed and a 0.5 cm, slightly dome-shaped, strongly contrast enhancing mass arising from the pituitary fossa, consistent with a pituitary macroadenoma, was seen. Due to this animal’s advanced age and small size, medical management was elected rather than surgery or radiation therapy. Treatment with ketoconazole was initiated with monthly monitoring of response to therapy. This is the first report of spontaneous hyperadrenocorticism secondary to pituitary neoplasia in a NWP. Advanced imaging was integral to confirming the presence of bilateral adrenal hyperplasia and pituitary enlargement as pituitary function tests proved inconclusive.

Key words: Hyperadrenocortisism, New World primate, pituitary neoplasia

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We thank Brookfield Zoo’s animal care and veterinary technician staff for their assistance with this case. We especially thank the primate keepers for their contributions and all their efforts to provide for this animal.

LITERATURE CITED


ADVANCES IN ASSISTED REPRODUCTION FOR POPULATION MANAGEMENT AND CONSERVATION OF SMALL-SIZED FELIDS

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Abstract

The Association of Zoos and Aquariums (AZA) maintains 18 felid species within North American zoological parks; of these, only three large cat species (lion, Panthera leo; tiger, Panthera tigris; jaguar, Panthera onca) are considered sustainable at 90% genetic diversity for the next 100 yr. The remaining cat populations, including all ten small-sized felid species, are projected to decline over time without improved breeding success and founder representation. For five priority small cat species (ocelot, Leopardus pardalis; fishing cat, Prionailurus viverrinus; sand cat, Felis margarita; black-footed cat, Felis nigripes; Pallas’ cat, Otocolobus manul), recent advances in assisted reproductive technologies are providing Species Survival Plan (SSP) coordinators with new tools to improve genetic and demographic sustainability. Over the past 5 yr, reproductive research studies have led to substantial improvements in semen cryopreservation, ovarian synchronization, and artificial insemination methods in felids. 1-6 In partnership with the respective SSP coordinators and in collaboration with SSP participant zoos, reproductive scientists have begun applying these new findings to achieve three primary objectives: 1) collection and cryopreservation of semen from the most genetically valuable males for each species, 2) propagation of recommended (but non-breeding) pairings using fixed-time laparoscopic oviductal artificial insemination (LO-AI), and 3) production of offspring using LO-AI with frozen semen from new founders and underrepresented males. The ultimate goal of this ongoing project, funded by the Institute of Museum and Library Services (IMLS), is to improve the sustainability and management of small felid species while demonstrating the applied value of assisted reproduction, as an adjunct to natural breeding, for endangered species conservation.

Key words: Artificial insemination, assisted reproduction, felids, ovarian synchronization, semen cryopreservation

ACKNOWLEDGMENTS

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LITERATURE CITED


ESTROUS SYNCHRONIZATION IN THE PERSIAN ONAGER (*Equus hemionus onager*)

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Abstract

The Persian onager (*Equus hemionus onager*) has experienced significant population declines over the past century due to poaching, habitat destruction and fragmentation, and resource competition.¹ Artificial insemination (AI) may be particularly useful in this species as a means of introducing genetic material from captive bred individuals to small, isolated wild populations that lack movement corridors to achieve such an exchange. The first successful AI in captive-bred Persian onagers was performed in 2013, at the Wilds in Southeast Ohio, USA, and utilized urine hormone analyses and regular ultrasound examinations.² A method for estrous synchronization in this species would alleviate the need for daily handling and injections and may provide a more feasible approach to AI. This study tested long-acting, controlled-release preparations of estradiol and progesterone, followed by a single injection of prostaglandin in six adult female Persian onagers to determine whether ovulation would occur within a narrow window. Means and standard deviations were determined for the lengths of follicular and luteal phases, follicle sizes, and time to ovulation. All six onagers ovulated between days 18 and 22, with three onagers ovulating on day 19, as determined by the presence of a corpus luteum visualized during transrectal ultrasound. This is an apparently safe and effective method for the synchronization of estrous in the Persian onager and may be used to develop a timed AI protocol for use at institutions that do not have specialized handling facilities to enable regular transrectal ultrasound for following follicular development.

