

JOURNAL OF
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REHABILITATION

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THE *Journal of Wildlife Rehabilitation* is designed to provide useful information to wildlife rehabilitators and others involved in the care and treatment of native wild species with the ultimate purpose of returning them to the wild. The journal is published by the International Wildlife Rehabilitation Council (IWRC), which invites your comments on this issue. Through this publication, rehabilitation courses offered online and on-site in numerous locations, and its outreach to those in the profession, the IWRC works to disseminate information and improve the quality of the care provided to wildlife.



ON THE COVER:

Double-crested cormorant
(*Phalacrocorax auritus*).

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LEFT:

Tasmanian Devil (*Sarcophilus harrisii*),
Cradle Mountain, Tasmania. IUCN red
list category—endangered.

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Providing evidence-based education
and resources on wildlife rehabilitation
to move the field of wildlife rehabilitation
forward; to promote wildlife conservation
and welfare; and to mitigate human-
wildlife conflicts worldwide, through
better understanding of wild animal
ecology, behavior, and welfare.

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EDITORIAL

Strengthening our voices through collaboration

I sit here watching news of storm system after storm system affecting the whole of the North American continent this week, I find myself (yet again) wondering why the world hasn't been listening to those of us in the scientific community who have voiced our concerns about climate change. I wonder how long until the southern California scrub flowers begin to germinate, signaling the small herbivores to start reproducing, beginning the cascade that will bring the new wildlife that will soon inundate our ecosystems, wildlife rehabilitation facilities, and minds.

Suddenly, my mind hops over to asking myself, "How do we strengthen our wildlife rehab voices on behalf of ourselves and the animals and ecosystems we care for? How do we gain more respect for the field of wildlife rehabilitation itself?" Our community knows the challenges we face daily, and we understand that, more often than not, we are an overlooked or truly unknown resource to the public.

The board of directors at The IWRC has been busy working on our objectives and priorities for the new year, as well as our short and long-term strategic plan so that we can be here to assist wildlife rehabilitators as long as the world needs them. I can speak for the board members

in stating that we have a duty to all wildlife rehabilitators around the globe, and our job is to unite us as a solid scientific and professional field.

We are always looking for ways to continue to unite and professionalize the field of wildlife rehabilitation. Through the newly formed Wildlife Trafficking Alliance pilot program, The Southern California Wildlife Confiscations Network, IWRC is looking forward to collaborating with rehabilitators and government agencies. Greater collaboration through these types of expanding programs will allow recruitment of more assets to combat illegal wildlife trade. We continue to refine and expand our educational offerings, keeping our staff and volunteers busy year after year. But by far, one of the most important things that we, The IWRC, do to raise the professional bar, promote welfare, and bring together our community, is publishing this scientific journal with the rigor and enthusiasm we all deserve.

My hats off to each and every single one of you for caring for the world around you by learning and sharing. Don't forget to care for yourself and your colleagues as we start a new trip around the sun.

—Brook Durham
IWRC Board President

FOUND: Iridescent blind mole with super-hearing powers re-discovered ‘swimming’ through sand dunes of South Africa

NORTHERN CAPE, SOUTH AFRICA (November 28, 2023)—The De Winton’s golden mole was lost to science for 87 years until November 2023. A team from the Endangered Wildlife Trust (EWT) and the University of Pretoria rediscovered the blind, iridescent-coated mole “swimming” through sand in South Africa. It hadn’t been seen since 1936.

The EWT-led team used a technique never used before to detect golden moles: environmental DNA (eDNA), which is the DNA that animals shed as they move through the environment. This is typically in the form of skin cells, hair and bodily excretions. Not only are the burrows of golden moles hidden, but the species’ sensitive hearing allows them to detect surface vibrations and evade discovery. They rarely leave visible tunnels that would indicate their presence as they move under the sand.

Samantha Mynhardt, conservation geneticist with the EWT and Stellenbosch University, explains,

Extracting DNA from soil is not without its challenges, but we have been honing our skills and refining our techniques—even before this project—and we were fairly confident that if De Winton’s golden mole was in the environment, we would be able to detect it by finding and sequencing its DNA.

After collecting more than 100 soil samples in June 2021 from beaches and dunes on the northwest coast of South Africa—including Port Nolloth beach, the only place where De Winton’s golden mole had ever been found—and conducting a complex and comprehensive genetic analysis of each sample, the team determined that there were several species of golden mole living in the sand along the stretch of coast.

Four species of golden moles were



De Winton's Golden Mole (*Cryptochloris wintoni*)

found. Two were common species—Cape golden mole and Grant’s golden mole, and the third was the endangered and rare Van Zyl’s golden mole. The fourth species found was De Winton’s golden mole, but because De Winton’s genetic profile is similar to that of Van Zyl’s golden mole, it took another year to conclusively identify their finding. The information they needed came in the form of eDNA.

At the time, only one De Winton’s reference DNA sequence existed, and it didn’t reveal the needed variation from Van Zyl’s golden mole.

It wasn’t until a year later that the information needed surfaced in the form

of a second gene sequence, made publicly available in January of 2022. This mitochondrial gene came from a more variable area of the genome, exposing the genetic differences that defined the De Winton’s golden mole. When these DNA sequences were compared with those from Port Nolloth beach, they revealed a clear match to De Winton’s golden mole.

Four additional De Winton’s golden mole populations have been identified since.

Rabies at Saguaro National Park

SAGUARO NATIONAL PARK, AZ, USA (January 23, 2024)—National Park Service officials identified rabies as a possible cause

PHOTO ©JP LE ROUX. CREATIVE COMMONS LICENSE.

for “strange wildlife behavior” and dead foxes at Arizona’s Saguaro National Park.

There was also a reported incident of a bobcat biting a park visitor, authorities said. Park staff have not yet recovered any animal carcasses for testing to determine the cause of illness in animals.

Officials urged visitors to notify park staff and seek medical attention immediately if they have had physical contact with an animal.

More Australian wildlife added to threatened species list in 2023 than ever before

AUSTRALIA (January 21, 2024)—More plants, animals and habitats were added to the national list of threatened wildlife in 2023 than in any year since the list was established, according to analysis by the Australian Conservation Foundation (ACF). New additions to the list totaled 144 animals, plants and ecological communities, five times more than the yearly average. Many of the species were nominated years ago but have now been officially added to the list.

US Fish and Wildlife Service completes initial reviews on Endangered Species Act petitions for 10 species

FALLS CHURCH, VA, USA. (January 24, 2024)—The US Fish and Wildlife Service has completed its 90-day findings on petitions to list 10 species under the Endangered Species Act. Based on the Service’s review, the petitions to list the ten following species contain substantial information that listing may be warranted, and status reviews will be initiated on them.

Betta hendra — A colorful freshwater fish endemic to the peat swamp forests of Central Kalimantan, Indonesian Borneo.

Betta rutilans — A red-colored freshwater fish endemic to the peat swamp forests of West Kalimantan, Indonesian Borneo.

Hickory Nut Gorge green salamander — An amphibian with a dark body and bright green to yellow patches on its back. It is found in the hardwood and cove forests in Hickory Nut Gorge in western North Carolina and was first described as a unique species in 2019.

Pygmy rabbit — A small rabbit that lives in a sagebrush habitat. It is found in the Great Basin and adjacent intermountain areas of the western United States, from southeastern Oregon and southern Idaho to southwestern Montana and south-central Wyoming to northwestern Colorado and southwestern Utah, central Nevada, and eastern California.

Railroad Valley toad — One of the smallest of the western toad species with a long head and limbs and dark brown spots. It lives only in the spring-fed wetlands in the Lockes Wildlife Management Area in Nye County, Nevada.

Southern Plains bumble bee — A large black and yellow bumble bee identified by its short hair, short head and typically yellow coloring between the head and thorax, between the wings. The species inhabits open prairies, meadows and grasslands of the Midwest, mid-Atlantic states, and the Plains states from Texas to North Dakota, as well as to the grasslands and pine savannas of Florida and the southeast.

Southwest spring firefly — A terrestrial invertebrate native to Arizona and associated with riparian and wetland habitats. Primary threats to fireflies include potential habitat destruction from alteration or loss of ground and surface water flows, livestock grazing, mining, effects from climate change, and light pollution.

White-margined penstemon — A rare perennial plant restricted to the Mojave Desert, with four disjunct populations in southeastern California, southern Nevada, and northwestern Arizona. It is 15–35

cm tall, with smooth stems and pink to purple petals.

Yellow-spotted woodland salamander — A large, slender salamander with a gray-brown body and two rows of yellow spots along its back. It inhabits steep shale and sandstone outcroppings along the Appalachian Plateau in Kentucky, Tennessee, Virginia and West Virginia.

Thermal vision shows endangered numbats feel the heat of warming climate

PERTH, AUSTRALIA (January 11, 2024)—Research using thermal imaging of numbats in Western Australia has found that during hot weather the endangered animals are limited to as little as ten minutes of activity in the sun before they overheat to a body temperature of greater than 40°C/104°F.

