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ZWVAT

Thailand Association of Exotic Pet Veterinarians TAEPV

ZOO, AQUARIUM AND EXOTIC ANIMAL CONFERENCE 2024

TOGETHER WE CAN!

KNOWLEDGE SHARING
FOR THE BETTER IN
ZOOLOGICAL MEDICINE

20-22 MARCH 2024

MARUAY GARDEN HOTEL
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ZOO & WILDLIFE Veterinarians Association of Thailand
SINCE 1997

Thailand Association of Exotic Pet Veterinarians TAEPV

Proceedings of

Zoo Aquarium and Exotic Animal Conference 2024

"Together we can: knowledge sharing for the better in zoological medicine"

March 20–22, 2024

Maruay garden hotel and Faculty of Veterinary Medicine, Kasetsart University, Bangkok, Thailand

Organized by

Zoo and Wildlife Veterinarians Association of Thailand, Association of Thailand Exotic Pet Veterinarians

Zoo Aquarium and Exotic Animal Conference 2024

Proceedings : Zoo Aquarium and Exotic Animal Conference:, ZAE 2024, March 20–22, 2024/Organized by Zoo and Wildlife Veterinarians Association of Thailand, Association of Thailand Exotic Pet Veterinarians; Edited by Saritvich Panyaboriban, Wanlaya Tipkantha, Kritsana Phanchinda. Bangkok: Zoo and Wildlife Veterinarians Association of Thailand, Association of Thailand Exotic Pet Veterinarians, 2024.

Editors:
Saritvich Panyaboriban
Wanlaya Tipkantha
Kritsana Phanchinda

Message from president of Zoo and Wildlife Veterinarians Association of Thailand (ZWVAT)

Dear Colleagues and Friends,

On behalf of Zoo and Wildlife Veterinarians Association of Thailand (ZWVAT), I am honored to welcome you to the "Zoo, Aquarium and Exotic Conference 2024." This year's theme, "Together We Can: Knowledge Sharing for the Better in Zoological Medicine," reflects our joint commitment of ZWVAT and ATEPV to advancing animal health and conservation through collaboration.

This conference unites wildlife and exotic pet practitioners, in a shared pursuit of excellence in zoological medicine and One Health principles. Our collective expertise will drive innovative solutions for the well-being of animals, as well as humans, and the environment.

We have the pleasure of including esteemed speakers from the United States and Thailand, who will share their invaluable knowledge and experience at this premier event. Through their thought-provoking presentations and our collective discourse, we will exchange progressive research, best practices, and insights spanning veterinary care, disease management, habitat preservation, and species reintroduction.

This convergence of global expertise will foster cross-disciplinary partnerships, unlocking new frontiers in zoological medicine. Let us embrace this opportunity to learn from one another, forge connections, and pave the way for a future where our planet's remarkable biodiversity thrives.

Together, we will make a lasting impact. I look forward to your active participation and invaluable contributions both in the conference during the day and the bonding activity during the night.

Sincerely,

Boripat Siriaroonrat
President, Zoo and Wildlife Veterinarian Association of Thailand
Co-hosting with Association of Thailand Exotic Pet Veterinarians (ATEPV)

Message from president of Association of Thailand Exotic Pet Veterinarians (ATEPV)

Dear Conference Attendees,

As the President of Association of Thailand Exotic Pet Veterinarians (ATEPV), I am honored to co-host the "Zoo, Aquarium and Exotic Conference 2024" with the Zoo and Wildlife Veterinarian Association of Thailand (ZWVAT). This year's theme, "Together We Can: Knowledge Sharing for the Better in Zoological Medicine," embodies our shared goal for the well-being and welfare of animals in the wild and in captivity.

By uniting the expertise of wildlife and exotic pet veterinarians, we create a powerful synergy of professions. Distinguished speakers from various areas of expertise will share insights spanning veterinary care and disease management. Additionally, the post-conference workshop about diagnostic techniques in rabbits will provide an opportunity for young, yet experienced, veterinarians in rabbit diagnosis to share their experiences.

This meeting presents an invaluable opportunity to forge cross-disciplinary partnerships and the sponsorships, exchange ideas, and unlock new frontiers in wildlife and exotic animal medicine. Together, we can pave the way for a future where our Thai veterinarians will grow better.

I look forward to your participation, which will shape the future of Thai veterinary professionals.

Sincerely,

Chaowaphan Yinharnmingmongkol
President, Association of Thailand Exotic Pet Veterinarians (ATEPV)

Message from chairperson Zoo Aquarium and Exotic Animal Conference 2024 (ZAE 2024) Organizing Committee

Dear all distinguished guests, speakers and participants,

On behalf of the organizing committee, it is my great pleasure to extend a warm welcome to all participants of the Zoo Aquarium and Exotic Animal Conference 2024, under the theme 'Together we can: knowledge sharing for the better in zoological medicine.' This theme reflects the incorporation of novel knowledge, technologies, and interventions into current diagnostic and therapeutic practices for wildlife, zoo, aquatic, and exotic animals.

As Chairperson, I am thrilled to see such a distinguished gathering of experts and enthusiasts in this field. This conference serves as a vital platform for the exchange of knowledge, ideas, and innovative solutions in the conservation and management of wildlife, zoo, aquarium, and exotic species.

I would like to deeply appreciate the contributions of the committees, sponsors, and honorable speakers who have worked tirelessly throughout the conference preparation period. Thank you for your participation and commitment to this important cause. I wish you all a productive and enriching conference experience.

Warm regards,

Dr. Nathavut Kanatiyanont
Chairperson, ZAE 2024 Organizing Committee

Message from chief scientific committee of ZAE 2024


Dear ZAE 2024 Attendees,

On behalf of scientific committee of the "Zoo, Aquarium and Exotic Conference 2024: Together We Can: Knowledge Sharing for the Better in Zoological Medicine" Annual Conference, I am thrilled to welcome you to this gathering of professionals from Zoo and Wildlife Veterinarians Association of Thailand and Association of Thailand Exotic Pet Veterinarians.

The scientific program for ZAE 2024 promises to be an exceptional showcase of diverse and compelling topics, ranging from foundational concepts to cutting-edge advancements in wildlife and exotic pet veterinary medicine in Thailand. Our esteemed speakers, renowned for their expertise and dedication, will present an array of insightful sessions, ensuring a comprehensive experience for all attendees.

Together, we can unlock the full potential of zoological medicine and contribute to the well-being of captive and wild animals alike.

Sincerely,

Dr.Watcharin Hinon
Dr.Wanlaya Tipkantha
Chief Scientific Committee of ZAE 2024

Zoo Aquarium and Exotic Animal Conference 2024
"Together we can: knowledge sharing for the better in zoological medicine"
ZAE 2024 Bangkok, Thailand

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Scientific program of Zoo Aquarium and Exotic Animal Conference 2024
"Together we can: knowledge sharing for the better in zoological medicine"

March 20–22, 2024
Maruay garden hotel and Faculty of Veterinary Medicine, Kasetsart University, Bangkok, Thailand

March 20, 2024

08.00-09.00	ลงทะเบียน
09.00-09.15	พิธีเปิด
09.15-09.45	Keynote speaker: "สัตวแพทย์ต้องเตรียมตัวอย่างไรในการเป็น Zoological vet?" โดย ผศ.น.สพ.ดร.สมโภชน์ วีระกุล
09.45-10.15	Keynote speaker: "Do wild animals get osteoarthritis?" โดย ศ.ดร.น.สพ.กรกฎ งานวงศ์พาณิชย์
10.15-10.30	Tea/Coffee break
	Wildlife
	Zoo/Wildlife/Marine
10.30-11.00	Invite: "Biologger: The tool for monitoring the rhythm of life " โดย สพ.ญ.ดร.นุชจรินทร์ ศงสะเสน
11.00-11.30	Invite: "pZP vaccine alternative method in elephant population management" โดย รศ.ดร.น.สพ.ฉัตรโชติ ทิตาราม
11.30-12.00	Invite: "Application of metagenomic sequencing in unusual mortality investigation of aquatic chelonians" โดย น.สพ.วีรพงษ์ เหล่าเวชประสิทธิ์
12.00-13.00	Lunch
	Case report
13.00-13.15	Oral presentation (1) : Presumed imaging diagnosis and successful treatment of hypovitaminosis A in white lion (*Panthers leo*): A case report โดย สพ.ญ.ณัฏฐณิชา เจือจันทร์
13.15-13.30	Oral presentation (2) : Fungal airsacculitis-pneumonia concurrent with avian malaria in captive Humboldt penguin โดย สพ.ญ.ณัชกานต์ ครึบกระโทก
13.30-13.45	Oral presentation (3) : Preliminary study of haloperidol effect in Asian elephants โดย นายพันธกิจ สิงหพร
13.45-14.00	Oral presentation (4) : Trocalization technique to release gas in elephant โดย น.สพ.กิตติกุล นามวงศ์พรม
	Anthropogenic affect on Wildlife/aquatic/marine health
14.15-14.35	Invite "Animal welfare in public aquarium : A new challenging issue in animal exhibition" โดย ผศ. น.สพ. ณ พัทธ์ ปัณฑุกำพล

14.35-14.55	Invite : "Microbiome and its implications in wildlife conservation" โดย ผศ.ดร.สพ.ญ.รศชงค์ บุณยฤทธิชัยกิจ
14.55-15.15	Tea/Coffee break
	Anthropogenic affect on Wildlife/aquatic/marine health
15.00-15.25	Invite: "How does marine debris affect endangered marine species?" โดย สพ.ญ.อรณี จงกลแพทย์
15.25-15.50	Invite: "Management and rehabilitation of endngered marine species impacted by oil spills: insights, challenges, and future directions" โดย สพ.ญ.พัชราภรณ์ แก้วโม่ง
15.50-16.15	Invite: "Epidemiological perspective: What could we do when rabies goes wild?" โดย น.สพ.ไพศิลป์ เล็กเจริญ
	Exotic
	Exotic & Aquatic Animals
10.30-11.30	"From shadows to clarity in exotic pet imaging: the journey of preparing and interpreting diagnostic images" โดย น.สพ.เชาวพันธ์ ยินหาญมิ่งมงคล
11.30-11.45	"Product presentation : In house veterinary diagnositc lab in exotic animal" โดย บริษัท โซเอทิส (ประเทศไทย) จำกัด
11.45-12.00	"Product presentation : Digital imaging for exotic pets" โดย บริษัท ดีเคเอสเอช (ประเทศไทย) จำกัด
12.00-13.00	Lunch
13.00-13.15	"Product presentation : ผลิตภัณฑ์สำหรับโรคผิวหนัง " โดย บริษัท เว็ทซินโนว่า จำกัด
	"Product presentation : คลิปนำเสนอหัวข้อ Hay the Oxbow way & critical care" โดย บริษัท เอ็กโซติค แอนิมัล แคร์ จำกัด
	"Product presentation : ระบบดิจิตอลเอกซเรย์" โดย บริษัท เพ็ทโตะ อาร์ อัซ จำกัด
13.15-14.00	"Exotic animal dentistry: focus on rabbit and rodent" โดย ผศ.สพ.ญ.ดร.ทักษอร ดวงอุไร
14.00-15.00	"Rabbit skull surgery: rhinostomy technique and more" โดย สพ.ญ.นวรัตน์ สุริยคุณ
15.00-15.15	Tea/Coffee break
15.15-16.00	"Update on viral diseases of psittacine in Thailand" โดย น.สพ.ชญา ทินกร
16.15-17.00	งานประชุมสมาคมสัตวแพทย์สัตว์ป่าและสวนสัตว์
18.00-19.00	Special talks: "Beyond the stethoscope: live and learn" โดย ผศ.น.สพ.ดร.สมโภชน์ วีระกุล และ น.สพ.เชาวพันธ์ ยินหาญมิ่งมงคล
18.00-22.00	งานเลี้ยงเชื่อมสัมพันธ์

March 21, 2024

08.00-08.45	ลงทะเบียน
	Wildlife
	Wildlife/ Aquatic/Marine species rescue or rehabilitation in Thailand
08.45-09.30	Invite: "Introduction to wildlife rehabilitation" โดย Dr. Victoria Hall
09.30-10.15	Invite: "Wildlife triage and emergency medicine" โดย Dr. Dana Franen-Klein
10.15-10.30	Tea/Coffee break
	Wildlife/ Aquatic/Marine species rescue or rehabilitation in Thailand
10.30-12.00	"Round table: rescue and rehabilitation, from captive to wild" โดย น.สพ.ยงชัย อุตระ, สพ.ญ.มัชฌมณ แก้วพฤหัสชัย, น.สพ.ทวีศักดิ์ อนันต์ศิริวัฒนา, สพ.ญ.วรางคณา ลังการ์พินธุ์, สพ.ญ.กิตติยากรณ์ เอี่ยมสะอาด, Dr. Victoria Hall และ Dr. Dana Franen-Klein
12.00-13.00	Lunch
	Wildlife research and conservation program in Thailand
13.00-13.30	Invite: "The challenges of wildlife health surveiliance in Thailand ways to move forward" โดย สพ.ญ.กนิษฐา ตันเชียงสาย
13.30-14.00	Invite: "Interface over sharing ecosystem: the role of free-ranging macaques in the dissemination of antimicrobial resistance *Salmonella*" โดย ผศ.สพ.ญ.ดร.สุชวัล พรสุขอารมณ์
14.00-14.30	Invite: "Malaria infected macaques in Thailand and their proteomic profile" โดย รศ.น.สพ.ดร.วีระศักดิ์ ฟุ้งเฟื่อง
14.30-14.45	Tea/Coffee break
14.45-15.15	Invite: "An investigation of the sylvatic potential of Dengue, Zika and Chikungunya virus among long-tailed macaques proximal to human populations of Thailand" โดย อ.ดร.นันธนิดา มงคล
15.15-15.45	Invite: "Molecular characteriization of *Staphylococcus aureus* complex isolated from free-ranging long-tailed macaques at Kosumpee forest park, Maha Sarakham, Thailand" โดย รศ.น.สพ.ดร.ณฐพล ภูมิพันธุ์
15.45-16.00	Oral presentation: "Thailand red-headed vulture project: reviving from extinction" โดย สพ.ญ.เสาวภางค์ สนั่นหนู
	Exotic
	Exotic & Aquatic Animals
09.00-10.00	"Hospitalization for ornamental fish" โดย น.สพ.ดร.ภุมเมศ ชุ่มชาติ