**Key words:** *Equus hemionus onager*, estradiol, ovulation, Persian onager, progesterone, reproduction

ACKNOWLEDGMENTS

Cleveland Zoological Society generously provided funding for this project, with in-kind support from the Wilds and Cleveland Metroparks Zoo.

LITERATURE CITED


DIAGNOSIS OF SALMON POISONING DISEASE IN AN AFRICAN LION (Panthera leo krugeri)

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Abstract

Salmon poisoning disease (SPD) is a neorickettsial disease most commonly affecting canids and seen almost exclusively in the Pacific Northwest.1,3,4 Resulting in severe gastrointestinal signs, this disease is often fatal if left untreated.1-3 SPD results from the consumption of raw salmonids carrying the fluke intermediate host infected with Neorickettsia helminthoeca.1,3 A 4-yr-old, female African lion (Panthera leo krugeri) at Wildlife Safari was diagnosed with SPD after accidental exposure to raw salmon. Clinical signs presented ten days after initial exposure, and included progressive lethargy, anorexia, and vomiting. Hematology and serum biochemistry testing revealed a neutrophilia and mild changes in serum electrolyte concentrations. Fecal sedimentation revealed a large number of fluke ova. Empirical treatment for SPD was initiated immediately, and included aggressive fluid therapy, parenteral oxytetracycline (Vetrimycin™ 200, VetOne, MWI., Boise, ID 83705 USA), and subcutaneous praziquantel (Praziquatel, TEVA Animal Health I nc, St Joseph, MO 64503). Two separate immobilizations over 7 days were required to maintain hydration and achieve clinical improvement. Once appetite returned, doxycycline (Doxycycline, PAR Pharmaceutical Co. Inc., Spring Valley, NY 10977 USA) was administered by mouth for an additional 7 days. Complete clinical resolution occurred within 14 days of initiating therapy. Neorickettsia helminthoeca was detected in the lion’s feces using real-time PCR. This is the first reported case of SPD in a felid species (domestic or wildlife). This case illustrates the importance of awareness in all aspects of enrichment, and suggests considering SPD as a differential based on history and gastrointestinal signs in any captive carnivore species.

Key words: African lion, Neorickettsia helminthoeca, Panthera leo krugeri, salmon poisoning

ACKNOWLEDGMENTS

The authors thank the Carnivore Department at Wildlife Safari for their dedication and assistance in all medical procedures and treatments.

LITERATURE CITED


TREATMENT OF RENAL ADENOCARCINOMA IN A BINTURONG (Arctictis binturong) WITH NEPHRECTOMY FOLLOWED BY ORAL CHEMOTHERAPY (TOCERANIB PHOSPHATE)

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Abstract

A 13-yr-old female binturong (Arctictis binturong) was anesthetized for examination due to a 1-wk history of decreased appetite. The animal was found to be thin, have hypercalcemia (calcium 12.2 mg/dl), and a mass present on ultrasound in the right kidney. No metastases were found. Review of records at the institution revealed that the animal’s dam and sire had both died from disseminated renal carcinoma. Renal neoplasia has been previously reported in binturongs.1,2 A nephrectomy was performed to remove the abnormal right kidney. Gross examination revealed a 2 × 3 × 3-cm firm, tan mass at the caudal pole and histopathology confirmed a renal adenocarcinoma. One week after surgery the animal’s appetite and behavior returned to normal. Two weeks later, treatment with toceranib phosphate4, a tyrosine-kinase inhibitor, was initiated. Overall, the animal tolerated the medication well, except for a 1-wk period of decreased appetite after initiation of the medication. Four months after initial diagnosis the animal’s appetite declined and the feces became loose. Metastases to the lungs were present on radiographs and the animal was humanely euthanized. Necropsy revealed disseminated adenocarcinoma throughout the lungs and remaining kidney. To the authors’ knowledge this case is the first report of the use of toceranib phosphate in an exotic species. The benefit of this oral medication was that it was a non-invasive treatment modality. Although, the treatment was minimally successful in this case, it was well tolerated by the animal with minimal side effects and likely improved its quality of life.