Lead author, Dr. Christine Cooper of the Curtin School of Molecular and Life Sciences, summarizes the findings,

Active only during the day and with an exclusive diet of termites, numbats are often exposed to high temperatures and gain heat from direct sunlight. Even when in the shade they gain heat from radiation from the ground, rocks and trees. Even with shade available, higher temperatures will reduce how long numbats can forage during the day, and because they have limited capacity to become more nocturnal, heat may become problematic for numbats. ■

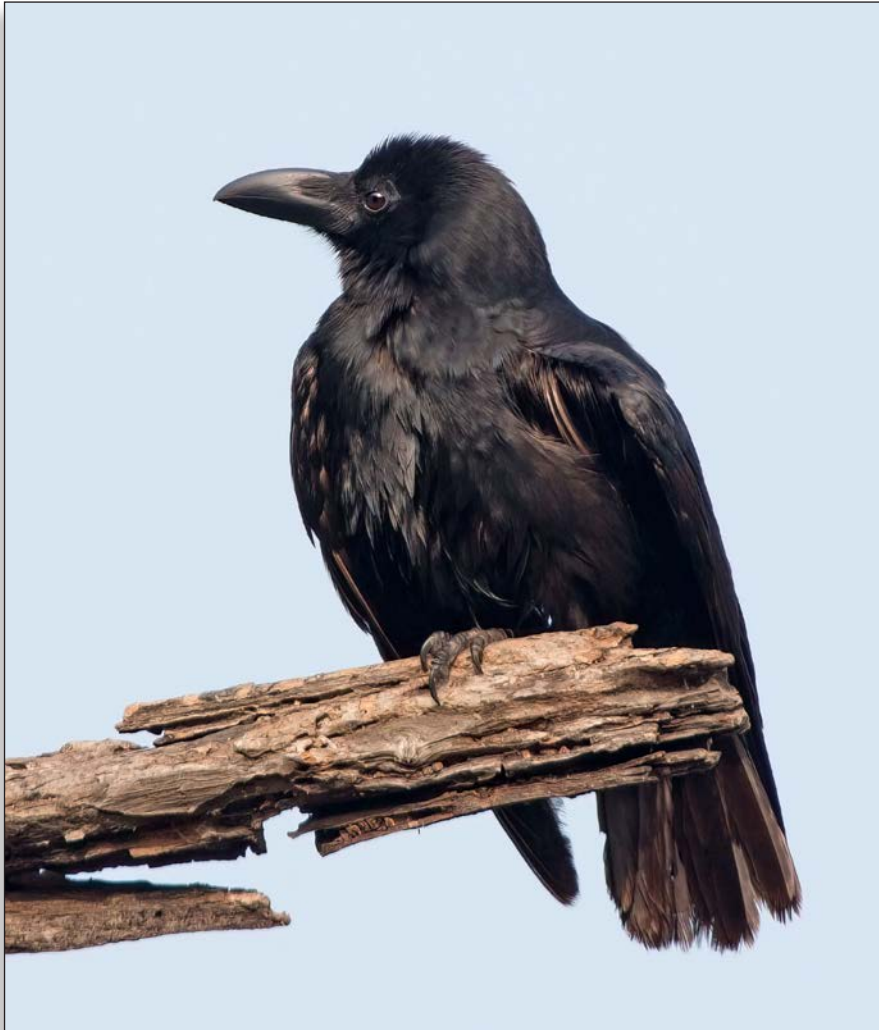


Numbat (*Myrmecobius fasciatus*) IUCN Red List – Endangered

Noninvasive treatment and rehabilitation of a large-billed crow (*Corvus macrorhynchos*) with a fractured humerus

Bong-Kyun Kim,^{1,2} Soo-Hyung Eo,¹ Kyu-Hyung Sim,² Minhye Lee,^{2,3} and Young-Jun Kim⁴

PHOTO © SUE MILKS. USED WITH PERMISSION.



Large-billed crow (*Corvus macrorhynchos*).

Introduction

The large-billed crow (*Corvus macrorhynchos*) is a member of the order Passeriformes and the family Corvidae. It is a widespread species found in various countries, including Korea, Japan, China, Russia, the Kuril Islands, the Philippines, and Indonesia.¹ It is one of the resident birds in Korea and can easily be spotted.² However, there is a limitation to analyzing its exact population, as not enough reliable data is available. It does not hold legal status in Korea, and the International Union for Conservation of Nature (IUCN) placed it under Least Concern in their Red List of Threatened Species.³

A fracture is defined as a partial or complete loss in the natural continuity of a cortical bone. Extrinsic trauma, such as collision with artificial structures or with vehicles,

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ABSTRACT: This case report describes the treatment and recovery process of an immature large-billed crow (*Corvus macrorhynchos*) with a fractured humerus, and evaluates treatment outcomes. The crow suffered a closed fracture of the left distal humerus due to physical trauma caused by falling from its nest. Noninvasive, conservative methods were used instead of a surgical approach, and stepwise rehabilitation followed the treatment. The crow was successfully released back into nature and has adapted to the environment without difficulties, even with anatomical asymmetry caused by the malunion of the humerus. It was concluded that an anatomical impairment caused by the malunion of the humerus can be overcome in terms of functionality, depending on the severity of the impairment. Therefore, the chance of survival of an injured wild animal in nature must be evaluated considering functional recovery and the potential for adaptation. The results of this case emphasize the need for a release evaluation method that comprehensively considers different factors, such as the species, ecological niche, characteristic habits and behaviors, and the eventual habitat of the animal patient.

KEYWORDS: conservative treatment, Corvidae, *Corvus macrorhynchos*, crow, humerus, large-billed crow, malunion, wildlife rehabilitation

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gunshot, plummeting, predation, and entrapment can cause a bone fracture.⁴ Depending on the location or severity of a fracture, surgical fixation using a rod or noninvasive treatment aided by proper wrapping and limiting physical activities have been recommended.⁵⁻⁸

Before releasing wildlife, it is crucial to thoroughly evaluate the species' ecological behaviors, including feeding patterns, hiding tendencies, alertness levels, and evasion techniques. Additionally, it is essential to assess their mobility factors such as flight speed, agility, endurance, and directional changes.⁵ This comprehensive evaluation ensures that the released animals possess all the necessary abilities to thrive in their natural habitat. Based on the species under consideration, appropriate rehabilitation measures and activities can be implemented to enhance their skills while evaluating their readiness for survival in the wild. At Chungnam Wild Animal Rescue Centre, outdoor enclosures range from 13 m² to 501 m², enabling thorough evaluation before an animal's release.

An immature large-billed crow that initially experienced a fractured humerus from falling from its nest has successfully adapted back to the wild, notwithstanding the hindrance caused by the trauma. An evaluation of the case focused on the noninvasive treatment method and the gradual rehabilitation techniques used on the large-billed crow.

State of the Problem

On April 25, 2021, a large-billed crow (patient number 21-0456) was found under a pine tree in a lowland forest in Eungbong-myeon, Yesan-gun, Chungcheongnam-do, Republic of Korea. It was rescued as it showed an absence of ability to move the left wing and could not stand still. The crow was considered a nestling, weighing 218 g at the time of intake. Based on the body condition score of 2 (out of 5) and the capillary refilling time, it showed moderate dehydration and starvation. Through palpation, it was suspected that a bone fracture caused the absence of movement in the left forelimb. A radiograph was taken to investigate the suspected injury further, and it showed a closed complete (transverse) fracture of the distal humeral diaphysis (Fig. 1).

A distal humerus fracture can sometimes be surgically repaired by combining cross-pinning and hybrid fixation. The young crow's fracture was just proximal to the elbow joint. A nestling is expected to undergo rapid physical development. Therefore, it was deduced that the surgical procedure may result in a poor prognosis. When treating fractures in wild birds, various factors should be considered, such as the area that is impacted, the fracture severity, and the individual's condition. Depending on these factors, some cases may benefit more from nonsurgical, noninvasive treatments.⁵ There has been such a case where a



FIGURE 1. A fracture of the left humerus was identified by radiography on admission.

Northern goshawk (*Accipiter gentilis*) was successfully returned to nature after noninvasive treatment of coracoid and scapular fractures. Its prolonged survivorship has also been observed.⁹ Accordingly, an indirect bone healing process was strategized for the large-billed crow. However, malunion of the humerus seemed unavoidable, as the soft callus had already formed around the transverse fracture surface. This could result in a left forelimb shorter than the normal right forelimb. Nonetheless, considering the species' life history as nonmigratory birds and preference for foraging over active hunting,¹⁰ it was evident that evaluating the crow's functional recovery throughout the rehabilitation process would be a valuable pursuit. Therefore, treatment was conducted anticipating a full recovery of function.

Methods

Noninvasive treatment was performed on a single large-billed crow described above. The left wing was fixed in place with a figure-of-eight bandage until a hard callus was formed (Fig. 2). A body wrap was not applied, considering the low mobility of the immature crow. The figure-of-eight bandage was replaced every two to three days. The continuous application of the bandage can lead to side effects, such as unnecessary pressure on the wing membrane ligament or hindrance of secondary feather development. Thus, the concerned area was regularly monitored when changing the bandage. The formation of the hard callus was confirmed 11 days after the initial application of the bandage. Subsequently, the bandage was completely removed, allowing voluntary movement and further fracture treatment to commence. The treatment consisted of inducing movement in the wing while carefully assessing posture, signs of pain, and abnormalities during the extension and folding of the affected wing. The treatment continued for 18 days and was terminated after evaluating the complete union of



FIGURE 2. A figure-of-eight bandage was applied over the fractured area to restrict physical activities and assist in immobilizing the wing.

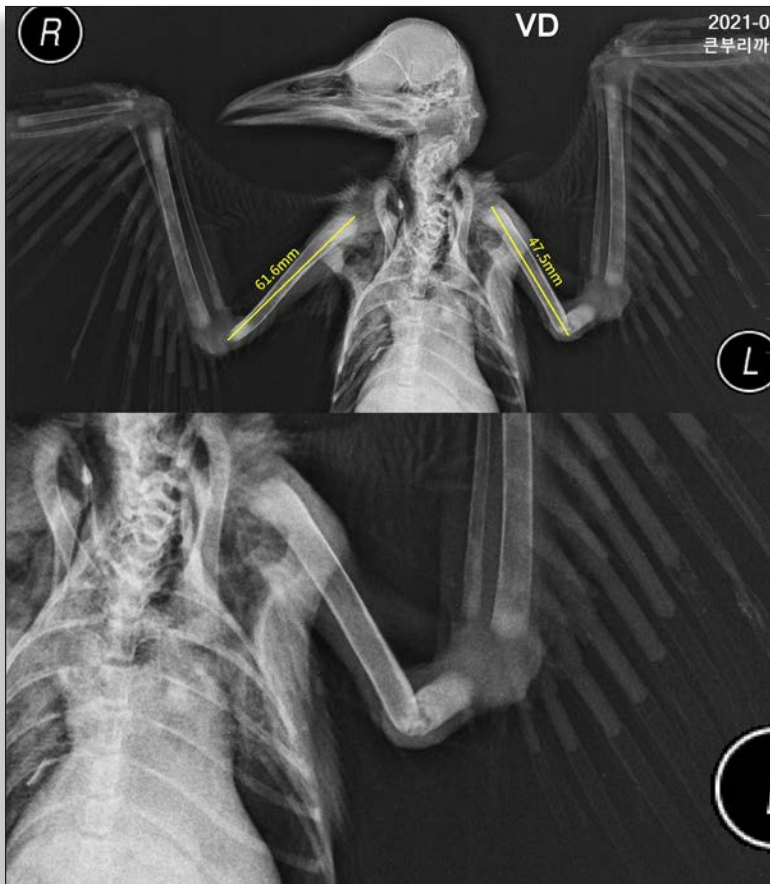


FIGURE 3. A radiographic comparison of humeral lengths was made. Deformities from trauma caused the length of the left humerus to be only 77.11% of the length of the right humerus.

the fracture. Radiography confirmed that the initially fractured bone was remodeled with a combination of angular and rotational deformities. To evaluate the structural differences between the two humeri, lengths from the proximal head to the distal end on each humerus were compared through radiographs. The right humerus measured 61.6 mm, while the left humerus measured 47.5 mm. There was a difference of 14.1 mm between the two humeri, indicating that the fractured left humerus was only 77.11% of the right humerus in length (Fig. 3).