10.00-10.05 "Product presentation : กรงนก"
โดย บริษัท ศูนย์พัฒนาบุคลากรและอุปกรณ์ทางการแพทย์ จำกัด

10.05-10.10 Tea/Coffee break

10.10-10.15 "Product presentation: คลิปนำเสนออาหารสัตว์ Mazuri"
โดย ห้างหุ้นส่วนจำกัด เรปไทเพลย์กราวด์

10.15-11.15 "Tip and trick for reptile restraint: physical and chemical part with Dr.Ohm"
โดย น.สพ.รัฐนินท์ พัชรกุลวรวัฒน์

11.15-12.00 "Update to shell repair technique in tortoise and turtle"
โดย สพ.ญ.ดร.ฐนิดา เหตระกูล

12.00-13.00 Lunch

13.00-14.00 "Necropsy tips for the exotic pet practitioner"
โดย ผศ.น.สพ.ดร.สว่าง เกษแดงสกลวุฒิ

14.00-15.00 "Hormone & egg-binding in tortoises: How to deal with this issue"
โดย น.สพ.ณัฐ กายสอน

15.00-15.15 "Product presentation : คลิปนำเสนอผลิตภัณฑ์ของบริษัท"
โดย บริษัท เพอร์เฟค คอมพาเนียน กรุ๊ป จำกัด หรือ สมาร์ทฮาร์ท

"Product presentation : ผลิตภัณฑ์ทำความสะอาดแผล Vetericyn, Supplement Dermocent, ผลิตภัณฑ์เครื่องมือแพทย์"
โดย บริษัท โอ สแควร์ ดิสทริบิวชั่น จำกัด

"Product presentation: Metacam & Nexgard combo"
โดย บริษัท เบอริงเกอร์ อินเกลไฮม์ แอนิมอล เฮลท์ (ประเทศไทย) จำกัด

15.15-16.00 "Vet experience and hospitalization in Loro Parque, Spain"
โดย น.สพ.เบญจพล หล่อสัญญาลักษณ์

16.00-16.15 สรุปการประชุมสัมมนาวิชาการประจำปี

16.15-16.30 พิธีปิด

March 22, 2024

Post-conference workshop: All you need to know about diagnostic techniques in rabbit

08.15-08.30	ลงทะเบียนและพิธีเปิด
08.30-09.30	บรรยาย: Wrap-up basic radiology and ultrasonography โดย อ.น.สพ.ดร.วุฒิวงศ์ ธีระพันธ์
09.30-12.00	"บรรยาย: All you should know about rabbit's blood • Blood collection • Rabbit hematology • Rabbit blood chemistry • Blood gas analysis" โดย น.สพ.จาตุรันต์ ลือพันธุ์, สพ.ญ.จันทร์มงคล ทองคณารักษ์, สพ.ญ.ณัฐภรณ์ ประยูรทอง
12.00-13.00	Lunch
13.00-16.00	"ปฏิบัติการ: Rabbit radiography • Skull • Thorax • Abdomen" "น.สพ.อนุพงศ์ อินิจา, สพ.ญ.กนกพิชญ์ อิ่มจรูญ "ปฏิบัติการ: Rabbit ultrasonography • Abdominal focused assessment with sonography for trauma, triage, and tracking (AFAST) • Find the abdominal organs • How to diagnose liver lobe torsion" โดย สพ.ญ.กัณธิตา ปวีณสกล, น.สพ.ศิริ กรพิบูลย์พงศ์ "ปฏิบัติการ: Rabbit physical examination and blood collection • Rabbit physical examination • How to restraint • Blood collection" โดย สพ.ญ.จันทร์มงคล ทองคณารักษ์, สพ.ญ.ณัฐกรณ์ ประยูรทอง
16.00-16.30	"อภิปราย: Case discussion • Four cases discussion" โดย น.สพ.จาตุรันต์ ลือพันธุ์, น.สพ. ชญา ทินกร

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Contents

Exotic

สัตวแพทย์ต้องเตรียมตัวอย่างไร ในการเป็นหมอสารพัดสัตว์ (Zoological Vet)

สมโภชน์ วีระกุล

Zoology ความหมายคือ สัตววิทยา วิชาวิทยาศาสตร์ชีวภาพที่ศึกษาเกี่ยวกับสัตว์ทุกชนิด Zoological Veterinary Science จึงเกี่ยวข้องกับสัตว์ทุกชนิด และไม่ทิ้งศาสตร์ของสัตวแพทยศาสตร์ทุกแขนง สิ่งที่สัตวแพทย์เรียนรู้จึงไม่แตกต่างจากหลักสูตรเดิม เพียงแต่เรายังขาดการบูรณาการหลักสูตรที่ดีพอ สำหรับการศึกษาแบบเปรียบเทียบ แต่มักให้ความสำคัญกับการแบ่งชนิดสัตว์ ซึ่งไม่ใช่การบูรณาการความรู้ผ่านระบบของร่างกาย จึงเป็นความได้เปรียบของผู้ที่ศึกษาด้านสรรพสัตว์และสรรพวิชา หากมีความรู้และความเข้าใจได้กว้างขวางและลึกยิ่งขึ้น นั่นหมายถึงผู้ที่จะเป็นสัตวแพทย์ด้านนี้จะต้องเตรียมตัวในเรื่องพื้นฐานที่ดี เพื่อการต่อยอดไปสู่สารพัดสัตว์อย่างเข้าใจ ได้แก่ อนุกรมวิธาน ชีววิทยา สัตววิทยา กายวิภาค สรีรวิทยา การบังคับสัตว์ พยาธิวิทยา เธนุเวชวิทยา อายุรศาสตร์ และศัลยศาสตร์ การจัดการ พฤติกรรมสัตว์ โภชนาการ และอื่น ๆ ในสารพัดสัตว์ ทุกแขนงเกือบทุกชนิดที่เราต้องพบ ซึ่งมีความหลากหลายมากขึ้น

การเรียนนั้นยังผ่านพื้นฐานของการเรียนจากสัตว์เลี้ยงและปศุสัตว์ และเพิ่มเติมด้วยการศึกษาต่อเนื่อง การขวนขวายด้วยตนเอง การฝึกงาน จากการอ่าน และการปรึกษาผู้รู้ สิ่งที่ผู้ศึกษาได้เปรียบหากได้ทำการศึกษาจริงจังและเป็นประโยชน์ในเชิงบูรณาการข้อมูล ยกตัวอย่างเช่น ความเข้าใจระบบการทำงานของไตที่หลากหลายยิ่งขึ้น ผ่านระบบ renal portal system ในสัตว์เลื้อยคลานและสัตว์ปีก ระบบไหลเวียนเลือดที่มีการไหลผ่านของเลือดแบบ left shunt หรือ right shunt ที่พบได้ในสัตว์เลื้อยคลานและโดยเฉพาะจระเข้ อย่างไรก็ตาม การจะเป็นสัตวแพทย์ที่มีความสามารถที่ดีขึ้นนั้น ต้องมีพื้นฐานที่ดีมาก่อนเสมอ โดยพบว่าผู้เรียนจำนวนไม่น้อยมีปัญหา เช่น การประเมินอาการทางคลินิกผิดพลาด และความเข้าใจด้านพยาธิสรีรวิทยาผิดพลาด รวมทั้งผู้สอนเองก็ต้องได้รับการพัฒนาด้านความรู้หลากหลายหรือปรับหลักสูตรเพื่อการเรียนร่วมให้เหมาะสม ดังนั้น การศึกษาเพิ่มเติมอย่างต่อเนื่อง ไม่แตกต่างจากกลุ่มสัตว์เลี้ยงและปศุสัตว์ก็มีความสำคัญ

Do wild animals get osteoarthritis?

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Keywords: Cartilage degradation, Degenerative joint disease, Wildlife animals

Osteoarthritis (OA) or Degenerative Joint Disease (DJD) is one of the most common joint diseases in companion animals such as dogs and cats. However, the question remains whether wild animals suffer from this disease. Osteoarthritis cannot cause death by itself, but it causes animals to suffer from pain, difficulty in movement, and, most importantly, it cannot be cured. Moreover, the cost of treatment remains high. This disease can be categorized into 2 types: primary and secondary OA. Primary OA occurs spontaneously without a clear or definite known cause, involving natural degradation and commonly found in senior animals. Secondary OA is caused by various factors such as injury or abnormality of bones and joints. The etiology includes aging, accidents, bone and joint diseases, doctor-induced diseases, medications such as steroids and antibiotics, obesity, the amount of fat cells in the body, and other diseases such as inflammatory bowel disease or infections in the body. The pathology of the disease starts with an imbalance between the anabolic and catabolic pathways of articular cartilage and surrounding tissue, synovial membrane, or fluids. The lesions include articular cartilage degradation, subchondral bone sclerosis, osteophyte formation, synovial membrane inflammation, synovial capsule fibrosis, and watery synovial fluid. The incidence of OA in live wild animals is not well established, with more reports from remain skeletons in museums. Examples of wild animals reported to have lesions of OA include Asiatic black bears (*Ursus thibetanus*), bears (*Ursidae* spp.), bushbucks (*Tragelaphus* spp.), blackbucks (*Antilope* spp.), gazelles (*Gazella* spp.), addax (*Addax nasomaculatus*), American bison (*Bison bison*), oryxes (*Oryx gazella*), white-tailed deer (*Odocoileus virginianus*), barasingha (*Cervus davaucelli*), sika (*Cervus nippon*), wapiti (*Cervus canadensis*), dromedaries (*Camelus dromedaries*), Burchell's zebras (*Equus burchelli*), great anteaters (*Myrmecophaga tridactyla*), aardvarks (*Orycteropus afer*), African lions (*Felis leo*), cheetahs (*Acinonyx jubatus*), gray wolves (*Canis lupus*), wolverines (*Gulo gulo*), gray foxes (*Urocyon cinereoargenteus*), rhesus macaques (*Macaca mulatta*), tigers (*Panthera tigris*), lions (*Panthera leo*), leopards (*Panthera pardis*), snow leopard (*Panthera uncia*), jaguars (*Panthera onca*), chimpanzees (*Pan troglodytes schweinfurthii*; *Pan troglodytes troglodytes*), lowland gorillas (*Gorilla gorilla gorilla*), and bonobos (*Pan paniscus*), Malayan tapir (*Tapirus indicus*) and sheep (*Ovis aries*), Sported hyena (*Crocuta crocuta*), Asian elephant (*Elephas maximus*) dugongs (*Dugong dugon*), and cetaceans. There is no report about the management of OA in wild animals; however, we can adapt knowledge from domestic animals. The multimodal management of OA includes medication, environmental management, and rehabilitation. In severe cases that do not respond to multimodal management, surgery is required, such as bone excision, arthrodesis, or total joint replacement. There have been reports of alternative treatments, including cell or stem cell transplantation and platelet-rich plasma (PRP) treatment.

Bio-logger: the tool for monitoring the rhythm of life

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The interaction between an animal's internal (physiological) and external (behavioral) states shapes its response to the environment. For wildlife species, these responses have evolved over time to allow species survival in natural landscapes. However, expanding human populations are rapidly altering natural habitats, making it more challenging for wildlife to respond effectively. Understanding how an animal's internal and external states interact can provide vital information about their ability to respond, breed, and ultimately survive in these changing environmental conditions. Recent advances in bio-logging now enable the long-term collection of previously inaccessible physiological data such as heart rate (HR). The ability to longitudinally monitor HR has tremendous potential for assessing animal well-being and the sympathetic responses to environmental conditions. By integrating physiological monitoring (endocrine and heart rate) with behavioral ecology, we can apply prospective and retrospective mechanistic models to inform ex situ and in situ wildlife management. Since 2018, we have collaborated with animal managers, veterinarians, researchers in U.S, Brazil and recently Thailand to deploy more than 60 Reveal LINQTM Insertable Cardiac Monitors in six wildlife species, including the maned wolf, scimitar-horned oryx, jaguars, giant anteater, clouded leopard, and elephants. The aim of this presentation is to discuss the applications of bio-logger technology in wildlife conservation.

Porcine zona pellucida (pZP) vaccine: alternative method in elephant population management

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Keywords: porcine zona pellucida (pZP) vaccine, immunocontraception, elephant

Habitat loss, fragmentation and degradation have drawn wild Asian elephants closer to human settlements and escalated the number of human-elephant conflicts. Specific region, i.e. eastern forest complex in Thailand is experiencing elephant population growth rates of 9.8 percent during 1977-2015 (ศุภกิจ และ คณะ, 2558). Local overabundance of elephants due to habitat compression or natural growth has resulted in more reports of human-elephant conflict (van de Water and Matteson, 2018), and problem elephants have usually been managed by removal (e.g., translocation, culling). However, more effective options are needed (Desai and Riddle, 2015).