4Palladia, Zoetis Inc, Kalamazoo, MI 49007, USA. Dose varied between 1.4 or 2 mg/kg p.o. once on Monday, Wednesday, and Fridays.

Key words: Arctictis binturong, binturong, neoplasia, nephrectomy, renal adenocarcinoma, toceranib phosphate

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LITERATURE CITED


RETROSPECTIVE ANALYSIS OF PYOMETRA IN THIRTY-EIGHT CAPTIVE LARGE FELIDS

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Abstract

From 2003-2014, there were 38 cases of pyometra in a captive exotic felid collection of over 300 non-domestic felids, including 11 previously reported cases.1 Fisher’s exact tests were used to compare prevalence, and student’s t tests were used to compare means. The prevalence of pyometra in lions (Panthera leo; 13/30, 43.3%) was significantly greater than that in tigers (P. tigris; 21/128, 16.4%; \( P = 0.0026 \)). Only one tiger was known to have received contraception prior to developing pyometra. The average (± SD) age of the tigers at time of diagnosis (12.6 ± 2.8 yr) was significantly greater than that of lions (10.15 ± 2.38 yr; \( P = 0.0145 \)). One lion died under anesthesia for ovariohysterectomy, and one tiger was found dead secondary to pyometra. The outcome after ovariohysterectomy overall was good. Average lifespan after treatment was not significantly different between lions and tigers, with a mean of 3.57 ± 2.01 and 2.81 ± 2.10 yr, respectively (\( P = 0.49 \)). White blood cell counts were significantly greater in lions (30.2 ± 13.5 × 10^3) than in tigers (16.3 ± 7.2 × 10^3; \( P = 0.0008 \)). On histopathology, lions had a statistically significant increase in frequency of cystic endometrial hyperplasia (CEH) compared to tigers (\( P = 0.0248 \)). There was no significant difference between the frequency of lions and tigers with at least one corpus luteum present on at least one ovary (\( P = 0.4706 \)). These findings show that lions are at an increased risk for developing pyometra as compared to tigers, possibly due to increased risk of CEH development.

Key words: Cystic endometrial hyperplasia, leopard, lion, pyometra, tiger

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The authors thank the staff at Tiger Haven for their dedication to the treatment of animals under their care, and for all of the people at the University of Tennessee who contributed to the medical treatments of these animals.

LITERATURE CITED

ACUTE DISSEMINATED MYCOBACTERIOSIS IN A CAPTIVE ATLANTIC GUITARFISH (*Rhinobatos lentiginosus*)

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Abstract

An adult female captive-born Atlantic guitarfish (*Rhinobatos lentiginosus*) was found acutely moribund on exhibit and died soon after presentation. Abnormalities on necropsy were focal skin erythema on the tail, a small liver, many variably sized friable ovarian follicles, and coelomic effusion. Histologic exam revealed systemic bacterial embolization, yolk coelomitis and systemic mycobacteriosis with minimal associated inflammation and some mineralization. Bacterial culture of blood and coelomic effusion grew rapid-growing *Mycobacterium* sp. The coelomic effusion culture was further identified as *Mycobacterium chelonae* using PCR amplification and sequencing of the RNA polymerase subunit beta (rpoB) gene of isolated genomic DNA. Although common in teleosts, there have been no reports of mycobacteriosis in elasmobranchs until very recently, including a single Atlantic guitarfish case with splenic *M. chelonae* granulomas.¹⁻³ Our case was an acute process with no granulomatous disease, with embolic lesions similar to those seen in syngnathids with mycobacteriosis. Mycobacteriosis is apparently uncommon to rare in elasmobranchs.⁴ Guitarfish may have greater susceptibility to mycobacteriosis than other elasmobranchs, and acute and chronic manifestations of the disease may exist in this species.