Management Implications

For the first 10 days after admission, the crow showed begging behavior instead of self-feeding. Consequently, it was hand-fed four to five times each day, every two to three hours. Quail and day-old chicks were usually provided along with more than three types of insects and fruits to ensure nutritional balance. During the 10 days, the crow was fed an average of 80 g in total each day. After the initial 10 days, the crow started self-feeding. Then 120 g of food was provided daily, consisting of 40 g of quail and day-old chicks each, along with 20 g of insects and fruits each.

During the initial 10 days following admission, the crow was placed in an Intensive Care Unit (ICU) enclosure (L 730 mm × W 700 mm × D 550 mm), which provided the optimum conditions of ideal temperature (36°C) and humidity (70%). The crow lacked a sufficient amount of feathers to self-regulate its body temperature. Therefore, the ICU was vital for keeping its body temperature within a normal range. Then, it was placed in a portable aviary (L 1,000 mm × W 1,000 mm × D 1,000 mm) for the next seven days. During the daytime (from 9 am to 6 pm), the aviary was placed outdoors and transferred indoors after dusk. At 18 days post-admission, the crow was placed in an outdoor enclosure (L 8,000 mm × W 4,100 mm × D 2,400 mm) as it was mature enough to start flying. The crow's recorded weight at this time was 346 g, showing a 58.72% increase compared to the weight measured on admission. The outdoor enclosure was large enough for the repetitive short-range flight of the crow-sized bird species. Perches of different heights were placed in the enclosure, which enabled the evaluation of takeoff and landing. By placing the crow in the outdoor enclosure, it was anticipated that the pectoral muscles and wing joints would be strengthened more efficiently.

The crow was unable to fly for the first two days in the outdoor enclosure and stayed on the ground for most of the time. It was difficult to identify the primary reason for the flightlessness since the crow had limited



FIGURE 4. Eurasian magpies (*Pica pica*) were placed in the same enclosure as the crow to stimulate behavioral learning experiences, including flight.



FIGURE 5. The crow was observed and identified for the first time post-release in December 2021.

exposure to natural experience and education from its parents and the possibility of permanent disability caused by the deformity of the humerus. Species that share similar ecological niches and are not in predator-prey relationships have been shown to bring about positive effects, such as stimulating behavioral learning experiences and maintaining the natural wild nature of captive wild animals when placed in the same enclosure.⁴ Several Eurasian magpies (*Pica pica*) were placed in the same outdoor enclosure to provide the crow with stimulation from similar species (Fig. 4). On the fourth day in the outdoor enclosure, the crow was frequently

observed actively moving its wings and flying at a low height. The frequency and the quality of flights improved over time. On the seventh day in the outdoor enclosure, the crow could fly from one end to the other end of the enclosure. Its wings were very asymmetrical as the range of movement differed, but there was no indication of pain or other factors related to flying that hindered the performance. After the flight was observed, flight and evasion were encouraged by staff members twice a day to increase the physical capacity and satisfy the standards for the crow's release back to nature.

Results

Thirty-three days after placement in the outdoor enclosure, the crow's flying ability and physical endurance were considered to meet the release standards. On June 14, 2021, 51 days after initial admission to the center, the large-billed crow was released at the entry to a mountain located at Galsin-ri, Daeheung-myeon, Yesan-gun, Chungcheongnam-do. For identification purposes, the crow was banded with a metal ring (serial number 100-12124) on its lower right leg (tarsometatarsus). On December 22, 2021, 190 days following the release, a crow with a metal ring on the right leg was found within Daehoe-ri, Yesan-eup, Yesan-gun, Chungcheongnam-do. The

serial number in the metal ring confirmed that this individual was the crow who had been released from rehabilitation six months previously with asymmetrical wings after sustaining a fractured left humerus. The wing asymmetry was still evident; the left wing appeared to droop compared to the normal right wing. The crow, however, demonstrated remarkable abilities overall in flying, walking, feeding, and cognition (Fig. 5).

The large-billed crow was repeatedly sighted in the same area following the initial observation. It was also observed occasionally entering an outdoor flight enclosure designed for large raptors



FIGURE 6. The outdoor flight enclosure was used for the rehabilitation of large raptors. Occasionally, the large-billed crow entered to scavenge the food provided for the cinereous vultures undergoing rehabilitation.



FIGURE 7. The large-billed crow was recaptured on February 8, 2022, eight months post-release, and a radiograph was taken to assess skeletal abnormalities.

through widely spaced iron bars (Fig. 6) in an attempt to scavenge the food provided for the raptors undergoing rehabilitation. On February 8, 2022, the crow was spotted inside the enclosure, foraging on the food intended for cinereous vultures under care. Since the crow remained voluntarily in the enclosure to consume the food, an opportunity arose to capture it for a brief examination. Although capturing posed challenges due to the large size of the enclosure (501 m²) and the crow's flying ability, which was similar to that of regular crows, three staff members managed to drive the crow toward the closed upper part of the enclosure (Fig. 6) and capture it. There was no sign of additional injuries or physical disabilities, and through radiography, it was confirmed that its skeletal system showed no further abnormality compared to the previous radiograph that was taken following the rehabilitation (Fig. 7). Overall, it was in good physical condition. After the examination, it was released back to the same location.

Discussion

Humerus fractures in birds often result from flying into a rigid object and colliding. The injured bird may end up being unable to fly with dysfunction in wing movements and abnormal posturing. The shortening of the fractured bone, caused by the malunion of the fractured surfaces, may lead to flight impairment. Typically, external fixation surgery is recommended for humerus fractures in birds. However, surgical reduction carries potential risks from anesthesia, bleeding, iatrogenic trauma, and damage to the elbow joint when the pin is inserted for fixation.⁵ The recommended method is also complicated to apply to a young individual whose bones are rapidly growing. As such, if the side effects of surgical reduction pose a significant concern, noninvasive treatment can be applied, with the expectation of functional recovery rather than anatomical recovery.⁹ Accordingly, immature individuals and individuals with a closed

fracture of the distal humerus may benefit from conservative treatment instead of surgical fixation, as it could reduce the side effects and still allow the individual to recover effectively.

The large-billed crow is completely omnivorous, with various foods to choose from, such as grains, fruits, insects, bird eggs, hatchlings, and even carcasses.¹⁰ Thus, it spends more time opportunistically feeding than actively chasing and hunting prey. Also, if the crow inhabits an urban area, it is relatively free from predators.^{2,11} Furthermore, since it is one of the resident birds of Korea, the ability to fly long distances may not be essential for survivorship. For these reasons, the ability to fly agilely and precisely in response to predator-prey relationships and the ability to fly long distances with sufficient physical strength may be relatively less vital for their survivorship. Limited disability due to a humerus fracture does not act as a significant factor in the survival of the large-billed crow.

Conclusion

This report examined a case in which a large-billed crow with a fracture of the left humerus successfully recovered and adapted to the wild through noninvasive treatment and appropriate stepwise rehabilitation. Noninvasive treatment was chosen over the surgical approach for fracture reduction, and following the completion of the treatment, a gradual rehabilitation process took place, leading to a release. Through several observations and a recapture followed by a physical examination after the release, it was deduced that impairment caused by the malunion of the fractured humerus, such as anatomical asymmetry, may be overcome functionally, depending on its severity. In conclusion, the viability in the wild must be evaluated not just by the level of physical impairment, but in conjunction with factors like species, ecological niche, behavior, and environmental conditions.

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Prevalence of melena in double-crested cormorants (*Phalacrocorax auritus*) presenting to a Florida wildlife rehabilitation center for suspected brevetoxicosis from 2017 to 2021

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Introduction

Brevetoxicosis (BT) secondary to red tide algal blooms of *Karenia brevis* is a well-documented cause of seabird morbidity and mortality in southwest Florida.^{1,2} This dinoflagellate produces brevetoxin, a potent neurotoxin, which causes seasonal mortality events in mollusks, fish, seabirds, sea turtles, and marine mammals due to a spectrum of neurologic deficits and systemic disease sequelae.³ The most widely reported signs of seabirds presenting to wildlife rehabilitation centers with suspected BT and laboratory abnormalities include cerebellar ataxia, anemia, and hypoproteinemia, with the double-crested cormorant (*Phalacrocorax auritus*; DCCO) being among the most severely affected.²

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ABSTRACT: Brevetoxicosis is a well-documented cause of morbidity and mortality in southwest Florida double-crested cormorants (*Phalacrocorax auritus*). Brevetoxin, produced from *Karenia brevis*, is a neurotoxin causing disease in many aquatic species. Cormorants are severely impacted by its effects. Both neurologic deficits and melena (the presence of black feces due to GI tract bleeding) are widely seen in cormorants presenting to rehabilitation centers with suspected brevetoxicosis. Data was collected from a wildlife rehabilitation center in southwest Florida from 2017 to 2021. Medical records (n = 882) were analyzed to document the prevalence of melena in cormorants presenting with brevetoxicosis and to determine correlations between release success and gastroprotectant protocol. The prevalence of melena in cormorants with brevetoxicosis was 18.29 times higher than in cormorants without brevetoxicosis. Release status had no significant correlation to gastroprotectant protocol or prevalence of melena. This study emphasizes the high prevalence of melena that can occur secondary to disease and the need for improved understanding of gastroprotectant use in avian species.

KEYWORDS: avian, brevetoxicosis, cormorant, gastroprotectants, *Karenia brevis*, melena, *Phalacrocorax auritus*, red tide

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There are no pathognomonic lesions associated with BT, although common histopathologic findings include hemosiderosis, cholangitis, nephritis, endoparasitism, and pulmonary congestion.^{1,2} In addition to these histologic findings and neurologic abnormalities, enteropathies are a common clinical manifestation of systemic disease sequelae in suspect BT cases seen at the Clinic for the Rehabilitation of Wildlife (CROW) in Sanibel, Florida. Regurgitation, hematochezia, and melena have all been observed, with melena being the most common.