Immunocontraception can serve as a promising population management tool for elephants, because vaccines are safe, tissue-specific, and relatively easy to administer (Ahlers et al., 2012). Porcine zona-pellucida (pZP) vaccines have effectively been used to manage African elephants (*Loxodonta africana*) in small, enclosed conservation areas (Delsink et al., 2006); however, frequent booster requirements preclude their application to larger, free-ranging populations (Druce et al., 2011). Here the principle of pZP vaccine and mechanism of reproductive control in elephants is reviewed, as well as the alternative methods in elephant population management.

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Application of metagenomic sequencing in idiopathic disease investigation of aquatic chelonians

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Detection and characterization of idiopathic diseases have been significantly improved since the emergence of metagenomic sequencing technologies in early 2010. Metagenomic technology allows unbiased sequencing, which provides the advantages over the conventional assay (e.g., conventional polymerase chain reaction, viral isolation, electron microscopy, and traditional re-infection experiment [i.e. Koch's postulate]) in identifying infectious agents without prior knowledge of those agents. Metagenomic sequencing also allows the rapid and effective discovery of important agents in multiple host species, e.g., SARS-COV2 (humans and felids) and turtle fraservirus 1 (aquatic turtles), which cause high morbidity and mortality in humans, domestic animals, and wildlife. This study demonstrates an example of metagenomic application in discovery of novel viruses as a cause of idiopathic meningoencephalomyelitis in multiple aquatic chelonians and confirm the first in-situ evidence of jingchuviral as a disease causation in vertebrate species. This provides a strong support that metagenomic sequencing can effectively enlighten idiopathic diseases, particularly in wildlife population.

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Presumed imaging diagnosis and successful treatment of hypovitaminosis A in a white lion (*Panthera leo*): A case report

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Keywords: Hypovitaminosis A, white lion, radiograph, computed tomography, magnetic resonance imaging, laser therapy

Introduction

Hypovitaminosis A is a common ailment found in young lions due to nutritional deficiencies and improper care. Clinical signs of hypovitaminosis A include locomotor disturbances and neurological symptoms. Diagnosis is based on the clinical symptoms, complete blood count, blood chemistry, radiographic findings, computed tomography (CT scan), and magnetic resonance imaging (MRI). This report details the successful treatment with intense dietary and rehabilitation measures.

Case History

A 12-month-old female White lion (*Panthera leo),* weighing around 100 kg and having a body condition score (BCS) of 7/9, was brought in with complaints of depression, weakness, lateral recumbency, and constipation. The lion was owned by the clinic and had been acquired six months prior to presentation. The symptoms had started mildly but had gradually worsened over the six months leading up to the visit. For the last six months, the lion had been fed white muscle (pork and chicken) without any visceral organs and given two meals per day. During the initial clinical examination, the lion was found to have lameness in the left hindlimb and pain on palpation of the limbs. A complete blood parameter test was conducted, and the results were normal. Radiographic findings showed generalized decreased bone density with poor mineralization of the adjacent zone of provisional calcification and the animal was suspected to have metabolic bone disease (MBD).

During the neurological examination, the lion was found to have weakness, but the cranial nerve exam was normal, without any head tilt or nystagmus. The reflexes were normal in both hindlimbs and forelimbs.

To conduct further tests, the lion was anesthetized by hand injection with 3 mg (0.03 mg/kg) of medetomidine (sedator®) and 120 mg (1.2 mg/kg) of tiletamine-zolazepam (zoletil®). Following endotracheal intubation, the anesthesia was maintained with isoflurane for x-ray, brain, cervical CT scan, and brain and whole spine MRI to detect any abnormalities (figure 1).

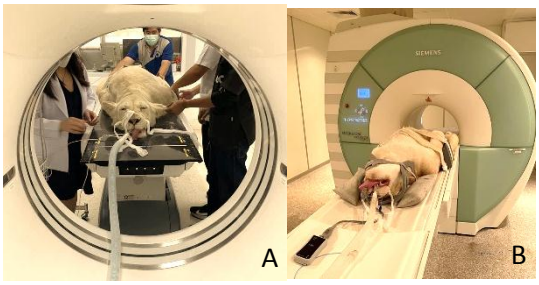

Figure 1 A) Computed tomography (CT scan) and magnetic resonance imaging (MRI) at Kasetsart University.

Results and Treatment

The CT scan and MRI results showed compression of the cerebellum from the mild thickening of the *tentorium cerebellum osseum* and occipital bone (figure 2) with no lesion of the spinal cord. The CT scan and MRI presumed imaging diagnosis of Hypovitaminosis A.

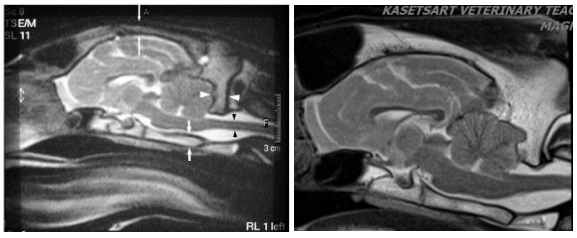

Figure 2 (A)Mid-sagittal T2W MRI of normal lion brain2. (B) Mild thickened *tentorium cerebellum osseum* and occipital bone (arrow).

The diet was changed to feeding once a day with good quality meat mixes, whole prey, bones, beef, muscle meat, and visceral organs. The diet was balanced with a calcium supplement powder every day. Additionally, a course of Vitamin A, D, and E treatment was given. The treatment involved a dose of 15000 IU/kg vitamin A, 5000 IU/kg vitamin D, and 2.5 mg/kg vitamin E, which was administered through intramuscular injection using a hand syringe technique weekly for 4 weeks.

To manage pain, intermittent use of 1 mg/kg prednisolone for 3days and omega supplement (antinol®) was utilized. Physical therapy was recommended, which involved several modalities such as laser therapy (MLS®) in the IVDD setting, point mode dose 4J/cm 2 at paravertebral muscles and spine between dorsal spinous processes, and therapeutic exercises. The use of a lure was also recommended as an appropriate motivation to encourage movement.

Discussion

In this report, we present a case of Hypovitaminosis A in a captive lion, where neurological symptoms were the most significant clinical manifestation resulting from a nutritional disorder. Our analysis shows that taking a detailed history of the animal's diet, nutrition, supplements, and clinical signs is crucial for early diagnosis. We observed that changes in mobility, play, hunting behavior, and lameness. The use of CT scans played a pivotal role in the definitive diagnosis of bone malformations, and the MRI allowed the examination of the central nervous system. In the case described, we did not perform a liver biopsy to confirm Hypovitaminosis A due to the risk of hemorrhage and the results from the CT and MRI showed bony changes with the resultant compression of the brain, correlated with the described magnetic resonance imaging findings of the disease[2]. For the treatment of this condition, we suggest pain management, multivitamin supplements, and rehabilitation, which can significantly improve the animal's clinical condition. After 26days of treatment, we observed a marked improvement in the clinical symptoms of the lion.

Acknowledgements

We would like to thank Kasetsart University Veterinary Teaching Hospital and the staff and veterinarians at Premier Pet Hospital for their support.

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A case report of pulmonary mycosis in a Humboldt penguin with avian malaria co-infection

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Keywords: Fungal infection, Avian malaria, Humboldt Penguin

Introduction

Avian mycoses are commonly found in captive penguins. Many of the fungal agents present in the environment are classified as opportunistic pathogens, which can become virulent due to various factors such as stress, immunodeficiency, and nutrition disorders. Avian malaria in penguins can lead to severe clinical symptoms and acute mortality, due to the lack of co-evolution with the pathogen.

This study presents findings on the clinical signs, radiograph readings, blood profiles, polymerase chain reaction (PCR) test results, treatment strategies, disease progression, necropsy findings, and histopathology results of a female adult Humboldt penguin, a survivor of an avian malaria outbreak at Khon Kaen zoo in June 2023, which afterward deceased due to concurrent infection of fungal airsacculitis and avian malaria.

Material and Method

A 2-year-9-month-old female Humboldt Penguin (*Spheniscus humboldti*), a survivor of the malaria outbreak in June 2023, had been under the care of the zoo veterinarians from June to August 2023. During the outbreak, the penguin did not exhibit any clinical signs and tested negative for avian malaria from PCR testing. However, the penguin received primaquine and chloroquine for 14 days as a prophylactic treatment measure.

On October 16th, 2023, the penguin began to exhibit symptoms including dyspnea, tachypnea, open-mouth breathing, anorexia, and pale mucous membrane. The veterinarians examined, diagnosed, and treated the animal. However, the penguin died on November 26th, 2023. Subsequently, a necropsy was performed to investigate the cause of death and gather additional information. Tissue samples from the lung, heart, liver, spleen, kidney, and air sac were collected and preserved at -20 degrees Celsius and in 10% formalin fixative. Blood samples and liver tissue were subjected to PCR analysis to confirm the presence of Plasmodium spp. Histopathological examination was performed on the liver, spleen, air sac, and lung using Hematoxylin and Eosin (H&E) and Periodic acid-Schiff stain (PAS).

Results and Discussions

The complete blood count (CBC) indicated mild anemia and blood chemistry results were unremarkable. Coelomic cavity radiographs revealed increased lung opacity and an obscured cardiac silhouette. The treatment included enrofloxacin, amoxicillin and clavulanic acid, itraconazole, amphotericin B nebulization, chloroquine, primaquine, bromhexine, aminophylline nebulization, metoclopramide, multivitamin, and force-feeding. However, these treatments proved ineffective. The clinical signs progressed, with the animal regurgitating immediately after force-feeding, and was frequently observed to be in sternal recumbency. Blood results showed leukocytosis and heterophilia. The coelomic cavity radiographs indicated a more pronounced nodular pattern at the cardiac area in the VD position during the late stage of the disease. The penguin died 41 days after the onset of clinical signs and postmortem examinations were performed.

Necropsy findings revealed pulmonary congestion associated with multiple white-yellowish granulomatous nodules, ranging from 0.5-1.0 cm in diameter. Thickening of air sacs was also observed, with multiple white-yellowish granulomatous nodules identified in these areas. Histopathological results suggested sepsis due to fungal airsacculitis-pneumonia concurrent with avian malaria, confirmed by positive PCR results for *Plasmodium* spp. in liver and blood samples. Notably, during the previous outbreak, the PCR result was negative. It is possible that the samples were collected during the latent period, in which the parasite

was persistent in internal organs without infecting the penguin. Schizonts presented in tissue and PCR results were positive despite Primaquine and Chloroquine treatment. This creates an obligation to monitor the penguin under treatment to assess therapy response, while further techniques are required to identify the fungal species. *Aspergillus* spp. is highly suspected due to its site of infection and prevalence.

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• Animal Health Center, Khon Kaen Zoo

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Preliminary study on haloperidol effect in Asian elephants

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Keywords: Asian elephant, Haloperidol, Long-acting tranquillizer

Tranquillizer is a group of drugs that provide calming effect and reduces responsiveness. The long-acting tranquilizer is usually used during wildlife transportation to reduce excitement. However, data regarding the use of this drug in Asian elephants is limited. Therefore, this study aimed to investigate the tranquilization effects of a long-acting tranquillizer, named Haloperidol. A crossover design study was performed in three captive Asian elephants. Each of them was assigned to three treatment groups; placebo group, low dose group (0.01 mg/kg), and high dose group (0.02 mg/kg) of Haloperidol (intramuscular injection, IM) with at least 7 days study interval. Vital signs, behaviors, and tranquilizing stage were recorded and used for further statistical analysis. The result showed no significant difference in the onset of each dosage. In addition, the elephants were starting to be tranquilized at minute 30±14.14 after injection. The peak effect of tranquilization was found at minute 90±42.42 (group 0.01 mg/kg) and at minute 120±48.99 (group 0.02 mg/kg). The duration of the tranquilization effect of the high dose group (0.02 mg.kg) was longer than the low dose group (0.01 mg/kg), which were 390±481.46 minutes and 270±14.14 minutes, respectively. Moreover, no significant difference in the vital signs between drug-given groups and placebo groups was found. In addition, this study found a concerned side effect of haloperidol in Asian elephants which was a strong stimulation of gut motility. The elephants showed signs of abdominal pain and defecated for multiple times between minute 70±14.14 to minute 283.33±23.57 (group 0.01 mg/kg) and between minute 30±0 to minute 380±101.98 (group 0.02 mg/kg). This study revealed that the long-acting tranquilizer, Haloperidol, can be used to tranquilize Asian elephants without affecting on vital signs. The tranquillized duration ranged from 30 minutes to 6 hours upon the dosage. Nevertheless, a comprehensive investigation into the mitigation of potential side effect is recommended before considering its application in the field.

Trocarization technique to release gas in Asian elephant

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Keywords: Asian elephant, Bloat, Trocarization

Bloat is a condition where elephants cannot defecate and leading to the accumulation of gas in the large intestine. The cause of bloat in elephant is generally caused by unsuitable feeding management. In some cases where the obstruction is not severe, the condition may resolve by using medical treatment. However, in severe cases where the gastrointestinal tract expands and compress on the lungs, the elephant may have difficulty breathing and eventually die.

Other animals, such as cows and horses, trocarization technique is used to release gas in the gastrointestinal tract. However, there have yet to be any reports of trocarization in elephants, which may be due to the unsuitability of the equipment and technique. In elephant hospital, National Elephant Institute, Lampang, the trocarization equipments and technique has been developed to release the gas from the Asian elephants.