**Key words:** Atlantic guitarfish, elasmobranch, mycobacteriosis, *Mycobacterium chelonae*, *Rhinobatos lentiginosus*

LITERATURE CITED


OVARIOHYSTERECTOMY AND MANAGEMENT OF POST-OPERATIVE INCISIONAL COMPLICATIONS IN A NORTHERN SEA OTTER (Enhydra lutris)

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Abstract

An ovariohysterectomy (OVH) was performed on an adult northern sea otter (Enhydra lutris) housed at the Seattle Aquarium (Seattle, WA, USA) due to clinical signs supporting a pyometra. A white discharge had been noted from the vulva intermittently over a span of 10 days with cytology revealing septic neutrophilic inflammation. Enlarged fluid-filled uterine horns were visualized on abdominal ultrasound. The OVH surgery was highly vascular and complicated likely due to the otter’s multiparous history. The uterine walls were thick but normal on histopathology. The incision was closed with a four-layer closure, the standard for sea otter abdominal surgeries for radio-transmitter implantation (Murray, M. pers. comm.). The sea otter recovered uneventfully from surgery. However, within 1 mo post-operatively there were signs of inflammation around the incision site that were determined histologically to be pyoderma. The animal was treated with oral antibiotics (Clavamox®, Zoetis, Florham Park, NJ 07932 USA) deemed appropriate via culture and sensitivity with minimal reduction of inflammation. The suture site became more inflamed and was resected 3 mo post-initial surgery with a two-layer closure (subcutaneous and intradermal) of Monocryl® (Ethicon, Inc., Cincinnati, OH 45242 USA). The resected incision site became inflamed in a similar manner and was successfully treated with oral prednisone. To the authors’ knowledge, this is the first report of an OVH performed in a northern sea otter and related post-operative issues. Due to the level of complications observed, the authors advise caution against use of OVH as a method for routine contraception in captive sea otters.

Key words: Enhydra lutris, ovariohysterectomy, pyometra, sea otter

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The authors thank Dr. Michael Murray of the Monterey Bay Aquarium for his support and review of this project. The authors thank the staff of the Animal Surgical Clinic of Seattle and the Seattle Aquarium for their support of this project.
CHARACTERIZING THE 25-HYDROXYVITAMIN D STATUS OF TWO POPULATIONS OF FREE-RANGING EASTERN BOX TURTLES (Terrapene carolina carolina)

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Abstract

Vitamin D is a circulating hormone that is a component of homeostatic mechanisms, including bone development, growth, neuromuscular function, reproduction, cardiovascular health, and immune function. In humans, adequate levels of vitamin D have been shown to decrease the risk of developing different conditions, including diabetes, muscular dystrophy, hypertension, and inflammatory bowel disease. Vitamin D status may be important in animals that are being affected by infectious diseases such as ranavirus and mycoplasma, since vitamin D can play a significant role in immune function. In omnivorous reptiles such as the eastern box turtle, vitamin D may be acquired through the diet, or through photobiochemical synthesis secondary to UVB radiation. This study measured vitamin D status in 60 individuals from two well-studied populations of eastern box turtles in Illinois (n = 24) and Tennessee (n = 36). Vitamin D concentrations in plasma were not significantly different between Illinois (mean: 117.5 nmol/L) and Tennessee (mean: 98.7 nmol/L) (P = 0.129) populations. Similarly, there were no differences between age class (P = 0.533) or sex (P = 0.532). There was a significant correlation between UV at the time of capture and vitamin D concentrations (R = 0.301, P = 0.030). Vitamin D was not correlated with total calcium (R = 0.018, P = 0.89) or Ca:P ratio (R = 0.025, P = 0.85). Data obtained can be used to improve the care of captive and free-ranging turtles, as well as better characterize the health of wild populations.