Melena, which presents as a black, tarry stool, occurs secondary to bleeding in the upper gastrointestinal tract from erosion or ulceration of the mucosa.⁴ Gastrointestinal hemorrhage has a multitude of diverse etiologies, with the most common ones being generalized inflammation, sepsis, hypovolemia/hypotension, renal disease, and coagulopathies.⁵ The severity of melena, as seen at CROW, in DCCOs presenting with suspect BT has necessitated the use of gastroprotectants in the treatment and supportive care protocols of these birds. Gastroprotectant drugs facilitate the treatment and prevention of gastric pathologies, such as ulcers and erosions. Although there is consensus about gastroprotectant use in small animal medicine, no such consensus exists in avian medicine.⁶ There is widespread use of gastroprotectants in avian case reports and in poultry model research, although there is little evidence describing the pharmacokinetics and pharmacodynamics of these drugs in avian species.⁷⁻¹⁰

The purpose of the study reported here was to compare the prevalence of melena in DCCOs presenting for suspect BT to those presenting for other causes and to investigate correlations with melena and release success. In addition, correlations between gastroprotectant administration and the occurrence of melena were examined. We hypothesized that DCCOs presenting for suspected BT have a significantly higher prevalence of melena than those presenting for other causes and that the choice of gastroprotectant protocol impacts the occurrence of melena.

Materials and methods

Animal use

This retrospective study utilized previously obtained medical records and did not require animal handling

for data collection. Fecal samples were collected from a prospective subset of 16 individuals for hemocult testing, which did not require animal handling or changes in husbandry.

Data retrieval

Utilizing the Wildlife Rehabilitation Medical Database (WRMD, The Wild Neighbors Database Project, PO Box 421, Middletown, CA, 95461 USA), medical records from DCCOs presenting to CROW from 2017 to 2021 were retrieved ($n = 882$). Working diagnosis, rehabilitation success, occurrence and duration of melena, gastroprotectant protocols and duration of administration, use of antibiotics, intravenous lipid emulsion therapy (IVLE; 15 ml/kg over 1 hr; Nutrilipid[®] 20% Fat Emulsion, B. Braun Medical Inc, Bethlehem, PA, USA), and mortalities were recorded. Any patients with incomplete records were excluded from the study, which left 868 individuals. In addition, any patient who died within 24 hr was only utilized for documenting the occurrence of melena, as no gastroprotectant protocols could be administered.



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Gastroprotectant protocols

Gastroprotectant protocols consisted of various combinations of omeprazole (20 mg/kg PO q 24 hr; Prilosec, Lannett Company Inc, Philadelphia, PA, USA), famotidine (1 mg/kg PO q 24 hr; Acid Reducer, Perrigo, Allegan, MI, USA), and sucralfate (50–100 mg/kg PO q 8 hr; Sucralfate, Greenstone LLC, Peapack, NJ, USA). All gastroprotectants were given for a variable number of days depending on the severity of clinical signs (melena, regurgitation, hyporexia). Metronidazole (25 mg/kg PO q 12 hr; Metronidazole, Amici Pharmaceuticals, Melville, NY, USA) and IVLE administration were part of a common protocol for all BT suspects based on the severity of clinical signs. Typically, all animals who could not stand or were severely ataxic were administered IVLE for one to two doses, and metronidazole was given until the bird was standing with no evidence of melena.

Confirmation of melena

Fecal hemocult (Hemocult Single Slides, Beckman Coulter, Brea, CA, USA) testing was performed opportunistically in a standard fashion on a subset population ($n = 16$) presenting between December 2020 and March 2021 to confirm that black feces were consistent with melena.^{11,12} Presence of black feces upon admission to 24 hours post-admission, diet, and duration of diet administration were recorded. Samples were considered hemocult positive if a color change was appreciated as directed by the hemocult test instructions.

Statistical analysis

The prevalence of melena in brevetoxicosis (BT) suspects and non-suspects (BT negatives) were calculated in a standard fashion. Melena status was evaluated in regard to suspect BT, gastroprotectant medication administration, and release status (releasability) utilizing Chi-squared tests and log-binomial generalized linear models for relative risk assessments. Melena status and release status were treated as outcome variables in the log-binomial model. Percentages were calculated for the releasability of all cormorants who exhibited melena during rehabilitation. Duration of melena was not compared to gastroprotectant administration or length of administration due to the inferred relationship between these two, as supportive care and gastroprotectants are administered when clinical signs of intestinal hemorrhage are present. All statistical analyses were performed using R (The R Project for Statistical Computing, version 4.1.2, The R Foundation, Vienna, Austria).

Results

Confirmation of melena

Black feces consistent with melena were noted in 6/16 individuals; all six had positive fecal hemocult tests. Of these six individuals, two were tested on admission in an apparent fasted state, and the other four had only been fed a critical care liquid diet devoid of prey items that might give a false positive result (10–20 ml per kg of body weight q 8 hr; EmerAid IC Piscivore, EmerAid LLC,

Cornell, NY, USA). Six of the remaining 10 animals with no evidence of melena were negative on hemocult testing. These individuals had either received the piscivore liquid diet ($n = 3$) or whole fish ($n = 2$) or were tested on admission to the hospital ($n = 1$). A positive hemocult test was noted in 4/10 animals fed whole fish and did not appear to have melena. These results agree with the accepted knowledge that diet influences fecal hemocult testing.¹³

Prevalence of melena

Melena was exhibited in 32.6% of DCCOs who presented for suspected BT and 1.8% who presented without signs of BT (Table 1). The prevalence of melena was significantly higher in DCCOs presenting for suspected BT as determined using Pearson's Chi-squared test ($X^2 = 43.99$; $P = 3.3 \times 10^{-11}$). The prevalence of melena is 18.29 times larger (95% confidence interval: [6.00, 109.49]) in DCCOs presenting with BT compared to those without, as estimated by the log-binomial model. This relative risk estimate is extreme due to the relative sparsity in BT-negative animals, especially those with melena.

The prevalence of melena had significant associations with some of the administered pharmaceuticals when evaluated by an overall Chi-squared test ($X^2 = 212.21$; $P < 1 \times 10^{-16}$). Relative risk estimates were determined for each pharmaceutical individually and adjusted for the other medications and IVLE. The prevalence of melena was reduced by 42.2% [27.6%, 52.1%] in DCCOs administered famotidine, increased by 485.9% [324.7%, 731.1%] for those administered sucralfate, and increased by 47.7% [3.9%, 127.6%] for those administered metronidazole. Omeprazole and IVLE had no significant correlations with melena prevalence.

TABLE 1. Relationship of melena status and brevetoxicosis diagnosis in double-crested cormorants (*Phalacrocorax auritus*) presented to a Florida wildlife rehabilitation center from 2017–2021.

	MELENA POSITIVE	MELENA NEGATIVE
BT ^a SUSPECT	247	509
BT NEGATIVE	2	110

^aBrevetoxicosis

Releasability

Release status had no significant correlation to the gastroprotectant medication administration used or the prevalence of melena ($P = 0.37$ and $P = 0.36$, respectively). The release percentages were 69.79% for DCCOs suspected of having BT without melena and 65.63% for DCCOs suspected of BT with melena.

Discussion

Melena appears to have a high prevalence in cormorants presenting for suspect BT compared to cormorants presenting for other causes. Gastrointestinal hemorrhage may be related to a multitude of pathophysiologies such as systemic disease (generalized



inflammation, sepsis, hypovolemia/hypotension, renal disease, and coagulopathies), ileus with secondary bacterial overgrowth and erosion, or from direct brevetoxin insult.^{4,14} The retrospective data presented in this study shows no correlation between gastroprotectant medication administration and releasability. However, famotidine was correlated with a decreased prevalence of melena when compared to other gastroprotectants. This result may be related to the administration of this drug as a preemptive measure prior to the occurrence of melena for many individuals, which skewed this data to represent a relatively diminished prevalence that may be unrelated to famotidine efficacy. In contrast to famotidine, sucralfate and metronidazole both correlated with an increased prevalence of melena, likely because they were administered only after melena occurred. Omeprazole and IVLE had no significant correlation to the prevalence of melena.

The lack of correlation between gastroprotectants, melena prevalence, and releasability indicates that DCCOs who are BT suspects can undergo successful rehabilitation regardless of melena status or variation in supportive care measures discussed in this study. However, relatively fewer DCCOs who experienced melena

were released (higher mortality) than those who did not, which holds clinical importance even in the face of statistical insignificance. Despite supportive care, melena remains a source of morbidity for these patients, and the need for an improved understanding of gastroprotectants still exists for DCCOs presenting for BT.

The most significant limitation of this study was the variability in gastroprotectant usage and supportive care administered to DCCOs who were retrospectively evaluated. From 2017 to 2021, gastroprotectant protocol for cormorants presenting to CROW with suspected BT incorporated various combinations of famotidine, omeprazole, and sucralfate in addition to routine supportive care (IVLE and metronidazole). The vast variations limit the conclusions that can be drawn.

Current small animal guidelines for the rational use of gastroprotectants indicate that in cases of gastrointestinal erosion and ulceration, gastroprotectants should be considered

standard of care.⁶ However, omeprazole, a proton pump inhibitor (PPI), is more effective at increasing gastric pH than famotidine, a histamine type-2 receptor antagonist (H₂RA), and use of these drugs in conjunction may decrease the effectiveness of the PPI.⁶ In addition, there is only weak evidence that supports the benefit of sucralfate in cases of dogs (*Canis lupus familiaris*) and cats (*Felis catus*) with melena.⁶ At this time, it is unknown if extrapolations about gastroprotectants from small animal medicine apply to avian species, and without prospective pharmacodynamic studies, it is difficult to elucidate accurate correlations about treatment efficacy when comparing these various pharmaceuticals.

Another limitation of the study includes possible inappropriate diagnosis. Only a small subset of these birds during 2021 was confirmed to have BT, and most diagnoses were made based on clinical signs and response to treatment. There is the potential for both false positive and false negative diagnoses of BT based on this method. However, 87% of suspect BT cases at this rehabilitation center were confirmed to be BT by enzyme-linked immunosorbent assay and had been accurately diagnosed in a separate study.¹⁵ In addition, limitations also include variable documentation of

melena occurrence. Although the hemocult testing confirmed that black feces are consistent with a positive fecal hemocult test, not all reports of melena could be verified.

This study emphasizes the need for an improved understanding of the pharmacokinetics and pharmacodynamics of gastroprotectants in avian species due to the high prevalence of melena that can occur secondary to disease. Conducting a prospective study to examine the length of time taken to release, the duration of melena, and the distinct supportive care protocols for DCCOs presenting for BT may improve our understanding of the efficacy of gastroprotectants in avian species and their potential contribution to rehabilitation success.