Custom made trocar-canula is modified and made to suitable for the depth and strength of the elephant skin and muscle. The location of trocarization is the dorsal area between last rib and tuber coxae. Ultrasonography is recommended to use for confirming the location of the gas. Lidocaine HCl is used for localized anesthesia. Proper surgical scrub is needed to prevent bacterial contamination. Trocar-cannula is put through the layer of muscle by veterinarian. After removing trocar-cannular, the surgical wound is left open without suturing. Bandaging is used to prevent contamination. The elephant is kept inside enclosure for 5 – 7 days until the wound is closed.

Although the trocarization technique is aimed to reduce the gas accumulation, it is noted that trocarization does not solve the cause of the problem and gas may accumulate again if the obstructed feces cannot excrete. Therefore, prevention should emphasize by providing a suitable diet to prevent elephant's bloat. Furthermore, if an elephant shows any clinical signs, it is recommended to notify the veterinarian immediately to treat the condition as soon as possible.

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Animal welfare in public aquarium: A new challenging issue in animal exhibition

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Keywords: welfare, public aquarium, five freedoms

Introduction

The first public aquarium has been established in London Zoo since 1853, however, the welfare of aquatic animal has not been well-understood. Homeostasis of aquatic animal, mostly is poikilothermic animal, rely on their aquatic environment. The key to keep them alive and with healthy condition is to provide the living condition similar to/as close as their natural habitat. Many animal keepers and collectors provided a good husbandry to their animal with trial-and-error to keep them survive for a long period of time. In the past, like in terrestrial animal, good welfare of animal in captivity may evaluated by reproducibility of the particular species. Nowadays, animal welfare perspective is focusing on the individuals, thus, five freedoms have been used for animal well-being assessment. This article will discuss on the aquatic animal requirement that might be useful for manage the condition for long-term animal display.

Macroscopic and Microscopic Approaches

Animal welfare science has been developed for over 50 years. In the past, animal welfare was measured at population-level by reproductive success of animal in captivity. It is also called macroscopic approach [1]. However, this might not be applied to modern day, welfare of livestock, for example.

Five-freedom concept has been proposed to a modern animal welfare assessment. This concept focuses on individually animal instead of the whole population. It is also called microscopic approach [1]. Over the last three decades, this has slowly changed as more veterinarians have received training in aquatic animal medicine and aquarists have become more aware about the species of fish they keep in captivity. Nevertheless, for most fish species found in aquariums has no species-specific requirement available, however, knowledge and experience exchange between organization can be done easier than in the past.

Fish Welfare

There are several scientific literatures provide evidence that fish possess the required mechanisms for awareness of poor welfare, such as touch, heat, and chemical. Additionally, it has been demonstrated that fish are able to learn from and remember unpleasant events, indicating that they possess the cognitive and behavioral abilities necessary to receive different kinds of information and react correctly [2,6]. Therefore, it is an ethical responsibility of the veterinary to address any issues that may have an adverse effect on the health and welfare of fish kept in any collection for public exhibition.

The physiological variations among species must be considered when assessing a species' given environment. Welfare assessments must be customized for each individual species or distinct groups of species in an exhibit.

The significance of water quality in fish exhibitions and habitats cannot be underestimated; water composition is critical to the health and wellbeing of all fish species. To provide the ideal environmental conditions, different species and life stages may need different water quality standards. Data from their natural environment is crucial to their welfare [8].

Compatibility of the tankmate is also important. Exhibits with a geographic theme often display a varied community of different species. We need to weaken the bond between predator and prey, providing hiding places for prey species, and allowing enough room for all species to coexist peacefully with less dominating species. Fish in the same species may have social structure issue, if gender selection is feasible, it should be considered because intraspecific territorial and sexual aggressiveness can seriously disrupt behavior in a tank.

For feed management, fish species contained in captivity have unknown specific nutritional needs. As a result, feeding an edible meal that satisfies the species' daily needs for nutrition and behavior is generally advised. Maintaining a healthy fish requires balance between feeding, natural behavior, and water quality.

Designing display area should be matched with their natural behavior or habitat. Any material used to construct a fish's physical habitat should be harmless to fish or covered with a nontoxic substance.

Fish enrichment activities are a great way to add variety to the captive habitat and encourage natural behaviors that are appropriate for their species [7]. However, a species-specific approach for each species may be necessary to fully provide sufficient enrichment because of the large diversity of fish species in public displays, each having varied physiological and behavioral features as well as different natural histories. Fish conditioning and training, such as target feeding, can be used to perform specific tasks or to feed individuals only; nevertheless, it should also be seen as an enrichment activity [6]. Good designing with adequate enrichment can minimize the unwanted behavior [5].

Welfare Assessment

Practical assessment of animal welfare has four categories [2]. 1) The behavioral-based indicators are visually detected and recognizable, aberrant, maladaptive, or stereotypic behaviors. 2) Functional-based indicators are typically simple to see or measure directly in fish. The growth rate and body condition score are good examples for this category. 3) Physiological-based indicators, fish must be captured to collect suitable samples for laboratory testing, which show changes in the fish's physiological, biochemical, or genetic composition [2,4]. And 4) the finally, the environmental standard assessment.

Conclusion

Since fish and other aquatic animal such as crustaceans and echinoderms have been kept in confinement for display in a public aquarium, providing their needs based on their natural habitat is crucial to maintaining these creatures in captivity. Like other poikilothermic animal, environment plays the most important role on their health [3]. The design of the habitat, life support systems, water quality, nutrition, lighting, temperature, structures and substrates, and enrichment should all work together to create an environment that stimulates the fish and encourages behaviors unique to their species. It is possible to follow the five-freedoms concept even it is the underwater zoo.

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Microbiome and its implications in wildlife conservation

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Keywords: microbiome, wildlife, conservation

The community of microorganisms, known as the microbiota, inhabits diverse anatomical regions, including the skin, digestive system, and respiratory system in both humans and animals. This microbial assemblage consists of bacteria, archaea, viruses, fungi, and protists. Research indicates that humans host 3.3 million microbial genes, significantly surpassing the approximately 23,000 genes in the human genome. The collective genetic material of this microbial community is termed the "microbiome." The composition and structure of the microbiome are shaped by internal factors (genetics, age, immune system, stress, and disease) and external factors (diet, environment, drug use, and exposure to chemicals).

Studies have demonstrated the microbiome's importance in physiological functions, including immune system stimulation, pathogen resistance, metabolic processes, and the development of the nervous system influencing behavior. A balanced microbiome supports normal bodily functions, but any disturbance leading to an imbalance, known as dysbiosis, can result in disease or abnormalities.

In wild animals, most microbiome studies focus on the impact of external changes, such as habitat alterations, diet variations, and behavioral shifts, on its composition and structure. Investigations also compare the microbiomes of wild animals in captivity with those in their natural habitat. For example, changes in habitat due to human activities can disrupt the environment, alter food sources, induce stress, and bring animals closer to humans and pets, exposing them to unnatural environments. This can lead to changes in the microbiome, impacting health, immune system function, and pathogen prevalence. Study on red colobus monkeys revealed that those in destroyed habitats exhibited a more diverse gut microbiome and fewer plant-digesting bacteria than their counterparts in undisturbed habitats, likely due to reduced food plant variety. These findings have implications for conservation efforts, especially during translocation to new habitats.

While ex-situ conservation (is essential, limitations exist in terms of space and food, deviating from a completely natural environment. Comparative studies on the microbiomes of the gastrointestinal tract and skin between wild animals in captivity and those in the wild are conducted across various species. Results show differences in both alpha and beta diversity between captive and wild animals. Some studies report increased diversity in captivity, while others show decreased diversity. These could be influenced by many factors such as sample size, microbiome study methods, and species-specific factors like food management, environment, and antibiotic use.

Understanding the basic knowledge of the microbiome in wild animals aids in improving captive wildlife management, particularly in terms of feed management. It also helps comprehend the impacts of changing habitats. Additionally, developing prebiotic and probiotic products for disease prevention and treatment in wildlife. Thus, microbiome knowledge plays a pivotal role in ensuring the success of conservation efforts.

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How does marine debris affect endangered marine species?

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Keywords: marine species, marine debris, sea turtle, dolphin, whale, endanger

Introduction

The marine debris still be a big problem in Thailand. There are many reports about the effect of marine debris to marine species and their habitats. This debris affects to animal's life by contaminate its feed and maybe injured its body. Marine debris problem is not a problem that can solve by someone. It's a huge problem that need a collaborate from people around the world, because the oceans are connected. Your trashes from the main land can travel and affect to other oceans. However, many people still do not know about this issue and do the same habit that release a lot of garbage into the ocean. Therefore, this study shows the effect of marine debris to the endangered marine species that the Thai marine vets have to deal with it.

Materials and Methods

In this study accumulate data from the endangered marine species stranded records. Then analyze and present information to the general public. Make it easy to understand and reach the target group. To stimulate awareness and improve behavior of the majority of citizens. Just starting to reduce the waste a little bit, many people can produce tangible results.

Results and Discussion

The results of this experiment are up to you. It's done when you and people around you start to adjust your behavior, reduce waste generation. That's how it works.

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All of our endangered marine species rescue networks. You all are one of a key for our success.

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Management and rehabilitation of endangered marine species impacted by oil spills: insights, challenges, and future directions

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The occurrence of oil spills in seas and coastal areas has pervasive environmental impacts, with petroleum hydrocarbons resulting from oil leakage posing a significant threat. These hazardous substances, present in varying concentrations, adversely affect marine life and ecosystems. Oil spills can have severe impacts on marine animals like birds, sea turtles, fish, and marine mammals. Common effects include stress responses, adrenal gland function impairment, cardiotoxicity, immune system dysfunction, blood cell disruption, locomotion effects, and oxidative damage. The Department of Marine and Coastal Resources has thus monitored the status of oil spills along the coasts of the Gulf of Thailand and Andaman Sea in Thailand from 2016to .2020In 23provinces, a total of 101oil spill incidents were identified during this period. According to the latest situation, sea turtles were found to be impacted by an oil spill from August 4 to 18, 2023, in the areas of Phuket and Phang Nga provinces. A total of 17 turtles were affected, comprising 16 live sea turtles (94%) and 1 carcass (6%). Among the impacted sea turtles, 94% were juvenile turtles with an average carapace length of 15.9 centimeters. The sea turtles suffer skin and soft tissue injuries, abnormal swimming behavior, and starvation. Treatment includes cleansing, administering fluids and antibiotics, and applying mixture techniques for removing oil stains in the digestive tract. After a month, the turtles displayed positive vital signs, appetite, and behavior. The treatment was successful, and they were transferred to larger pools for more rehabilitation before being released back into the wild. Additionally, collaborative initiatives aim to develop sustainable solutions for addressing Thailand's persistent oil spill challenges.

ปัญหาการเกิดน้ำมันรั่วไหล)Oil spill) ในทะเลและชายฝั่งเป็นผลกระทบที่ส่งผลต่อสิ่งแวดล้อมอย่างแพร่หลาย โดยพบว่าสาเหตุของการรั่วไหลของน้ำมันทำให้เกิดการปนเปื้อนของสารปิโตรเลียมไฮโดรคาร์บอน)Petroleum hydrocarbons) ซึ่งบางกลุ่มที่ตกค้างมีความเป็นพิษเฉียบพลัน หรือเรื้อรังต่อสิ่งมีชีวิตที่อาศัยในระบบนิเวศทางทะเลและชายฝั่ง โดยเฉพาะอย่างยิ่งสัตวน้ำ นกทะเล และสัตว์ทะเลหายากจำพวก เต่าทะเลและสัตว์เลี้ยงลูกด้วยนมทางทะเล ซึ่งได้รับความเป็นพิษจากการถ่ายทอดในห่วงโซ่อาหารตามลำดับ ผลกระทบของสารปิโตรเลียมไฮโดรคาร์บอนส่งผลทำให้เกิดการตอบสนองต่อความเครียด การทำงานผิดปกติของต่อมหมวกไต พิษต่อหัวใจ ระบบภูมิคุ้มกันทำงานผิดปกติ การทำลายเซลล์เลือดผลกระทบต่อการเคลื่อนไหว และก่อให้เกิดความเสียหายจากการปฏิกิริยาออกซิเดชันในสัตว์แต่ละชนิด กรมทรัพยากรทางทะเลและชายฝั่งจึงได้มีการติดตามสถานภาพน้ำมันรั่วไหลบริเวณชายฝั่งอ่าวไทยและอันดามันของประเทศไทยระหว่าง พ - 2559 .ศ. 2563ใน ครั้ง 101 จังหวัด พบเหตุการณ์รั่วไหลทั้งหมด 23 โดยสถานการณ์ครั้งล่าสุดพบว่ามีเต่าทะเลที่ได้รับผลกระทบจากน้ำมันเมื่อวันที่ – 418 สิงหาคม บริเวณพื้นที่จังหวัด 2566 ภูเก็ตและพังงา จำนวนทั้งหมด17 ตัว โดยแบ่งเป็นเต่าทะเลมีชีวิตจำนวน 16 ตัว 94)% (และเป็นซากจำนวน ตัว 1)6% (94) ตัว 16 และ%ของเต่าทะเลที่ได้รับผลกระทบเป็นเต่าวัย (เซนติเมตร 15.9 เด็กที่มีความยาวกระดองเฉลี่ยเต่าทะเลได้รับบาดเจ็บบริเวณผิวหนัง มีพฤติกรรมการว่ายน้ำที่ผิดปกติ และมีภาวะขาดอาหาร หน่วยงานจึงได้ทำการการบำบัดและรักษาด้วยการทำความสะอาดบาดแผลอย่างละเอียด ให้อาหารและสารน้ำที่เหมาะสมรวมไปถึงการรักษาทางอายุรกรรม และเทคนิคการกำจัดคราบน้ำมันในทางเดินอาหาร หลังจากการฟื้นฟูเป็นรยะเวลา เดือน 1เต่าทะเลมีการตอบสนองที่ดีต่อการรักษา มีพฤติกรรมการกินอาหารและการว่ายน้ำเป็นปกติ จึงได้มีการเตรียมความพร้อมสำหรับการปล่อยกลับไปยังสิ่งแวดล้อมธรรมชาติต่อไป นอกจากนี้กรมทรัพยากรทางทะเลและชายฝั่งยังได้ร่วมมือกับหน่วยงานต่างๆ เพื่อหาแนวทางในการจัดการแก้ไขปัญหาของสถานการณ์น้ำมันรั่วไหลของประเทศไทยอย่างยั่งยืนต่อไป

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Epidemiological perspectives: What could we do when rabies goes wild?