Key words: Box turtle, vitamin D
SPINAL OSTEOARTHRITIS IN MALE LIONS (*Panthera leo*)

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Abstract

Based on observations of clinical signs and necropsy lesions, the authors suspected an increased incidence of spinal osteoarthritis in captive, adult African lions (*Panthera leo*), compared to that seen in female lions and male tigers (*Panthera tigris*). A retrospective study of clinical observations and necropsy reports of all male and female lions, and a comparable number of male tigers fitting the inclusion criteria, was performed to investigate this observation. All animals were held in captivity, ≥ 5 yr old, and had full necropsies performed. Spinal osteoarthritis, if present, was confirmed by necropsy (n = 58) or, in one case, by ante-mortem radiographs. Nine of 18 male lions and 3/17 female lions had spinal osteoarthritis. Four of 24 male tigers had spinal osteoarthritis. Difference in the prevalence of osteoarthritis was compared using Pearson’s chi square and Fisher exact tests. Male lions had significantly more spinal osteoarthritis compared to male tigers (P = 0.041), and male lions tended to have more spinal osteoarthritis than female lions (P = 0.075). The mean age of male lions with spinal osteoarthritis was 12 yr, and affected male lions were significantly younger than male tigers (mean age = 17 yr; P = 0.03) and female lions (mean age = 19.3 yr, P = 0.006) with spinal osteoarthritis. Most of the osteoarthritis lesions in male lions included the cervical spine (n = 8), while all of the affected female lions and male tigers had lesions in the lumbar spine (n = 3 and n = 4, respectively). Cervical spine osteoarthritis should be strongly suspected in captive, middle-aged male lions showing signs such as paresis, recumbency, and ataxia.

Key words: Lion, osteoarthritis, *Panthera leo*, *Panthera tigris*, spine, tiger

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The authors thank Dr. Ann Reed for assistance with statistical analyses, and the UTCVM Department of Biomedical and Diagnostic Sciences for assistance with these cases.
YOLK EMBOLIZATION IN TWO RELATED KOMODO DRAGONS (Varanus komodoensis)

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Abstract

Two related (clutchmates) adult female Komodo dragons (Varanus komodoensis) presented with lethargy and coelomic distention during the breeding season. One died spontaneously and the other was euthanized at surgical exploration. Antemortem hematology and biochemistry profiles were within normal ISIS limits for the species.1 On gross post-mortem examination, both dragons exhibited proteinaceous hemorrhagic coelomic fluid and, bilaterally, the ovaries supported multiple necrotic-appearing and ruptured vitellogenic follicles. Multiple slugs were observed in the coelomic cavity of one dragon. Two significant histologic lesions included yolk protein material within the vasculature of many internal organs (kidney, lung, liver, spleen, intestines, adrenal glands, heart, and ovarian stroma) and severe renal mineralization of the glomerular mesangium.

Yolk coelomitis has been reported in Komodo dragons and is well described in Fiji Island banded iguanas (Brachylophus fasciatus).2,4 These two cases, while supporting some mild lesions of yolk proteins free in the coelom, had a more significant yolk embolization. Within reptilian genera, yolk embolization has been described in adult female sea turtles, all with identified evidence of trauma.3

The glomeruli appear to be one of the least common sites for renal mineralization. Vitamin D toxicity resulting in hypercalcemia is one of the better described causes; however, mineralization is generally found in additional sites such as the gastric mucosa, lungs, and major blood vessels. Further research on the pathogenesis of follicle stasis, atresia, and rupture as well as the pathophysiology of calcium metabolism in female lizards is warranted.

Key words: Komodo dragon, lizard, reproductive disease, Varanus komodoensis, yolk coelomitis, yolk embolization

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