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Case study: Rehabilitation of a Mexican boa (*Boa sp.*) with severe dysecdysis and growth deficit

Lizardo Bedolla-Ayón¹ and Andrés Estay-Stange²

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Introduction

The popularity of reptiles as pets has increased over the years,¹ however, 90% of the reptile species are extracted from wildlife populations.² The species of the genus *Boa* are widely reproduced in captivity for the purpose of being sold as pets,³ due to their attractive colors, great size, resistance, and relative docility.⁴ They are some of the most common reptiles to be received in rehabilitation centers⁵ because of the pet trade, illegal tenure, and poor maintenance.

Boa constrictor is included in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix II (www.cites.org). In Mexico, *Boa constrictor* is included in the NOM-059-SEMARNAT-2010 as a threatened species.

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ABSTRACT: In this case study, we discuss the rehabilitation of a Mexican boa (*Boa sp.*) who presented with severe dehydration, resulting in severe dysecdysis, which ultimately caused strangulation and necrosis of the tail. These severe medical problems experienced by the Mexican boa were directly attributable to the inadequate conditions in which the snake was kept in captivity after being illegally purchased. In addition, the snake was not fed sufficient amounts of food for six months, which caused a delay in the animal's development. Upon entry into rehabilitation, the snake was provided with a suitable terrarium for its size, and the environmental humidity was kept high through an ultrasonic humidifier to help with sloughing of the retained shed. Furthermore, we established routines of basking and hydration accompanied by the use of aloe vera, vitamin B-1, and vitamin B-3 powders. The snake was also provided with a rodent-based diet and was fed according to its size. This diet helped compensate for the inadequate nutritional intake experienced by the snake during captivity, which led to a delay in growth. The snake's resultant growth after the introduction of the new diet showed the phenomenon of compensatory growth that had not been previously reported in a species of this genus.

KEYWORDS: compensatory growth, dehydration, dysecdysis, environmental humidity, nutritional rehabilitation

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Outlook of medical disorders in boas caused by captivity

Captive reptiles are frequently exposed to various medical conditions when the environmental and dietary parameters necessary for good physical health are not met. The most common medical conditions include dehydration, weight loss⁵, and dysecdysis, which can provoke or worsen other health conditions.⁶

Dysecdysis usually occurs in snakes, although it may develop in any reptile species. It can be caused by many factors, including systemic illness, inadequate environmental temperature,⁷ hyperthyroidism (causing the excessive production of triiodothyronine (T3) and thyroxine (T4) delaying the release of the molt),⁸ wounds, scars, deficient humidity, severe ectoparasite infections, dehydration, and inadequate diet. By far, the most common cause is a deficit in environmental humidity.⁷

Optimal captivity parameters for *Boa constrictor*

The ideal humidity level for most snakes is 50% to 60%.⁷ In the case of *B. constrictor*, the recommended humidity is often higher due to the tropical distribution of the species.⁴ The suggested level is around 50% to 70% during the normal maintenance period with an increase during ecdysis, always taking measures to prevent the snake from remaining on the wet substratum for too long⁹ because excessive humidity can cause blister disease.⁷

Blister disease (also known as vesicular dermatitis) is a common condition in reptiles due to poor environmental management, such as excessive humidity, inadequate substrate, dirty conditions, incorrect temperatures, or any combination thereof. Watery blisters are the first sign. Later, these scales become swollen and infected by opportunistic bacteria (*Pseudomonas* spp.). The infection may enter the body, causing septicemia and affecting internal organs.

Another critical factor for the correct maintenance of *B. constrictor* is the provision of an adequate temperature gradient. During the day, this gradient should consist of temperatures in the range of 27°C to 29°C (80°F to 85°F), with a main heating spot of up to 35°C (95°F), although the temperature could decrease to 25°C without provoking stress on the snake.¹⁰ During the night, the temperature gradient should consist of temperatures between 21°C and 27°C (70°F to 80°F).⁹

Boas are active predators whose diet consists of various vertebrate groups (mammals, birds, reptiles, and fishes).⁴ The suggested diet usually varies between 10% and 20% of the snake's body weight, but these recommendations are merely anecdotal among the herpetoculturists.¹¹ The wrong diet or an improper feeding routine can lead to physiological and ethological problems like malnutrition, anorexia,¹² intestinal obstructions,¹³ and so forth.

Case study

Historically, *B. constrictor* has been considered the only representative of the genus in America, but recent studies of systematics based on molecular characters divide the genus into three species, two of which are distributed in Mexico.¹⁴ However there

is not a consensus due to the lack of diagnostic morphological characters.¹⁵ It is impossible to identify the species of an organism when it has been illegally traded without doing the corresponding molecular analysis or without knowing the locality from which it was extracted. Therefore, the individual in this case study will be referred to as *Boa* spp.

A specimen of *Boa* spp. was presented at the facilities of the Wildlife Conservation Center Konkon (UMA) by the Federal Attorney for Environmental Protection (PROFEPA) on September 15, 2019, coming from an illegal purchase in a local market. It had been kept for a year and a half in a crystal enclosure with wood and coconut fiber substratum, without any humidity source, and with a heat mat as a constant heat source. During that period, the snake never achieved a complete shedding process and displayed severe dysecdysis. The last time it was given food was four months before its presentation to the center because it attacked its former keeper.

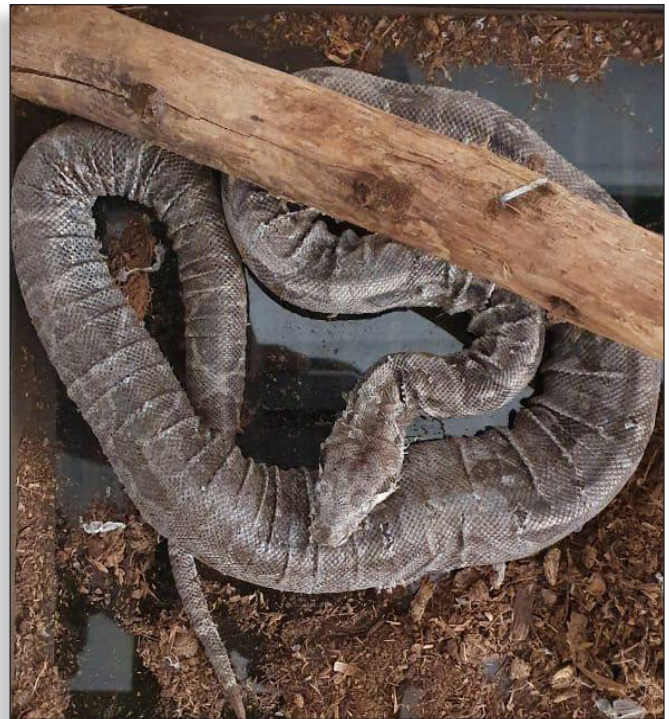


FIGURE 1. Original physical and environmental conditions of the boa upon intake. Severe dysecdysis and an unsuitable habitat are evident.



FIGURE 2. Close-up of the tail strangulation.

At the time of intake, a routine health check was performed. The snake showed sub-optimal development, reaching only 70 cm in length. Boa hatchlings usually reach an average length of 55 cm^{4,16} and weigh from 50 g to 80 g.¹⁶ They normally grow 4 cm to 4.5 cm and gain 280 g to 380 g per month before they achieve their maximum weight in 36 mo to 48 mo,⁴ whereby in one and a half years, this snake should measure at least 127 cm long and weigh more than 5 kg.

Several retained sheds were noticed (Fig. 1), as well as various minor strangulations and a major strangulation with necrosis focalized at the end of the body (last vertebra), provoked by retained sheds (Fig. 2). Severe dehydration was also noticed.

Treatment

The boa was introduced to a 64 cm x 64 cm x 110 cm terrarium since boa constrictors have arboreal habits,⁴ and extra height allows them to have a more varied heat gradient. The terrarium was equipped with an ultrasonic humidifier, which is recommended to maintain high environmental humidity without using a large amount of water,¹⁷ and a heating sunlight bulb plus a night light bulb. These devices maintained a temperature gradient of 24°C to 28°C and a humidity gradient that ranged from 60% to 80%. The snake was sprayed once a day with aloe vera and vitamins B-1 and B-3 diluted in water to help with cutaneous humectation and regeneration. This solution is widely used in the treatment of dermopathies.^{5,18} This treatment was used only until the first shedding.

Twenty-five percent of the snake's weight in mice was initially offered once a week, given the evidence that weekly feeding helps to increase size faster,¹¹ improves metabolic rates, and increases the absorption of nutrients.¹⁹ This diet was provided during the first month and was later reduced to 20% of the snake's body weight in rats because the ingestion of whole mammals meets the complete nutritional input required by carnivorous reptiles.²⁰

The snake was provided with sun-basking hours in filtered sun to promote calcium absorption,²¹ and it was also provided with a UVB (ultraviolet B) bulb in its terrarium. During the basking periods, the snake was set in a receptacle with water to help with the shedding process and to contribute to water consumption,⁶ since it has been proven that the water obtained by prey consumption is not adequate for treating cases of dehydration.²²

Between September 10 and 24, 2019, the boa began to remove the retained shed in pieces. On September 25, the snake was observed with retained shed on the tail strangulation and the right eye, forming a thick layer over the eye that prevented vision. On October 30, the boa again shed in pieces, maintaining the retained shed on the eye. On January 30, 2020, the first almost complete shed (80 cm) occurred without losing the retained shed on the right eye. On March 29, it made the first complete shed (90 cm), finally losing the part that covered the eye (Fig. 3). Subsequently, the snake continued undergoing complete sheds on April 29 (108 cm), May 30 (117 cm), and July 18 (121 cm), when it finally achieved the size it should have been upon entry to the center. On January



FIGURE 3. Shed in which the retained scale on the eye was removed.

13, 2021, it underwent another complete shedding (145 cm). Subsequently, the veterinary staff of the UMA Konkon performed the removal of the necrotic tail, and only a small scar remained (Fig. 4).