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Keywords: Rabies, Golden jackal, Wildlife, Oral rabies vaccine, Wildlife – domestic animal interface

Introduction

Increased interaction between domestic dogs and wild carnivores could have implications for rabies transmission dynamics. In areas where the roles of wildlife in rabies circulation are unclear, such as in Thailand, understanding the dynamics of rabies transmission is crucial for effective control and prevention. Wild carnivores, such as jackals, mongooses, and civets, can become infected and potentially transmit the virus, posing threats to conservation and public health. Efforts to mitigate rabies transmission in regions where wildlife is involved require a multi-faceted approach, including vaccination campaigns targeting both domestic and wild carnivores, along with measures to reduce their interactions. This study offers epidemiological perspectives inti rabies in Thai wildlife, aiming to enhance collaborative rabies prevention and control among One Health partners.

Materials and Methods

This study employed a comprehensive methodology to assess the rabies situation in Thai wildlife. Data from Thairabies.net database and investigation reports during 2018-23, especially those involving jackals were reviewed. Complementary surveys were conducted to ascertain the presence of jackals and other wildlife with a focus on understanding interactions with villagers. Moreover, efforts were made to boost animal rabies vaccination coverage, including the distribution of oral vaccines to free-roaming dogs. Key findings were synthesized to recommend enhanced collaboration, especially within wildlife sectors, to strengthen rabies prevention and control strategies.

Results and Discussion

Rabies prevention and control in Thailand a collaborative effort between the Department of Livestock Development (DLD) and public health sectors in alignment with the Zero by 30 campaign initiated by the WHO, WOAH, and FAO. This joint effort aims to eliminate human deaths caused by dog-mediated rabies by 2030. However, a more holistic strategy involving wild animals in rabies control programs is essential for greater efficacy[1]. While uncommon, there were 3 reported instances of wildlife attacking humans and domestic animals in the community between 2019-2020. Rabid jackals (*Canis aureus*) exposed several individuals, dogs, and cattle, necessitating prompt post-exposure prophylaxis. The inability to accurately identify wildlife species in animal rabies surveillance data likely led to an underestimation of wildlife rabies prevalence. Our findings revealed instances of confirmed jackal rabies in four provinces, namely Khon Kaen, Roi Et, Nakhon Ratchasima, and Sakaeo, dating back to 2018. Although the response protocol is ready for action upon encountering a rabid animal or human bite incident, it lacks specific protocols for handling suspected rabid wild animals. Studying the genetic relationship of the virus in both domestic and wild animals serves multiple purposes: understanding virus evolution, tracing outbreak sources, and elucidating the role of wildlife in transmission dynamics[2]. Despite the provision of ORV for community dogs in the 2020 outbreak in Sakaeo, jackal rabies and related roadkill were observed again in 2023. Conducting community assessments and landscape-level surveys is vital for unraveling the intricate dynamics of rabies transmission. These efforts elucidate the ecology of interactions, including the types and locations of encounters with common wildlife species. Furthermore, studying the biology of both hosts

and the virus provides essential insights into the underlying mechanisms driving transmission. Integrating findings from these multidisciplinary approaches enables a comprehensive understanding of wildlife's role and associated risk profiles in rabies transmission, informing effective prevention and control strategies[3]. Incorporating wildlife into enhanced rabies surveillance is crucial, utilizing methods such as wildlife mortality surveillance[4], roadkill monitoring[5], and engaging citizen science initiatives. Additionally, animal bite surveillance plays a pivotal role[6,7]. These efforts aid in comprehensively understanding transmission dynamics and enable more effective interventions. They also help identify areas for targeted surveillance and guide the implementation of oral rabies vaccination in locations with high interactions between wildlife and domestic animals[5].

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Introduction to wildlife rehabilitation

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Wildlife rehabilitation is the treatment and temporary care of injured, diseased, and displaced indigenous animals, and the subsequent release of healthy animals into appropriate habitats in the wild (NWRA, 2013). Animals might enter rehabilitation for a variety of reasons- but often humans play a role. In the United States alone, it is estimated that over 500,000 animals will enter wildlife rehab facilities every year. This talk will discuss the core rehabilitation process, as animals are rescued, rehabilitated, and released, as well as look at the opportunities that wildlife rehabilitation facilities present for broader environmental and infectious disease surveillance activities to monitor ecosystem health and conservation efforts.

Wildlife triage and emergency medicine

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This 45 minute presentation provides information for veterinarians with limited experience working with wildlife on the initial admission examination and treatment of wildlife patients. Topics covered will include obtaining a history and performing a visual assessment to help direct your admission procedures, information that is unique to an admission exam of a wildlife patient, and common treatments needed within the first 24 hours. While the majority of content included in the lecture will focus on raptors and birds, the information provided is applicable to all species.

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The challenges of wildlife health surveillance in Thailand: Ways to move forward

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Keywords: Surveillance, Wildlife health, Information sharing, Challenge, Action

'Surveillance' is the systematic and continuous collection, analysis, interpretation, and timely dissemination of information related to animal health so that action can be taken (1). The key difference between surveillance and monitoring is their regularity. Surveillance is typically characterized as continuous and ongoing, whereas monitoring is more intermittent or episodic (2). Wildlife health surveillance is a valuable tool to track and monitor disease trends (3) and can be a complementary component of human and animal health surveillance (4). It provides information on continuously monitoring domestic and wild animal morbidity and mortality. This allows us to identify changes in patterns of disease occurrence over time and assist in the early detection of disease outbreaks, including emerging diseases (4). The type of surveillance applied relies on the objectives of the surveillance, the accessible data sources, and the required outcomes to facilitate decision-making (3).

Collaboration between the U.S. Geological Survey, Mahidol University Thailand-Wildlife Health Center, and the Monitoring and Surveillance Center for Zoonotic Diseases in Wildlife and Exotic Animals under the World Organisation for Animal Health (WOAH) since 2019, aims to improve wildlife health surveillance and information management through partner surveys, workshops, and training. This collaboration also promotes global expertise exchange and capacity building through the WOAH Laboratory (or Collaborating Centre) Twinning Project (5). The benefits of this project to wildlife health partners include enhancing the expertise of the wildlife health workforce in disease surveillance, conducting a comprehensive analysis of wildlife disease surveillance in Thailand, and offering recommendations for a sustainable system.

The Thailand Wildlife Health Network, led by a steering committee comprising representatives from various organizations, including governmental agencies, universities, and wildlife health cooperatives, provides guidance and resources for wildlife health efforts across Thailand. Thailand Wildlife Health Center (Thailand-WHC) serves as a coordinating office for wildlife health, facilitating the execution of wildlife health surveillance, monitoring, education, and research (6). A needs assessment conducted for the Thailand-Wildlife Health Center (Thailand-WHC) highlighted the importance of establishing a network for general wildlife disease surveillance and developing associated data and information systems as primary objectives. The implementation of a comprehensive data and information management system is a targeted goal. This system aims to enable effective actions utilizing the usefulness of surveillance, such as monitoring endemic disease trends, identifying the geographical distribution and seasonality of diseases, detecting epidemics, evaluating control measures, generating hypotheses for further research, and facilitating the planning of wildlife health surveillance efforts.

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Interface over sharing ecosystem: the role of free-ranging macaques in the dissemination of antimicrobial resistance *Salmonella*

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Keywords: Antimicrobial resistance, Community, Macaque, *Salmonella*, Thailand

Introduction

Interfering of free-ranging macaques toward human community in sharing environment is concerned to be the source of antimicrobial resistant (AMR) *Salmonella* dissemination causing public health problems.

Aims

This study was to characterize the prevalence of AMR *Salmonella* regarding to phenotypic and genotypic distribution in free-ranging long-tailed macaque *(Macaca fascicularis)* population and surrounded ecosystems across Chonburi, Thailand.

Methods

A total of 224 long-tailed macaques rectal swab samples and 60 environmental samples including pooled macaque feces, stray dog feces, feed, and soil were collected for *Salmonella* identification. The minimum inhibitory concentration (MIC) level of 14 antimicrobials were determined by broth microdilution. The confirmed *Salmonella* isolates were sent for phylogenetic analyses using 16S rRNA sequencing.

Results

The prevalence of *Salmonella* according rectal swabs was 2.23% (5/224), while the prevalence from environmental samples was 11.67% (7/60) belonged to 5 serovars including Corvallis, Weltevreden, Hvittingfoss, Uganda, and Cerro. The most frequent resistance was found in tetracycline and tigecycline followed by ampicillin, azithromycin, and sulfamethoxazole. Majority of isolates (71.43%) derived from environment were considered as multidrug resistance (MDR) which were resistant to at least 6 antimicrobials in this case. The 16S rRNA sequence-based tree revealed the closed relatedness of *Salmonella* isolates recovered from macaque and domestic animals in community.

Conclusion

The dissemination of AMR *Salmonella* could potentially occur by direct or indirect contact between human, macaques, domestic animals, and sharing environment. Therefore, public awareness of disease transmission and prevention should be promoted in community for life-long sustainability.

Malaria infected macaques in Thailand and their proteomic profile

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Keywords: Plasmodium, Malaria, Macaque, Zoonosis, Proteomic

Malaria is one of the most important infectious diseases caused by protozoa parasite which is a member of the genus *Plasmodium*. Till date, more than 250 *Plasmodium* spp. have been identified in mammals, birds, reptiles and rodents. Over 30 malaria species have been reported in non-human primates, 13 of which were found in Southeast Asia. A significant number of zoonotic malaria cases have been reported in human throughout Southeast Asia and Thailand. In this study, a total of 93 blood samples from captive and wild *Macaca fascicularis*, *Macaca leonina* and *Macaca arctoides* macaques were collected from four locations in Thailand. *Plasmodium* spp. was identified using a nested-PCR assay on the DNA extracted from these samples. Twenty-seven of the 93 (29%) samples were found to be *Plasmodium*-positive. Among these, all the wild *M. fascicularis* (100%) were infected with malaria parasite, followed by *M. arctoides* (50%), *M. leonina* (25%) and the captive *M. fascicularis* (6.35%). All 5 *Plasmodium* species were detected in the samples. *M. arctoides* as a new natural host for *P. knowlesi*, *P. inui*, *P. coatneyi* and *P. fieldi*. The proteomic expression in the serum samples of *M. arctoides* were analyzed using LC-MS/MS and bioinformatic tools. The targeted proteomic indicated that 142 out of the 9,532 total proteins were associated with organismal system, genetic information processing, environmental information processing, metabolism, cellular processes and causing human disease. Additionally, nine potential reporter proteins were identified. We indicated that the presence of macaques infected with malaria parasite, presents a potential public health risk to the local population. Proteomic has the potential to improve our understanding about the fundamental processes involved with malarial parasite, with the host response being crucial for medication and therapeutic interventions improve human health.

An investigation of the sylvatic transmission and reservoir potential of Dengue, Zika and Chikungunya viruses among long-tailed macaques proximal to human populations of Thailand

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Keywords: Seroprevalence, Dengue Virus, Chikungunya Virus, Non-Human Primate, PRNT

Zoonotic viruses, including dengue (DENV), zika (ZIKV), and chikungunya (CHIKV), have a considerable influence on public health. However, the role of monkeys as DENV, ZIKV and CHIKV reservoirs in endemic areas, notably in Thailand, needs additional investigation. This study aims to improve our understanding of how monkeys influence DENV, ZIKV, and CHIKV transmission cycles by investigating neutralizing antibodies (NAb) in both monkeys *(Macaca fascicularis)* and nearby human populations. Serum samples were collected from 349 people and 387 long-tailed macaques in three different research locations: Hua Hin, Laem Chabang, and Mueang Lopburi. According to the plaque reduction neutralization test (PRNT), 0.44% of monkeys in Laem Chabang and 0.98% in Hua Hin were positive for DENV-1 and DENV-2 antibodies, respectively. Surprisingly, 5% of monkeys in Hua Hin and 30% of monkeys in Lopburi were positive for ZIKV antibodies. In humans living in close proximity, 96.85% of people at all three study locations had NAbs against at least one DENV serotype. Moreover, more than 50% of the human population had antibodies against all four serotypes. Especially, DENV-2 showed the greatest seropositivity, with a greater frequency and antibody titer than the other serotypes in all three research locations. Approximately 17.64% of the monkeys tested positive for CHIKV antibodies at a high titer. The presence of CHIKV-neutralizing antibodies in monkeys raises the possibility of CHIKV infection and transmission among non-human primates (NHPs). This discovery gives important insights into the possible role of these primates as reservoir hosts for CHIKV. As for the human population, the seropositivity rates for CHIKV in Hua Hin, Laem Chabang, and Mueang Lopburi were found to be 33.33%, 40%, and 14.81% respectively. Interestingly, we also observed a lack of DENV-neutralizing antibodies in monkeys living in close proximity to humans. This finding may suggest that DENV has fully adapted to the urban transmission cycle, as monkeys in the area did not exhibit significant antibody responses against DENV. These results shed light on the complex dynamics of viral transmission between monkeys and humans, particularly regarding CHIKV, ZIKV and DENV.

In addition, this study also assessed the concentration of IgG against *Aedes aegypti* salivary gland extract (SGE) in both monkey and human serum samples. Notably, the highest titers of anti-SGE IgG were detected in serum samples collected from participants residing in Laem Chabang, surpassing those found in Hua Hin and Mueang Lopburi study sites. However, monkey serum samples from all three study sites displayed low levels of anti-SGE IgG titers.

These significant findings contribute to a better understanding of the intricate relationship between humans and monkeys in the transmission of DENV, ZIKV and CHIKV. Moreover, the data obtained and subsequent statistical analysis from this study can have various practical implications for tourism, NHP-human interactions, and the development of policy-driven educational programs aimed at enhancing public health in Thailand.

การศึกษาคุณสมบัติทางอณูชีววิทยาของเชื้อ *Staphylococcus aureus* Complex ที่แยกได้จากลิงแสม ณ วนอุทยานโกสัมพี จังหวัดมหาสารคาม

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Keywords: ลิงแสม, สแตฟฟิโลค็อกคัส, ออเรียส, ยีนก่อโรค, วนอุทยานโกสัมพี

Staphylococcus (S.) *aureus* Complex ทั้ง *S. aureus* ที่ดื้อต่อยา methicillin (MRSA) และ *S. aureus* ที่ไวต่อ methicillin (MSSA) เป็นแบคทีเรียก่อโรคที่ทำให้เกิดการติดเชื้อทั้งคนและสัตว์ *Staphylococcus argenteus* เป็นสายพันธุ์ใหม่ที่แยกออกมาจาก *S. aureus* complex และมีสาเหตุจากการติดเชื้อเฉียบพลันและเรื้อรังในมนุษย์ สัตว์เลี้ยง ปศุสัตว์ และสัตว์ป่า รวมไปถึงลิงแสมหางยาวซึ่งไม่ค่อยมีรายงานการศึกษาดังกล่าวในประเทศไทย การศึกษานี้มีวัตถุประสงค์เพื่อประเมินลักษณะทางโมเลกุลของเชื้อ MRSA /MSSA และสายพันธุ์ *S. argenteus* ที่แยกได้ในลิงแสมป่า)*Macaca fascicularis*) ที่อาศัยอยู่ ณ วนอุทยานโกสัมพี จังหวัดมหาสารคาม ประเทศไทย เชื้อแบคทีเรียจากตรวจสอบว่าเป็น *S. aureus* complex ทั้งหมด ไอโซเลท 21 เป็นชนิด)MRSA 14 ไอโซเลท, MSSA ไอโซเลท และ 5*S. argenteus* 2 ไอโซเลท ที่ได้จากการ (swab เยื่อบุกระพุ้งแก้มของลิงแสมจำนวน ตัว นำมาวิเคราะห์ด้วยปฏิกิริยา 17) ลูกโซ่โพลีเมอเรสPCR) เพื่อทดสอบการ carry ยีนก่อโรครุนแรง (virulence genes) หลายชนิด ได้แก่ *pvl, tst, hla, hlb clfA, spa (*x-region*), spa (*IgG bidding region*)* และ *coa* ผลการศึกษาชี้ให้เห็นว่า ยีนก่อความรุนแรงของเชื้อสแตฟฟิโลค็อกคัสที่มีการพบมากที่สุดคือ *clfA, coa* และ *spa* IgG bidding area ซึ่งเจอทั้ง 21 ไอโซเลท ((%100ของแบคทีเรียทั้งหมดที่แยกได้ นอกจากนี้ มี 12 ไอโซเลท (71.43%) ที่มียีน *hlb* ที่น่าสนใจคือแบคทีเรียที่แยกได้ทั้งหมดมียีนกลุ่ม hemolysin อย่างน้อยหนึ่งชนิด และมี 11 ไอโซเลท)52.38%) ที่มีทั้งยีน *hla* และ *hlb* การศึกษาในครั้งนี้บ่งชี้ว่าแบคทีเรียเหล่านี้มีศักยภาพในการก่อโรคที่รุนแรง ซึ่งมีลิงแสมป่าในวนอุทยานโกสัมพี เป็นสัตว์รังโรคตามธรรมชาติ ซึ่งมีความจำเป็นอย่างยิ่งในการติดตามและเฝ้าระวังเกี่ยวกับแหล่งกักเก็บเชื้อที่เป็นสัตว์ป่าเหล่านี้ เนื่องจากเชื้อเหล่านี้มีศักยภาพในการก่อโรคซึ่งอาจทำให้เกิดโรคร้ายแรงทั้งในสัตว์และในคน แนวทางการควบคุมและป้องกันเชิงรุกในการจัดการความเสี่ยงด้านสาธารณสุขและทางสัตวแพทย์จึงเป็นสิ่งจำเป็นอย่างยิ่งในการป้องกันผู้คนและสัตว์ที่อาจสัมผัสกับสัตว์ที่ติดเชื้อในพื้นที่ศึกษานี้

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Thailand red-headed vulture project: Reviving from extinction

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Introduction

The red-headed vulture (*Sarcogyps calvus*) is classified as a protected species in Thailand under the Wild Animal Conservation and Protection Act, B.E.2562 (1), and is designated as a critically endangered species on the IUCN red list (2). This medium-sized vulture plays a vital role as a scavenger and helps maintain the delicate balance of the ecosystem. They were once reported to be widespread in Asian countries but have undergone a massive decline in both number and range in recent decades.

In Thailand, the red-headed vultures were once reported is in Huai Kha Khaeng Wildlife Sanctuary. The last known group in the wild met a tragic fate in 1992, when they succumbed to poisoning while scavenging on a carcass that had been baited for hunting tigers. However, 6 individuals remain in captivity under the care of the Zoological Park Organization of Thailand and Department of National Parks, Wildlife and Plant Conservation.

The Thailand Red-headed vulture Project was established in 2016 through a collaborative effort led by The Zoological Park Organization of Thailand, in partnership with the Department of National Parks, Wildlife and Plant Conservation, Kasetsart University, and Sueb Nakasatean Foundation. This initiative marked the beginning of a dedicated mission to re-establish, protect, and conserve the red headed vulture population in Thailand.

Methods

The operational plan of this project includes a captive breeding program and reintroduction program. For the captive breeding program, we established a breeding center at Nakhon Ratchasima Zoo and paired two pairs of red-headed vultures. Additionally, we initiated intensive healthcare measures including physical examinations, blood work, blood parasite screening, X-rays, screening for important infectious disease. During the physical examination, all vultures were diagnosed with respiratory aspergillosis and was treated with itraconazole orally at a dosage of 10 mg/kg once a day for 30 days (3), with close post-treatment monitoring.

A rehabilitation center has been initiated at the Sub Fa Pa Forest Protection Unit, located within the Huai Kha Khaeng Wildlife Sanctuary for the future reintroduction of the vulture in the area. The process began with cage preparation and the selection of one pair of the red-headed vultures based on their health assessment, followed by continuous monitoring of their progress during and after rehabilitation.

Results and Discussion

Thailand Red-Headed Vulture Project stands as a beacon of hope for the revival of a critically endangered species. Through collaborative efforts and dedicated conservation strategies, significant milestones have been achieved. After pairing the vultures, we obtained 3 breeding pairs: 2 reside in the zoo and 1 in the wildlife sanctuary, showing positive signs to each other. The vultures responded positively to the aspergillosis treatment and made remarkable recovery.

We observed a promising sign when we detected an egg in the uterus in 2021, although it turned out to be infertile. However, we successfully obtained an egg in 2023, and decide to artificially incubate the egg and handle the hatching process. The egg was incubated at 36.5

to 37 °C, 60 % of humidity for 50 days, resulting in the first vulture chick hatching in Thailand after 30 years. Furthermore, we obtained the first egg at wildlife sanctuary on December 2023, which hatched after an incubation period of 54 days. The chick is thriving, displaying robust health and steady growth.

These accomplishments underscore the importance of proactive conservation measures and highlight the potential for species recovery even in the face of daunting challenges.

Acknowledgements

We would like to extend our heartfelt gratitude to the dedicated staffs of the Zoological Park Organization of Thailand and the Department of National Parks, Wildlife and Plant Conservation for their commitment and tireless efforts in caring for the red-headed vultures involved in this project. Additionally, we extend our sincere thanks to our partners for their support throughout this endeavor. Without their invaluable support and collaboration, the achievements of the Thailand Red-headed Vulture Project would not have been possible. We are deeply thankful for their contributions to the conservation of this critically endangered species.

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From shadows to clarity in exotic pet imaging: The journey of preparing and interpreting diagnostic images

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Keywords: CT Scan, Radiography, Diagnostic imaging, Exotic pet

In the field of exotic animal medicine, conventional imaging methods like radiography and ultrasound are commonly used for diagnostics. However, advanced technologies such as computed tomography (CT) and magnetic resonance imaging (MRI) are not as widely employed, despite their significant advantages. Radiography is often the initial choice, but it has limitations, particularly in cases where complex conditions like gastrointestinal obstructions need to be ruled out. CT scanners, though less common, offer superior capabilities. They work by rotating an X-ray tube around the patient, creating 360-degree images that provide better tissue differentiation. Unlike traditional radiographs, CT scans don't suffer from superimposition issues, and their 3D modeling capabilities enhance diagnostic potential. However, CT scans involve higher radiation exposure and often use iodinated contrast media for improved tissue contrast, especially in pre-radiation treatment or surgical planning. CT scans have proven highly effective in diagnosing dental abnormalities in small animals and identifying minute fractures in skeletal structures. They can complement radiography by detecting subtle changes that might be missed in standard radiographs, making them invaluable for assessing lung metastases in cancer patients and brain injuries. When abdominal ultrasound results are inconclusive, whole-body CT scans become necessary. In neurology, CT imaging is increasingly used for spinal canal and head trauma assessments due to its superior contrast and relatively short procedure duration. In summary, while conventional radiography serves as the initial diagnostic tool in exotic animal medicine, its limitations necessitate the use of additional imaging modalities such as CT scans. CT imaging provides superior tissue differentiation, eliminates superimposition issues, and allows for 3D modeling. However, it requires specialized equipment and exposes patients to increased radiation. Nonetheless, its benefits in diagnosing dental, skeletal, and soft tissue abnormalities, detecting metastases, and assessing head injuries make it a valuable addition to the diagnostic toolkit in exotic pet medicine.

Exotic animal dentistry: focus on rabbits and rodents

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Keywords: rabbit, rodent, dentistry, dental diseases, abscess

Introduction

Both rabbits and rodents have heterodont dentition with several tooth shapes of incisors, premolars, and molars. The dental formula of rabbits is 2 x (12/1, C 0/0, P 3/2, M 3/3) = 28 whereas, the dental formula of rats is 2 x (1 1/1, C 0/0, P 0/0, M 3/3) = 16. The dental formula of the guinea pig/chinchilla is: I 1/1; C 0/0; P 1/1; M 3/3 = 20. The rabbit dentition has 4 maxillary incisors as compared with 2 maxillary incisors in rodents. Two smaller maxillary incisors (peg teeth) caudal to the two large incisors in rabbits. Other difference between rabbits and rodents is that rabbit's mandibular jaw is narrower than upper maxilla. Besides, rabbits have a side-to-side chewing motion while rodents have more front-to-back motion. Large toothless gap between the last incisor and first cheek tooth of rabbits is called diastema. All rabbits and rodents have continuously growing incisors. Especially, rabbits, guinea pigs and chinchillas have open-rooted continuously growing premolars and molars. However, rats, mice, hamsters, and gerbils have molars that are closed roots (do not continuously grow). In rabbits, the large maxillary incisors grow 2.0 mm/week, while the mandibular incisors grow 2.4 mm/week. The teeth continue to grow without proper occlusive wear, leads to be malocclusion. Excessive overgrowth of maxillary incisors may cause nasolacrimal duct obstruction or penetrate into the sinuses. Furthermore, cheek teeth malocclusion may cause lacerating buccal mucosa or tongue. Traumatic malocclusions are the result of overgrowth of a tooth after the loss or fracture of teeth. The clinical signs of dental diseases in rabbits and rodents are non-specific such as low appetite and weight loss. Excess salivation is commonly found in rabbits and guinea pig/chinchilla with dental disease that result in secondary dermatitis. Ocular and nasal discharge are also found in rabbits with dental disease. Facial masses may be observed in case of the dental abscesses or bony changes of skull. Eye protrusion can be seen if there is retrobulbar abscess behind the eye. In severe cases, the animals showed systemic signs and death. Difficulty breathing caused by pseudo-odontoma is often found in some rodents such as squirrels and prairie dogs. Pseudo-odontoma affecting maxillary dentition results in obstruction of the nasal cavities and lead to dyspnea.

Dental Examination

A good oral examination is important practice for the diagnosis of dental diseases. Otoscopy can be used to examine oral cavity in case of unanesthesia but this technique cannot be seen all lesions in oral. The best oral examination is under anesthesia with the use of mouth gags and cheek pouch dilator that are placed to allow visualization of the cheek teeth. Moreover, endoscopy can be help to examine the oral cavity. Other diagnostics including radiographs and computed tomography (CT) and magnetic resonance imaging (MRI). Skull radiography with several views, including lateral, dorsoventral, oblique, and potentially rostro-caudal positions is an important technique of oral examination. The alterations of bone structure are indicated malocclusion, root teeth abscesses and pseudo-odontoma. CT and MRI are advanced imaging techniques that performed for more information of dental diseases and for surgical planning.