The boa's recovery from the growth and body-mass deficit was remarkable, as evidenced by the accelerated weight gain, size increase, and shedding frequency. These observations suggest a process of compensatory growth because a very rapid growth rate should not occur beyond the juvenile period.⁴ Compensatory growth in reptiles has been studied primarily in lizards²³ and marine turtles,²⁴ while few studies have been done in snakes.²⁵

Beyond the intrinsic disadvantages of delayed growth in various animal species,²⁶ the consideration of compensatory growth in constrictor snakes can be controversial because research has proven that the diet during the first months of life is key to the size development of the adult stage.²⁷ Compensatory growth has

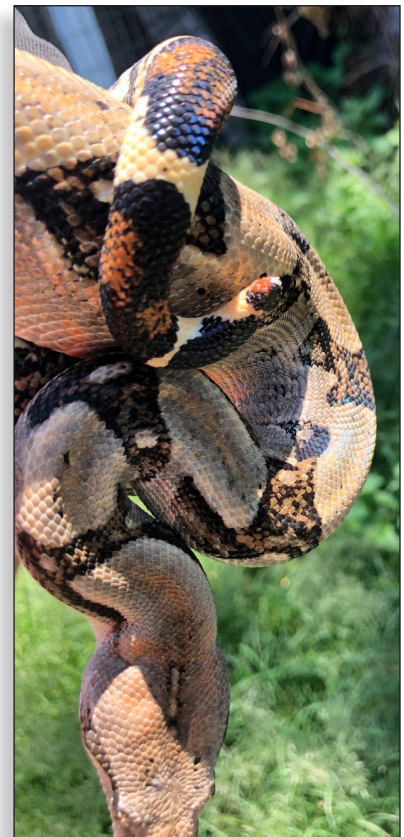


FIGURE 4. Scar caused by tail strangulation.



direct repercussions on an animal's fitness. On the other hand, organisms whose growth does not stop when sexual maturity is reached possess a longer life span (as is the case for the genus *Boa*) and do not tend to be as affected by compensatory growth.²⁴ Therefore, more data is needed to decide if rehabilitated animals with this type of growth are suitable for release.

Conclusion

The recovery process of this Mexican boa was satisfactory. There was a favorable recovery from the problems of dysecdysis and dehydration through the proposed treatment, without resorting to more invasive actions. Also, the correct diet facilitated weight and length gain that did not occur during the prior period of substandard care. We explain this as a process of compensatory growth, which had not been reported for this genus before, proving that correct environmental management and proper diet may improve the quality of life of a neglected snake.

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Overview of oil spills worldwide and impacts on marine megafauna

de Lima Silva FJ, Attademo FLN, Gavilan SA, Rossi S, de Farias DSD, da Costa Bomfim A, et al. *BJCR*. 2024;4:78–94. doi:10.52600/2763-583X.bjcr.2024.4.1.78-94.

Oil spills have a significant impact on the environment, posing threats to various marine species. This review aims to gather information on various oil spills that have occurred worldwide and discuss their impact on marine megafauna (marine mammals, sea turtles, and seabirds), in order to provide useful insights that can be applied in decision-making during rescue and rehabilitation efforts. The publications were obtained from oil spill searches in databases such as Elsevier-Scopus, Scielo, JStor, and Google Scholar. Oil spills can cause lethal damage to marine biodiversity, affecting individuals of different ages and species. Although the acute effects of oil contamination on wildlife are evident, it is challenging to treat and recover from. Hydrocarbons can persist in the environment for a long time, leading to prolonged exposure of animals to the contaminants. In conclusion, this research demonstrates that the effects of oil spills on marine megafauna may not be observed in the short term, such as contamination through the bioaccumulation of compounds in the food chain. It is necessary to conduct systematic studies on local fauna at all developmental stages of oil activities, including seismic research, exploration, and oil distribution to address the impact of oil spills on marine megafauna.

Recovery of ciril bunting, *Emberiza cirius*, song diversity after translocation

Collins SA, Croft S, Jeffs C, Brown S, de Kort SR. *Conserv Sci Pract*. 2023. doi:10.1111/csp2.13060.

In order to improve conservation outcomes translocation or reintroduction of individuals may be necessary. When song learning birds are translocated, changes in



Ciril bunting (*Emberiza cirius*)

the cultural diversity of song repertoires, or abnormal vocalizations, in the new population can be a problem. We monitored song production over 8 years in a reintroduced population of the ciril bunting (*Emberiza cirius*). Chicks were removed from nests in Devon, UK, between 2006 and 2011, translocated at 6 days old to be hand-reared and released in Cornwall, UK. Recordings at the release site in 2011 showed a significantly reduced population repertoire and individuals sang abnormal song types compared to the source populations in Devon. However, recordings in 2019, showed population song repertoire had reached the level of source populations of similar size, and song types were species typical. Our study shows that species can recover from a cultural bottleneck and suggests that, for some song learning birds, if translocation of nestlings is necessary it may not lead to long-term problems for communication and thus population persistence. For future translocations of nestlings, we recommend that efforts are made to provide tutoring to enable song learning. This may be achieved

by providing recordings, but may also include providing adult song tutors. In addition, playback of “normal” songs to translocated populations may aid in development of species typical song repertoires, although care must be taken that this is not disturbing the reintroduced birds.

Amino acid-specific nitrogen stable isotope analysis reveals the trophic behavior of Icelandic fin whales in winter and suggests variable feeding strategies

Rita D, Borrell A, Wodarg D, Víkingsson G, García-Vernet R, Aguilar A, Loick-Wilde N. *Mar Mamm Sci*. 2023. doi.org/10.1111/mms.13097.

Fin whales (*Balaenoptera physalus*) aggregate west of Iceland during summer, where they feed mostly on krill, but their winter distribution is poorly known. This study investigates the winter behavior of fin whales that summer off Iceland by analyzing amino acid-specific nitrogen isotope ratios in the baleen plates. This technique is increasingly used in large marine vertebrates to discriminate between changes in

trophic position and changes in isotopic baseline levels, while ruling out the effect of fasting on these patterns. Analyses were conducted on samples extracted from two baleen plate segments: one corresponding to winter, another to summer. The trophic position was higher and slightly more variable in winter (3.6 ± 0.7) than in summer (3.0 ± 0.4), which indicates that during winter fin whales tend to feed on fish and are more generalist in feeding habits. Interestingly, the $\delta^{15}\text{N}$ values were not lower in winter than in summer (winter: $5.2\text{‰} \pm 2.4\text{‰}$; summer: $4.0\text{‰} \pm 2.1\text{‰}$). This was unexpected because baseline $\delta^{15}\text{N}$ values (e.g., zooplankton) tend to be lower at low latitudes, where fin whales are believed to spend the winter. Fin whales may remain in relatively high latitudes during winter or visit low-latitude areas with locally higher than average $\delta^{15}\text{N}$ values, such as upwelling areas.

Trends of human–wildlife conflicting in Kali Tiger Reserve Forest, Karnataka, South India

Ajith M, Joshi AT, Sushmitha KS, Deshmanya JB, Mohan Kumar B, Deekshith S. *International Journal of Environment and Climate Change*. 2023;13:6. doi:10.9734/ijec/2023/v13i123734.

Human–wildlife conflict (HWC) is a growing concern, impacting both conservation efforts and livelihoods. This study was conducted to analyse trends in wildlife conflicts involving agriculture, cattle, and human injuries from 2015–16 to 2022–23 with a focus on the Kali Tiger Reserve in Karnataka, India. The compound annual growth rate (CAGR) method was used to assess the data, revealing critical insights. Agriculture–wildlife conflict showed an overall upward trend with a CAGR of 3.16 per cent. Notably, there was a significant increase in 2016–17, followed by fluctuations in subsequent years. This conflict arises due to natural habitat fragmentation and deterioration resulting animals encroaching on agricultural fields. Cattle–wildlife conflict exhibited a CAGR of 8.20 per cent, indicating a gradual increase with fluctuating cases from year to year. Tigers and leopards

pose a threat to farmers who graze cattle near the forest reserves. Innovative solutions are required to balance the synergy of agriculture production and wildlife management policy. Human injuries due to wildlife displayed fluctuations, with a slight overall decrease (CAGR -0.47%) in the number of cases and an increase of 2.66 per cent in compensation. These incidents occur when people venture into forests for various reasons. Proper regulations and permissions are necessary to minimize such encounters. Overall compensation payments showed a CAGR of 5.83 per cent, reflecting fluctuating growth rates and significant changes in 2022–23. The forest and wildlife conservation sectors determine compensation based on specific factors for crop loss, cattle deaths, and human injuries. However, conflicts related to human injuries have shown a declining trend. The study suggests relocating rehabilitation efforts away from forest buffer zones and introducing off farm activities for affected communities to reduce their dependence on the forest.

Iatrogenic gas embolism in a juvenile loggerhead sea turtle (*Caretta caretta*)

Suárez-Pérez A, Orós J. *J Comp Pathol*. 2024;208:50–3. doi:10.1016/j.jcpa.2023.12.002.

A mild pneumocoelom was diagnosed by computed tomography in a stranded juvenile loggerhead sea turtle (*Caretta caretta*). After gas extraction by ultrasound-guided puncture, the animal did not improve and was subjected to hyperbaric oxygen therapy (HBOT). After HBOT, the turtle developed marked subcutaneous emphysema and was found dead the following morning. Gross lesions included a distended right atrium with numerous gas bubbles within the epicardium, gas bubbles in the hepatic, gastric and mesenteric veins, a small gas-filled bulla in the left lung and diffuse haemorrhages in the encephalon. Histological lesions included gas-like emboli in the lumen of the right atrium with myocardial necrosis, gas-like emboli in the lumina of intestinal, pulmonary and renal blood vessels and severe meningeal

haemorrhages. From a forensic pathology perspective, the subcutaneous emphysema of immediate onset after HBOT and the greater severity of the histological lesions in blood vessels, heart, lung and brain differentiate this case from other cases of gas embolism in turtles due to incidental capture. Two factors contributed to this outcome: the existence of a probably unresolved pneumocoelom and the application of HBOT without an initial diagnosis that accurately indicated its use. Therefore, as in human medicine, the use of HBOT in sea turtles with lung lesions and pneumocoelom is discouraged. This is the first description of an iatrogenic gas embolism in a sea turtle.

Sequence capture identifies fastidious chytrid fungi directly from host tissue

Mulder KP, Savage AE, Gratwicke B, Longcore JE, Bronikowski E, Evans M, Longo AV, Kurata NP, Walsh T, Pasmans F, McInerney N, Murray S, Martel A, Fleischer RC. *Fungal Genet Biol*. 2023;170:103858. doi:10.1016/j.fgb.2023.103858.