Dental Diseases

Incisor malocclusion: The genetic problem, mandibular prognathism is commonly resulting in incisor malocclusion. The upper incisor teeth with root elongation may compress nasolacrimal duct and cause tear duct obstruction.

Cheek teeth malocclusion: The most common dental problem in rabbits and guinea pig is

cheek teeth elongation. Cheek teeth elongation may be the result of lack of adequate wear due to malocclusion, unappropriated diets, genetic disease, periodontal disease, or metabolic bone disease. Dental spur or spike of cheek teeth malocclusion cause traumatic injury to oral cavity. Furthermore, this leads to periodontal disease and abscess formation.

Treatment

The treatment of incisor malocclusion is teeth trimming using disc or incisor extraction. Treatment of cheek teeth malocclusion is including dental spur burring, trimming of the affected teeth and tooth extraction. A diamond bur is useful for trimming on the premolars and molars. Depending on the rate of tooth growth and the degree of malocclusion, trimming may need to be performed every 3-6 weeks. Dietary changes for increasing of chewing may be helpful. Treatment of dental abscesses usually done by surgical removal and antibiotic use. Infected teeth are treated with antibiotics based on drug sensitivity results. Antibiotics are usually be given long-term in case of teeth abscesses. Dental extraction is performed in uncontrol infected teeth and in case of pseudo-odontoma. Surgery for abscess draining, marsupialization is recommended for wound dressing and local treatment.

Conclusion

Rabbit and rodent dental diseases are common problem in clinic. The understanding of normal anatomy and the dental disease, the use of diagnostic techniques and appropriate treatment are important for maintain a good quality of life. Since the continuous teeth growth makes recurrence and progression of problems.

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Rabbit skull surgery: Rhinostomy technique and more

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Upper respiratory tract disease is commonly diagnosed in domestic rabbits, specifically chronic rhinitis and particularly debilitating in this obligate nasal-breathing species. Reported causes include bacterial infection, a foreign body, dental disease and trauma. Neoplasia including adenocarcinoma of the nasal turbinate has also been reported. Bacterial infection is common with *Pasteurella multocida, Bordetella bronchiseptica, Pseudomonas spp.* and *Staphylococcus spp.* However, environmental and physiologic factors such as poor air quality, high humidity and immunosuppression can result in clinical signs of the disease. Cases of chronic rhinitis can be mild to severe. Surgical therapy requires a thorough understanding of upper respiratory anatomy of the rabbit and is an option for chronic rhinitis cases nonresponsive to medical therapy.

Signs of upper respiratory tract disease in rabbits include nasal discharge, sneezing, epiphora, dyspnea and bony deformities of the skull. Bacterial infection of the nasal passages can produce a large volume of purulent material that accumulates in nasal passages and the adjacent maxillary sinus, causing mucosal erosion, atrophy of the nasal turbinate and deformation of nasal bone. Various diagnostic modalities may be used to evaluate affected rabbits. Radiographs of the skull are difficult to interpret because of lack of anatomic detail and the interposition of overlapping tissue planes. Direct examination of the nasal passages with rhinoscopy may be performed with rigid endoscope. However, a complete examination in rabbits possibly limited by small size of nares and presence of the nasal turbinate. Currently, computed tomography (CT) of the head is preferred for evaluation of the severity of the rabbits with signs of upper respiratory tract disease, especially chronic rhinitis cases. This technique provides detailed of anatomic information, severity of the disease and beneficial in determining to treat the patient medically or surgically. CT is the most suitable for surgical planning.

Before surgery, a rabbit's respiratory function should be assessed with a thorough physical examination. Pulse oximetry and blood gas analysis could be useful to evaluate the respiratory function. In case of a suspicion of an infectious process, performing a thoracic radiograph is recommended, as bacteria in the nasal cavities can colonize secondarily lungs, and a rabbit with bronchopneumonia carries a higher risk on anesthesia. A patient that presents in respiratory distress should be stabilized under oxygen. NSAIDs and targeted antibiotics should then be initiated. Rabbits must be intubated for all nasal cavity surgeries. Indeed, during the surgery, there is a high risk that blood, pus, or saline will enter the nasopharynx and then the lungs, inducing aspiration pneumonia.

Rhinostomy is relative technique for treatment of upper respiratory disease refractory to medical therapy. Purulent material in rabbits tends to rapidly acquire semisolid consistency, which impedes spontaneous drainage and response to simple lavage. In affected patients, this material associated necrotic tissue required debridement via curettage with appropriate antimicrobial treatment as determined by result of bacterial culture and susceptibility testing of sample. The primary goal of surgical debridement is to establish patency of the nasal cavity to facilitate breathing.

The most commonly reported technique for surgical debridement is rhinostomy, dorsal approach (Fig.1 and Fig.2). With this technique, the skin is incised over the nasal bone and osteotomy is performed for direct access to the nasal cavity. This approach can be unilateral or bilateral. Debridement and lavage are then performed. The skin around the rhinostomy site is then either marsupialized to the adjacent mucosa for ongoing treatment, with subsequent healing by secondary intension or the bone flap is replaced and the surgical site is closed primarily. Commonly reported complications of this technique include repeated premature occlusion of the rhinostomy site, major postoperative hemorrhage, severe pain, delayed healing and poor cosmetic.

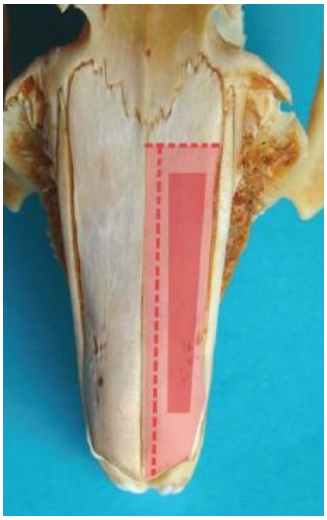

Figure 1 Unilateral rhinostomy, dorsal approach

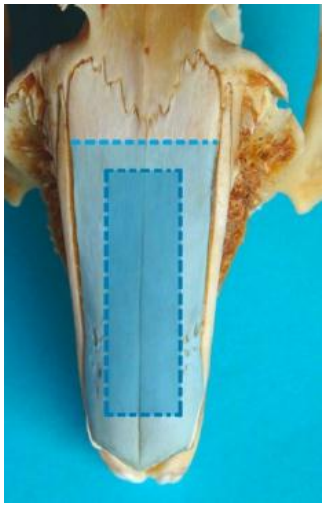

Figure 2 Bilateral rhinostomy, dorsal approach

Figure 3 Pararhinostomy, lateral approach. The yellow area shows facies cribrosa of the maxillary bone

Pararhinostomy or lateral rhinostomy is an alternative rhinostomy that can access to the maxillary recess through the facies cribrosa of the maxillary bone, porous region of the maxillary bone located aproximately halfway between the medial canthus of the eye and the ipsilateral naris (Fig.3). Finally, creation of a temporary nasal ostium by marsupialization at rhinostomy site to facilitates flushing, topical antimicrobial treatment and prevents reaccumulation of purulent material. This approach may be associated with fewer perioperative complication such as hemorrhage, premature closure of the ostium, avascular necrosis of the bony flap and poor cosmetic, and it does not require specialty instruments such as a bone burr or saw.

Until the animal is fully recovered from anesthesia, it is kept in ventral recumbency with the head elevated and the nostril positioned ventrally to allow residual saline or blood to flow out of the nasal cavity. Respiratory function needs to be closely monitored, and oxygen may be required. Surgeries of the nasal cavities usually induce significant inflammation. An NSAID should be administered, and laser therapy sessions seem to be helpful during the recovery phase.

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Update on viral disease of psittacine in Thailand

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Keywords: Psittacine, Psittacine beak and feather disease virus, Avian bornavirus, Avian polyomavirus, Pacheco's disease, Newcastle disease virus, Avian adenovirus

From since the beginning of time, viral diseases have been among the most prevalent causes of health issues in companion animals. The parrot group (Psittacine) is currently experiencing an upsurge in popularity among pet owners. However, this group has also been affected by persistent health issues resulting from viruses, including Psittacine beak and feather disease virus (PBFDV), Avian bornavirus (ABV), and Avian polyomavirus (APV). Presently, the number of parrot's owner has grown exponentially, and pet care practices have evolved significantly since the past. An increased availability of accurate diagnosis and treatment is observed. Furthermore, advancements in veterinary knowledge have altered previous understanding of numerous viral diseases, including details regarding the virus itself, its etiology, symptoms, and treatment methods. Each of the aforementioned measures not only increased the volume of diagnostics but also enhanced the effectiveness of diagnostic protocols. Some diseases whose incidence may have previously evaded diagnosis or detection become more widely known as a result. Hence, the author compiles recently published data on a variety of viral diseases affecting parrots in order to contribute novel insights that can be incorporated into treatment protocols and diagnostic procedures. Moreover, the aim of the author was to communicate their insights and experiences concerning the care and handling of parrots that were afflicted with viral infections. This article presents recently discovered information regarding the virus and frequently observed symptoms, shifting disease patterns or incidences, and diagnostic and therapeutic guidelines for patients. This study will concentrate on the following five major viral diseases: Pacheco's disease (PD), Avian paramyxovirus or Newcastle virus (NDV), Avian adenovirus (ADV), Psittacine beak and feather disease virus (PBFDV), Avian bornavirus (ABV), Avian polyomavirus (APV), and Pacheco's disease (PD).

Hospitalization for ornamental fish

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Hospitalization for ornamental fish is a critical aspect of fishkeeping, especially when dealing with sick or injured fish. Providing proper medical care in a controlled environment can significantly improve the chances of recovery and prevent the spread of diseases to other tanks inhabitants. In this essay, we'll delve into the importance of hospitalization for ornamental fish, the procedures involved, and the key considerations for successful treatment. Hospitalization for ornamental fish is akin to providing medical care for any other pet. Just as you would take a sick dog or cat to the veterinarian, fish also require specialized attention when they fall ill. However, unlike land animals, treating fish presents unique challenges due to their aquatic environment and physiology.

The first step in fish hospitalization is recognizing signs of illness or injury. Common symptoms include abnormal swimming behavior, changes in appetite, discoloration, lesions, and gasping for air. Once a problem is identified, prompt action is crucial to prevent further deterioration of the fish's health and to minimize the risk of spreading diseases within the aquarium. The hospitalization process typically involves setting up a separate tank or container specifically designated for treating the sick fish. This quarantine tank should be appropriately sized, ideally matching the conditions of the main aquarium in terms of water temperature, pH, and salinity. It's essential to ensure that the water parameters remain stable throughout the treatment period, as fluctuations can stress the fish and impede recovery.

Before transferring the sick fish to the hospital tank, it's crucial to thoroughly clean and disinfect all equipment, including nets, buckets, and any decorations or substrate. This helps prevent cross-contamination and the introduction of pathogens into the hospital environment. Once the fish is in the hospital tank, close observation is essential. Carefully monitor its behavior, appetite, and any changes in symptoms. Depending on the diagnosis, various treatments may be administered, including medication, water additives, or supportive care such as salt baths or temperature adjustments. Medication dosages should be carefully calculated and administered according to the instructions provided by a qualified aquatic veterinarian or reputable fish care resources. Overdosing can harm the fish, while underdosing may be ineffective against the targeted ailment.

In addition to medical treatment, maintaining pristine water quality is paramount for the fish's recovery. Regular water changes and diligent monitoring of ammonia, nitrite, nitrate, and pH levels are necessary to prevent stress and secondary infections. While the sick fish is undergoing treatment, it's crucial to prevent the spread of disease to other aquarium inhabitants. This often involves implementing strict quarantine measures, isolating the affected fish from the main tank, and disinfecting any equipment used in the hospitalization process.

The duration of hospitalization varies depending on the severity of the illness or injury and the response to treatment. Some fish may recover within a few days, while others may require weeks of intensive care.

In conclusion, hospitalization for ornamental fish is a vital component of responsible fishkeeping. By providing proper medical care in a controlled environment, hobbyists can improve the chances of recovery and ensure the well-being of their aquatic pets. However, successful treatment requires careful observation, accurate diagnosis, appropriate medication, and meticulous attention to water quality. By following these guidelines, fish keepers can help their sick or injured fish regain their health and vitality.

Tip and trick for reptile restraint physical & chemical part

เทคนิคการจับบังคับสัตว์เลื้อยคลานเพื่อการตรวจรักษา และการวางยาสลบสัตว์เลื้อยคลานเบื้องต้น

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ในปัจจุบันทั้งผู้เลี้ยง และสัตวแพทย์ยังคงเข้าใจว่าในกลุ่มสัตว์เลื้อยคลานเป็นสัตว์ที่ดูแลง่าย ไม่ต้องดูแลมากมาย แต่ทั้งที่จริงแล้ว สัตว์กลุ่มนี้มีความต้องการในการดูแลที่มีรายละเอียดค่อนข้างมาก ทั้งในส่วนเรื่องโภชนาการ สภาพแวดล้อมในสถานที่เลี้ยง และเรื่องอื่นๆที่จำเป็น ดังนั้นโรคในสัตว์เลื้อยคลานโดยส่วนมากแล้ว มักเกิดจากการดูแลที่ไม่เพียงพอ และการจัดสภาวะแวดล้อมในที่เลี้ยงที่ไม่เหมาะสมใน ตามแต่ชนิดของสัตว์และแต่ละช่วงอายุของสัตว์ เมื่อสัตว์ป่วยที่มีความเครียดอยู่ก่อนแล้วมารักษา การจัดการ, การจับบังคับเพื่อการตรวจวินิจฉัยและการดูแลต่อเนื่องในสถานพยาบาล จึงต้องมีรายละเอียดที่มากขึ้น เพื่อลดความเครียด และเพิ่มศักยภาพในการรักษาในสำเสร็จมากขึ้นตามไปด้วย ดังนั้นความเข้าใจในข้อมูลพื้นฐานของสัตว์เลื้อยคลาน และเทคนิคในการตรวจวินิจฉัยที่เหมาะสม จึงเป็นเรื่องที่จำเป็นเรื่องแรกที่ควรปฏิบัติ เพื่อเพิ่มโอกาสในการรักษาได้มากขึ้นเช่นกัน

Guidelines for the treatment of shell fracture in turtles

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Treating a broken shell in turtles can be difficult and take a long time, ranging from about a month to more than a year, before the turtles can be released back into the wild. Therefore, good and correct wound care can help the turtle to return to a good life. Although the condition of the broken carapace is not the same, because the broken or loose part of the shell will not be regenerated to replace the damaged part. Caring for a broken shell turtle involves several factors to focus on. The first thing to consider is the condition of the animal at that time. This is because turtles with broken shells experience a lot of pain and stress. There may also be blood loss from large wounds. Therefore, the movement should be done gently and with care that the broken carapace has minimal movement. In addition, pain relievers should be given to help relieve symptoms, fluids to replace large amounts of blood loss, and hemostatic or pressure medication for a period of time in case the bleeding has not stopped. After ensuring that the animal is stable, the severity of the wound should be determined and an x-ray should be taken to assess the damage. In case of multiple cracks and instability, the carapace should be partially fastened with surgical screws, wire or plates. Because a ruptured shell wound is important to treat as an open wound, do not close the wound permanently until you are sure that there is no infection of the wound. Initially, the wound should be cleaned once a day and covered with a temporary dressing to make it easier to wash the wound and help prevent insects from entering the wound. Continuous proper administration of antibiotics is necessary to control infection and supportive care should be done on a daily basis. After the wound has completely healed and the turtle is able to eat normally, before releasing it into the wild, it is worth considering closing the carapace where the fracture is missing. This can be done in several ways by creating a custom-fit shell prosthetic using materials like epoxy putty, fiberglass resin, or dental materials. The prosthetic is shaped to match the contours of the shell and securely attached using adhesive or screws.

Necropsy tips for the exotic pet practitioners

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Diagnosis is a crucial rule for the treatment, control, elimination, and eradication of the disease. Prompt and accurate diagnosis was the key point to success in problem handles. The accuracy of diagnosis was composed of three components (clinical history, clinical signs, and diagnostic tests). Recently, many diagnostic tools have been widely available including pathological aspects, microbiologic, immunological, toxicological, chemical, and molecular techniques. Pathological diagnosis examines the lesion involved in the disease outcome. This technique had both advantages and disadvantages and is the critical point in sampling techniques for other diagnostic techniques. Necropsy was an important technique in pathological aspects. The purpose of the necropsy was to rule out the cause of death and support clinical diagnosis. The necropsy was done as the first step for diagnosis to control disease outbreaks and zoonoses. In addition, a necropsy was used to investigate the emerging or re-emerging diseases. Generally, to gain more informative data from the necropsy, the diagnostician should consider three steps, 1) the preparation step, 2) the necropsy step, and 3) the post-necropsy step. However, there species variation has existed in exotic pets. To perform necropsy on exotic pets requires precision, care, and a deep understanding of the unique aspects of each species. These tips can help ensure thorough examinations, accurate diagnoses, and valuable contributions to veterinary medicine and research. In addition, biosafety and biosecurity aspects were the other aspects that should be more concern, especially the zoonotic potency or other infectious diseases in exotic pets.

In the preparation step: The identification of the species was the first step to gaining information including signalment, animal husbandry, and clinical history and signs. Then, differential diagnoses were documented to facilitate sampling equipment and tissue selection in the necropsy procedure. Moreover, the precaution will be a concern based on differential diagnosis, especially preparation of the personal protective equipment (PPE) such as gloves, surgical masks, eye protective gear, etc. In addition, necropsy tools, cleaning tools, and disinfectants should also be well prepared before performing a necropsy.

In the necropsy step: The selection of the location was an important point. The location should facilitate the procedure and easily clean up when finished to diminish the spreading the infectious agents. During the necropsy procedure, the diagnostician must put on proper PPE at all times to prevent potential pathogens and zoonoses. The necropsy procedure was dissected the carcass to find out the lesion existed. It had some species-specific in the necropsy procedure including fish, reptiles, amphibians, avian, and mammals. The procedure must be done in the whole body to gain more information. However, a systemic approach is based on the clinical history and signs that are flavored to emphasize the problem. During the procedure, the diagnostician should recognize the lesion in each examined organ that is characterized by the abnormal in size, shape, color, consistency, etc. When recognizing the lesion, documenting the lesion should be done by writing or photography. The collection of the tissue for further tests must be done. Intriguingly, some exotic species have unique anatomical and physiological features or limits in number. Research these aspects beforehand or consult with colleagues experienced in that particular species. Systematic documentation was also crucial to getting more knowledge from the necropsy.

In the post-necropsy step: Since the necropsy procedure was done, the collected sample should be carefully handled for further investigations. After that, disposal of the remains and disinfection of the necropsy area

must be implemented to diminish the spreading of the pathogens. The disposal should done according to the guidelines of local regulations of waste disposal. After completing the necropsy, sharing findings with the pet owner or referring veterinarian was also necessary for further purposes. Clear communication is essential for understanding the cause of death and potential implications for other animals.

Finally, the necropsy is an important tool in the veterinary field that requires good preparation and careful examination. The necropsy of exotic pets is not only used to find out the cause of death or disease in exotic pets but also can be used to learn more aspects in exotic pets that had limited information.

Hormone & egg-binding in tortoises : How to deal with this issue

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Keywords: Egg-binding ,Tortoises,Hormone,Oxytocin,Calcium,VitaminD3

Overview

Egg-binding in tortoises is a critical condition characterized by the failure of a female tortoise to lay her eggs, potentially due to hormonal imbalances, environmental factors, or nutritional deficiencies. This situation demands immediate attention as it can pose a significant threat to the animal's health, leading to severe complications or even fatality. This article aims to provide a concise yet comprehensive overview of how to manage this issue, highlighting the importance of early detection, appropriate care, and preventive measures.

Diagnosis

The initial step in addressing egg-binding involves recognizing its symptoms, which may include lethargy, reduced appetite, swelling near the hindquarters, and unsuccessful attempts to lay eggs. Upon observing such signs, Diagnostic tools may include physical examinations, radiography, and ultrasound to confirm the presence of retained eggs and assess the tortoise's overall health condition.

Causes

Understanding the causes of egg-binding is essential for effective treatment and prevention. Factors contributing to this condition can be broadly categorized into hormonal imbalances, environmental inadequacies, and nutritional shortcomings. Hormonal issues might prevent the normal progression of egg-laying, while suboptimal habitat conditions, such as incorrect temperatures or humidity levels, can inhibit natural behaviors necessary for egg deposition. Furthermore, a diet lacking in calcium and vitamins may impair eggshell formation, complicating the laying process.

Management

The management of egg-binding in tortoises requires a multifaceted approach, focusing on alleviating the immediate condition and addressing its root causes:

Medical: Hormonal treatments, such as oxytocin injections, may be administered to stimulate the laying process. In cases where medical management is ineffective, surgical intervention might be necessary to remove the eggs and alleviate the condition.

Environmental: Creating an optimal habitat that mimics natural conditions is vital. This includes adjusting temperature gradients, humidity levels, and providing suitable nesting areas to encourage natural laying behaviors.

Nutritional Support: A balanced diet enriched with calcium and vitamin D3 is crucial for preventing egg-binding. Supplements may be recommended to ensure that dietary needs are met, supporting healthy egg development and laying.

Preventive

Prevention plays a pivotal role in mitigating the risk of egg-binding. Regular health checks, a balanced and nutritious diet, and an environment that closely resembles a tortoise's natural habitat can significantly reduce the occurrence of this condition. Monitoring the health and nutritional intake of breeding females is particularly important to ensure they remain in optimal condition for egg production and laying.

Conclusion

Egg-binding in tortoises represents a serious health issue that requires prompt and effective management. By understanding its causes, signs, and appropriate intervention strategies, tortoise keepers can ensure the well-being of their pets. Collaborating with a specialized veterinarian and adhering to preventive guidelines are paramount to safeguarding the health of these remarkable reptiles.

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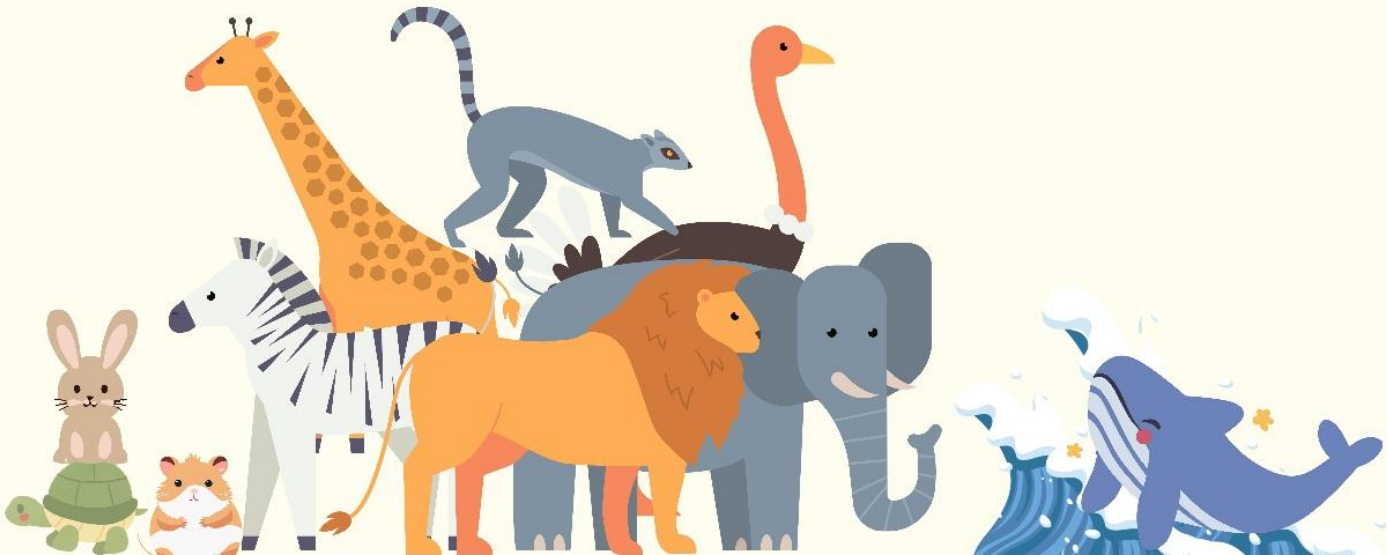

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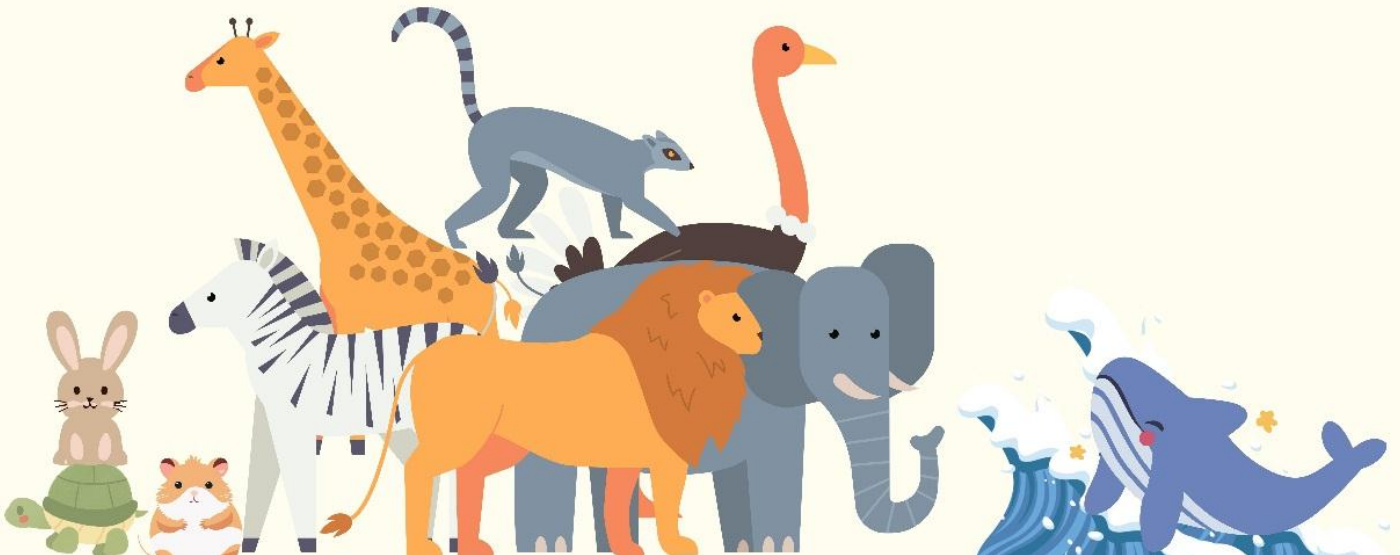

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