The chytrid fungus *Batrachochytrium dendrobatidis* (Bd) was discovered in 1998 as the cause of chytridiomycosis, an emerging infectious disease causing mass declines in amphibian populations worldwide. The rapid population declines of the 1970s–1990s were likely caused by the spread of a highly virulent lineage belonging to the Bd–GPL clade that was introduced to naïve susceptible populations. Multiple genetically distinct and regional lineages of Bd have since been isolated and sequenced, greatly expanding the known biological diversity within this fungal pathogen. To date, most Bd research has been restricted to the limited number of samples that could be isolated using culturing techniques, potentially causing a selection bias for strains that can grow on media and missing other unculturable or fastidious strains that are also present on amphibians. We thus attempted to characterize potentially non-culturable genetic lineages of Bd from distinct amphibian taxa using sequence capture technology on DNA extracted

from host tissue and swabs. We focused our efforts on host taxa from two different regions that likely harbored distinct Bd clades: (1) wild-caught leopard frogs (*Rana*) from North America, and (2) a Japanese Giant Salamander (*Andrias japonicus*) at the Smithsonian Institution's National Zoological Park that exhibited signs of disease and tested positive for Bd using qPCR, but multiple attempts failed to isolate and culture the strain for physiological and genetic characterization. We successfully enriched for and sequenced thousands of fungal genes from both host clades, and Bd load was positively associated with number of recovered Bd sequences. Phylogenetic reconstruction placed all the *Rana*-derived strains in the Bd–GPL clade. In contrast, the *A. japonicus* strain fell within the Bd–Asia3 clade, expanding the range of this clade and generating additional genomic data to confirm its placement. The retrieved ITS locus matched public barcoding data from wild *A. japonicus* and Bd infections found on other amphibians in India and China, suggesting that this uncultured clade is widespread across Asia. Our study underscores the importance of recognizing and characterizing the hidden diversity of fastidious strains in order to reconstruct the spatiotemporal and evolutionary history of Bd. The success of the sequence capture approach highlights the utility of directly sequencing pathogen DNA from host tissue to characterize cryptic diversity that is missed by culture-reliant approaches.

Threats to health and conservation of free-living sloths (*Bradypus* and *Choloepus*) under anthropic influence in the city of Manaus, Amazonas state, Brazil

Santos LS dos, Teixeira CR, Nava AFD, Chiesorin Neto L, Ichikawa RS, Rahal SC. *Biota Neotrop.* 2023;23:e20231476. doi:10.1590/1676-0611-BN-2023-1476.

Anthropogenic disturbances affecting forest areas can increase disease prevalence and susceptibility in several species of arboreal mammals, such as sloths. Thus, this study aimed to evaluate the most common



Brown-throated sloth (*Bradypus variegatus*) is a species of three-toed sloth.

conditions in body systems of free-ranging sloths admitted at the Wildlife Triage and Rehabilitation Center of Amazonas of the Institute of Environment and Renewable Natural Resources. A total of 227 individuals (139 retrospective cases from 2015 to 2019, and 88 prospective cases from July 2020 to July 2021) were evaluated over a six-year period. Cases from the genus *Bradypus* showed involvement of the following body systems: 44% respiratory, 29% integumentary, 15% musculoskeletal, 5% digestive, 3% visual, 2% auditory, 1% circulatory and 1% genitourinary, while that distribution in the genus *Choloepus* was: 39% musculoskeletal, 27% integumentary, 19% respiratory, 9% digestive, 3% circulatory, 1% visual, 1% auditory and 1% genitourinary. The results reveal significant differences between the condition detected and the genus (*Bradypus* and *Choloepus*), age and case outcome. These results can provide data for future investigations of sloth diseases, confirming lesions, as well as motivating and suggesting adequate management methods.

Raptor pediatrics

Duvall A. *Vet Clin North Am Exot Anim Pract.* 2023. doi:10.1016/j.cvex.2023.11.012.

Neonatal and juvenile raptors may differ from adults in their husbandry, disease predispositions, and medical therapies. There are differences between captive

bred juveniles and those presented for rehabilitation to the wild, which must be taken into consideration for successful long-term outcomes. In captive settings, many metabolic and infectious diseases may be linked to problems with diet. The successful rehabilitation and release of wild raptor chicks requires special precautions beyond avoiding imprinting.

Wildlife pediatrics

Dominguez-Villegas E. *Vet Clin North Am Exot Anim Pract.* 2023. doi:10.1016/j.cvex.2023.11.014.

Injured, sick, and orphaned wildlife neonates arrive by the thousands to wildlife rehabilitation centers, veterinary hospitals, and wildlife hospitals in North America. With the ultimate goal of releasing them back into the wild, veterinarians need to know the ecology, biology, and specific problems encountered by the various species of wildlife.

Is a blunt sword pointless? Tooth wear impacts puncture performance in Tasmanian devil canines

Pollock TI, Hocking DP, Evans AR. *J Exp Biol.* 2023. doi:10.1242/jeb.246925

As teeth wear, their shapes change and functional features can be dulled or lost, presumably making them less effective for feeding. However, we do not know the magnitude and effect of this wear.

Using Tasmanian devil canines as a case study, we investigate the impact of wear on puncture in pointed teeth. We measured aspects of shape impacted by wear (tip sharpness, height, and volume) in teeth of varying wear followed by 3D printing real and theoretical forms to carry out physical puncture tests. Tooth wear acts in two ways: by blunting tooth tips, and decreasing height and volume, both of which impact performance. Sharper tips in unworn teeth decrease the force and energy required to puncture compared to blunter worn teeth, while taller unworn teeth provide the continuous energy necessary to propagate fracture relative to shorter worn teeth. These wear-modulated changes in shape necessitate more than twice the force to drive worn teeth into ductile food and decrease likelihood of puncture success.

A retrospective analysis of admission trends and outcomes in a wildlife rescue and rehabilitation center in Costa Rica

Costa MM, Pinto da Cunha N, Hagnauer I, Venegas M. *Animals*. 2023;14:51. doi:10.3390/ani14010051.

The evaluation of data regarding rehabilitation practices provides reference values for comparison purposes among different rehabilitation centers to critically review protocols and efficiently improve each center. The aim of the present work was to present the main causes of admission to Rescate Wildlife Rescue Center for each taxonomic group, to determine the admission factors that influenced the release and mortality, and to determine the predictive factors of release and mortality of wildlife. To this end, a retrospective study was carried out based on 5785 admissions registered in the database of Rescate Wildlife Rescue Center in Costa Rica in 2020 and 2021. Statistical analysis consisted of sample characterization via the analysis of several categorical variables: species, order, class, age group, cause of admission, outcome, clinical classification and days in the hospital, and respective association with the mortality or release rate. Most of the rescue animals were birds (59.3%), then mammals (20.7%), reptiles (17.4%), and

finally 'others' (2.6%). The main causes of admission were 'captivity' (34.9%), 'found' (23.3%), and 'trauma' (19.3%). Animals rescued due to 'captivity' and the classes 'birds' and 'reptiles' had the highest release rates. The causes of admission 'trauma' and 'orphanhood' and the class 'birds' had the highest mortality rates. In general, a greater number of days spent in the hospital and membership in the classes 'reptiles', 'juveniles', in need of 'basic care', or 'clinically healthy' were predictors of survival. In contrast, the age groups 'infant' and 'nestling' were predictors of mortality. These results demonstrate the value of maintaining, improving, and studying databases from wildlife rehabilitation centers, as they can provide useful information that can be used to enhance the allocation of economic resources, treatment methods, disease surveillance, public education, and regulatory decision-making, leading to a better understanding of threats to wildlife and subsequent implementation of conservation actions.

Shorebirds plastic ingestion: a multispecies analysis of ingestion rates and feeding ecology

Wijaya BN. Thesis. [Auckland (NZ)]:University of Auckland; 2023. <https://researchspace.auckland.ac.nz/handle/2292/66913>.

Plastic is a common pollutant that now has become prevalent in the environment and negatively affect wildlife. Birds are among the most vulnerable group of animals to pollution. Many seabird species have been recorded to ingest plastic and many studies have been done to cover this topic. However, this topic is still understudied in shorebirds. Despite past research show 21 shorebird species ingest plastic, the amount of literature for shorebird plastic ingestion is still low considering there are 246 known extant shorebird species. Aotearoa New Zealand is the habitat for 72 shorebird species. Some of these species are migratory species using New Zealand as their wintering ground. Research overseas indicate that plastic ingestion affects fat deposition in shorebirds negatively, which could put these migratory species at risk. However, little study of shorebird plastic

ingestion in New Zealand has been done. Moreover, study regarding the biology of New Zealand shorebirds is still scarce and how plastic ingestion relate to shorebird biology is not well known. In this thesis I aim to explore plastic ingestion in six New Zealand shorebird species: variable oystercatcher (*Haematopus unicolor*), South Island pied oystercatcher (*Haematopus finschi*, Haematopodidae), bar-tailed godwit (*Limosa lapponica*, Scolopacidae), red knot (*Calidris canutus*, Scolopacidae), pied stilt (*Himantopus himantopus*, Recurvirostridae), and wrybill (*Anarhynchus frontalis*, Charadriidae). I also explore their morphology and sensory ecology to see how these factors relate to their foraging ecology and plastic ingestion. This thesis also provides first record of shorebird plumage colouration measurements. Using morphological and sensory feature measurements from shorebird specimens from museums, a wildlife rehabilitation centres, beach wrecked cadavers, and Massey University. I found that shorebird species in New Zealand differ in their morphological and sensory features, whether these measurements relate to their foraging strategy is still not conclusive. From shorebird spectral measurement I found that reflection of ultraviolet wavelengths is not prevalent in shorebird plumage, but is strongly present on wrybill and pied stilt head and breast. Through dissection of shorebird cadaver combine with sediment and faecal analyses, I found that shorebird species in New Zealand do ingest plastic and the rates of ingestion correlate to their sensory ecology. I hope this thesis provides a useful first snapshot of plastic ingestion rates in New Zealand shorebirds.

Trends in admissions and outcomes at a British wildlife rehabilitation centre over a ten-year period (2012–2022).

Mullineaux E, Pawson C. *Animals*. 2023;14(1):86. doi:10.3390/ani14010086.

Millions of animals pass through wildlife rehabilitation centres (WRCs) globally each year, some dying in captivity, others euthanised, and some released into the wild. Those caring for these animals

are generally well-intentioned, but skills, knowledge, and resources may be limited, potentially compromising animal welfare. WRC databases provide an opportunity to provide an evidence base for treatment and conservation efforts. Over a 10-year period, 42,841 records of animals that were admitted to a British WRC were analysed. More birds (69.16%) were admitted than mammals (30.48%) and reptiles and amphibians (0.36%). Most admissions were in the summer (48.8%) and spring (26.0%) months. A total of 9 of the 196 species seen made up 57% of admissions, and hedgehogs were the most common species admitted (14% of all admissions and 20% of mammals). Juvenile animals (35.5%) were admitted more frequently than 'orphans' (26.0%) or adults (26.4%). 'Orphaned' was also the predominant reason for admission (28.3%), followed by 'injured' (25.5%). 42.6% of animals were eventually released back to the wild, 19.2% died in captivity, and 37.2% were euthanised; 1% of outcomes were unknown. The prognosis was better for orphaned animals than for those admitted because of injury. Unexpected natural deaths in captivity were found to decline over the period of study, consistent with improved early triage. These findings can be used to focus veterinary and WRC training and seasonal resources on the species and case types most likely to be successfully rehabilitated and released. The findings also have the potential to contribute to our understanding of anthropogenic impacts, historical and regional variations in ecosystem health, and resultant implications for animal welfare.

Disease-driven top predator decline affects mesopredator population genomic structure

Beer MA, Proft KM, Veillet A, Kozakiewicz CP, Hamilton DG, Hamede R, McCallum H, Hohenlohe PA, Burridge CP, Margres MJ, et al. *Nat Ecol Evol.* 2024. doi:10.1038/s41559-023-02265-9.

Top predator declines are pervasive and often have dramatic effects on ecological communities via changes in food web dynamics, but their evolutionary

consequences are virtually unknown. Tasmania's top terrestrial predator, the Tasmanian devil, is declining due to a lethal transmissible cancer. Spotted-tailed quolls benefit via mesopredator release, and they alter their behaviour and resource use concomitant with devil declines and increased disease duration. Here, using a landscape community genomics framework to identify environmental drivers of population genomic structure and signatures of selection, we show that these biotic factors are consistently among the top variables explaining genomic structure of the quoll. Landscape resistance negatively correlates with devil density, suggesting that devil declines will increase quoll genetic subdivision over time, despite no change in quoll densities detected by camera trap studies. Devil density also contributes to signatures of selection in the quoll genome, including genes associated with muscle development and locomotion. Our results provide some of the first evidence of the evolutionary impacts of competition between a top predator and a mesopredator species in the context of a trophic cascade. As top predator declines are increasing globally, our framework can serve as a model for future studies of evolutionary impacts of altered ecological interactions.

Potential and mitigation analysis of Nipah beach forest ecosystem changes, North Lombok Regency as a sea turtle habitat

Syaputra M, Wahyuningsih E, Suparyana PK, Permatasari D, Lestari AT. *MUDIMA.* 2023;3:2632–44. doi:10.55927/mudima.v3i12.7339.

The Nipah beach forest in Malaka Village is used as a nesting habitat for sea turtles, which are protected and endangered wild animals in Indonesia. In current conditions, the Nipah Beach forest ecosystem is faced with development, economic growth, and the community's high demand for land so the integrity of the turtle habitat in the area is threatened. Analysis of potential changes in wildlife habitat is important to carry out at Nipah Beach, Malaka Village, and is interrelated with efforts to prepare plans and strategies for

handling and protecting turtle biodiversity itself. This research aims to 1). Knowing the characteristics of turtle diversity in the Nipah Beach forest area, North Lombok Regency. 2). Changes potential analyzing for Nipah Beach forest ecosystem, North Lombok Regency as a sea turtle habitat. 3). Develop a mitigation plan for changes in the Nipah Beach forest ecosystem, North Lombok Regency as a sea turtle habitat. Measuring sea turtle diversity was carried out using the observation method, while risk analysis of habitat change in this study was carried out using risk analysis techniques using SNI/ISO 31010, and mitigation plans were prepared using the Mitigation Hierarchy. The results obtained were analyzed using risk analysis based on AS/NZS Australian/New Zealand Risk Management Standard 4360 (2004). The conclusions of this research are: 1). Sea turtle diversity on Nipah Beach consists of three species, namely the Hawksbill turtle (*Eretmochelys imbricata*), Green turtle (*Chelonia mydas*), and Olive ridley turtle (*Lepidochelys Olivacea*). The important habitat for turtles on Nipah Beach is at stations 2, 3 and 5. 2). Potential changes to the Nipah Beach forest ecosystem are divided into five degrees of change, from mild to disaster. The highest degree of change occurs if the important nesting habitat of the Hawksbill turtle (Critical Endangered IUCN) is disturbed/lost on a large scale. 3). Mitigation steps in protecting the Nipah Beach forest ecosystem for sea turtle habitat consist of avoiding, minimizing, rehabilitation and balancing.

Hematology and biochemistry reference intervals for rehabilitated European badgers (*Meles meles*)

Gelli D, Gerardi G, Lai O, Stefani A, Contiero B, Segato S. *J Zoo Wildl Med.* 2024;54(4):801–4. doi:10.1638/2023-0035.

The goal of this study was to establish routine reference intervals (RI) for common laboratory tests for the European badger (*Meles meles*). Blood samples were collected from 13 female and 11 male adult European badgers in a wildlife rehabilitation facility and used for standard hematology and biochemistry analyses. The established

95% RI (2.5th–97.5th percentile) were determined by either parametric (normally distributed data) or robust (nonnormal data) statistical methods and showed a lower range of variability compared with those reported in previous literature. Sex did not affect any investigated parameters. As the first RI study on free-living European badgers in Italy, these reported hematology and serum chemistry RI provide a set of accurate and reliable laboratory parameters for this species.

Environmental DNA from soil reveals the presence of a “lost” Afrotherian species

Mynhardt S, Matthew E, le Roux JP, Little I, Bloomer P, Theron C. *Biodivers Conserv*. 2023. doi:10.1007/s10531-023-02728-2

Environmental DNA (eDNA) sampling has attracted worldwide attention over the past few years as an emerging approach to characterising and monitoring biodiversity, and has become particularly important for species that are rare, elusive or endangered. Most animal studies to date have focused on aquatic taxa; studies on other metazoan taxa, particularly wildlife in terrestrial environments, are scarce, with only a handful utilizing soil sources. We aimed to investigate the use of DNA barcoding from soil eDNA in (1) detecting rare/elusive/threatened species and (2) as a tool to investigate and potentially monitor range distributions. Through extensive eDNA sampling along the west coast of South Africa, we aimed to refine the distributions of four golden mole species thought to occur there, and specifically to determine whether De Winton’s golden mole, *Cryptorchloris wintoni* (IUCN Critically Endangered; Possibly Extinct), is in fact extant or extinct. Sequences were generated for three barcode markers (mtDNA cytb, 12S and nuclear GHR) using next-generation amplicon sequencing. Tissue samples from four specimens were used to generate reference sequences for species identification, along with available GenBank sequences. We were able to (1) successfully detect all four species in our data, and (2) improve records of the distributions of these species. Furthermore, we uncovered cryptic

diversity in *Eremitalpa granti*. Our data conclusively reveal the presence of the elusive *Cryptorchloris wintoni* and suggest that this species may in fact be widespread, but not necessarily abundant, and certainly less so in areas subjected to mining activities, which continue to pose a threat to the species.

African savanna raptors show evidence of widespread population collapse and a growing dependence on protected areas

Shaw P, Ogada D, Dunn L, Buij R, Amar A, Garbett R, Herremans M, Virani MZ, Kendall CJ, Croes BM, et al. *Nat Ecol Evol*. 2024;8:45–56. doi:10.1038/s41559-023-02236-0.

The conversion of natural habitats to farmland is a major cause of biodiversity loss and poses the greatest extinction risk to birds worldwide. Tropical raptors are of particular concern, being relatively slow-breeding apex predators and scavengers, whose disappearance can trigger extensive cascading effects. Many of Africa’s raptors are at considerable risk from habitat conversion, prey-base depletion and persecution, driven principally by human population expansion. Here we describe multiregional trends among 42 African raptor species, 88% of which have declined over a ca. 20–40-yr period, with 69% exceeding the International Union for Conservation of Nature criteria classifying species at risk of extinction. Large raptors had experienced significantly steeper declines than smaller species, and this disparity was more pronounced on unprotected land. Declines were greater in West Africa than elsewhere, and more than twice as severe outside of protected areas (PAs) than within. Worryingly, species suffering the steepest declines had become significantly more dependent on PAs, demonstrating the importance of expanding conservation areas to cover 30% of land by 2030—a key target agreed at the UN Convention on Biological Diversity COP15. Our findings also highlight the significance of a recent African-led proposal to strengthen PA management—initiatives considered fundamental to safeguarding global biodiversity, ecosystem functioning and climate resilience.

A novel feeding platform design for behavioral research on wild Tanimbar corellas (*Cacatua goffiniana*)

O’Hara M, Auersperg AMI, Prawiradilaga DM, Huber L, Mioduszewska B. *Front Ecol Evol*. 2024;11. doi:10.3389/fevo.2023.1275949.

The study of animal behaviour and cognition would not be complete without investigations of wild, free-ranging individuals in their natural environment. However, direct observations of species living in dense habitats can be challenging, leading many studies to focus on attracting target species to pre-selected, monitored locations baited with food. So far, researchers have rarely applied this approach to studying wild psittacines—an avian group of high scientific interest due to their advanced cognitive skills and conservation threats. We developed hoistable feeding platforms and tested their suitability for reliably attracting groups of wild Tanimbar corellas (hereafter: Goffins), opportunistic feeding generalists well-known for their advanced cognitive skills. To this end, we recorded the visitation rates of free-ranging groups at feeding platforms temporarily baited with dry corn. Moreover, we investigated the effects of several weather-related measures, the temporal distribution of foraging activity, and the effect of conspecific contact calls (playback stimulus). The results indicate that Goffins accepted the feeding platforms and reliably aggregated within their natural daily foraging bouts. While group size during visitation bouts depended on rainfall and resource abundance, platforms were still regularly visited by fewer, possibly locally residing individuals. These results provide the first systematic investigation of the temporal distribution and social dynamics of foraging bouts in wild Goffins. This study presents a novel method for reliably attracting wild opportunistic feeding generalist psittacines to a standardised, monitored location. It provides a suitable approach for observing foraging aggregations and, in the future, testing the problem-solving abilities of free-ranging Goffins in their natural habitat. ■

TAIL ENDS



At first Henry went to yoga for the chicks, but with his improved mental health he could finally be at peace with the bird looking back from his reflection.

American White Pelican

Pelecanus erythrorhynchos

IUCN Red List—Least Concern, Population Trend – Stable

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Tanimbar corolla (*Cacatua goffiniana*) in Changi Village, Singapore.

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