

The Importance of Using Images for Analysis and Assertive Therapy in the Conservation Process of Sea Turtles Victims of Strandings and Fishing on the South Coast of São Paulo, Brazil

La Importancia del Uso de Imágenes para Análisis y Terapia Asertiva en el Proceso de Conservación de Tortugas Marinas Víctimas de Varamientos y Pesca en el Litoral Sur de São Paulo, Brasil

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Lorraine dos Santos Silva

Veterinary Medicine undergraduate student at Faculdade Mais de Ituiutaba - FACMAIS-MG

Institution: Institute of Marine Biology and the Environment/IBIMM

Address: Avenida Trinta e um- Ituiutaba- MG- CEP: 38300-104

E-mail: lorraine.santos@aluno.facmais.edu.br

Jessica Duemes

Postgraduate in Veterinary Medicine from Estácio de Sá University - RJ

Institution: Institute of Marine Biology and Environment/IBIMM

Address: Av. Tancredo Neves, 204, apto 103. Ilhéus - BA - CEP: 45655-120

E-mail: jessicaduemes@gmail.com

Rodrigo Rabello de F. C. e F. Passos

Master's Degree in Veterinary Sciences from the Federal University of Uberlândia - UFU

Institution: Institute of Marine Biology and the Environment/IBIMM

Address: Av. Tancredo Neves, 204, apto 103. Ilhéus - BA - CEP: 45655-120

E-mail: rodrigorabello77@gmail.com

Diego Henrique Cortez

Postgraduate in Medical Practice for Unconventional Pets from FAMESP-SP

Institution: Institute of Marine Biology and the Environment/IBIMM

Address: Rua Duque de Caxias, 593 - Vila Pinheiro- Pirassununga-SP - CEP: 13630-390

E-mail: Diegocortez_vet@hotmail.com

Tatiane Gonçalves de Lima

Graduating in Biological Sciences from the Cruzeiro do Sul University in São Paulo

Institution: Institute of Marine Biology and Environment

Address: Fazenda Palmares - Santa Cruz das Palmeiras-SP- CEP: 13650-000

E-mail: tatiane@ibimm.org.br

Edris Queiroz Lopes

PhD in Morphological Sciences from FMVZ - University of São Paulo - USP

Institution: Institute of Marine Biology and Environment - IBIMM

Address: Fazenda Palmares - Santa Cruz das Palmeiras- SP- CEP: 13650-000

E-mail: edris@ibimm.org.br

1 INTRODUCTION

The effect of a globalized, consumption-driven society has serious repercussions on marine biodiversity (Duckett and Repaci, 2015).

In addition to solid waste, many toxic substances used in agriculture and industry are released untreated into the river and marine environment and enter food chains, affecting the lives of many species. Fishing gear abandoned in the marine environment is also responsible for the deaths of thousands of marine animals every year, known as "ghost fishing" (Gilardi and Gilman 2010).

One of the most recent global threats to marine life is pollution from plastic waste (Barnes et al., 2009; Browne et al., 2011; Cole et al., 2011; Derraik, 2002). The accumulation of anthropogenic waste in the ocean is considered a growing threat to marine fauna. Almost 700 species of marine animals, including megafauna such as sea turtles and whales, are threatened by ingestion or interaction with solid waste (Pfaller et al., 2020).

Lopes et al., (2019) describes that of the seven species of sea turtles in the world, five of them can be found along the Brazilian coast, with emphasis on the green turtle *Chelonia mydas* (Linnaeus, 1758), considered threatened by the International Union for Conservation of Nature and Natural Resources (IUCN) (Seminoff, 2004), being the only species of herbivorous turtle, occupying a unique niche among sea turtles.

As these turtles have a long life cycle and late sexual maturation, knowledge and protection of feeding and growing areas are crucial for conservation, as reducing mortality of immature stages allows more specimens to reach reproductive age (Almeida et al., 2011).

When solid waste is ingested, there may be partial or total obstruction of the gastrointestinal tract, with the formation of large masses of dry, hardened feces, known as fecalomas (Lazar and Gracan, 2011). If the amount of feces in the intestine is prolonged, it can generate a large amount of gas and the animals may lose the ability to submerge to search for food and escape predators (Bjorndal, 1997).

In addition, injuries caused by ingested fragments can compromise tissue vascularization, as well as causing lesions and ulcers, thus compromising nutrient absorption. Nutrient absorption is severely compromised and can lead to cachexia (i.e. the continuous loss of adipose tissue and muscle mass), which culminates in death (Nelms et al., 2015).

Radiology is the imaging technique that stands out most in the clinical routine of wild animals (Zoller et al., 2019; Pinto, 2020), as it is cost-effective, non-invasive, allows research into various diseases and is easily accessible (Bortolini et al., 2013; Thrall, 2014; Pinto, 2020). Radiological examination plays a crucial role in the diagnosis of different species, helping veterinarians to detect various pathologies (Thrall, 2014; Pinto, 2020).

In the wild animal clinic, diagnostic imaging techniques are often used to complement clinical assessment, since wild animals arrive at screening centers with no clinical history available and some reptile species have complex anatomies that make clinical assessment difficult (Divers and Stahl, 2019; Dutra, 2020).

However, other diagnostic imaging techniques, such as ultrasound, computed tomography and magnetic resonance imaging, have gained popularity as complementary diagnostic methods, contributing to both the welfare and conservation of species (Valente, 2007; Zoller et al., 2019).

Through the use of computerized images (Lopes et al., 2019), an unprecedented discovery was made about 02 new bones located in the hyoid of the green turtle (*Chelonia mydas*) and opened new doors about the importance of using images for previously unknown accesses in this area and as a tool for less invasive methods that help in the veterinary medical clinic of these animals.

The large presence of marine litter, incidental fishing, predatory fishing and the large number of garbage dumped in the oceans, contributes every day to the emergence of very serious cases related to the ingestion of solid waste and the compaction of the gastrointestinal system of sea turtles, since all the procedures to be performed on these animals are very complex and invasive. Therefore, the use of diagnostic therapies with the use of images will greatly contribute to solving problems (Lopes et al., 2021).

This study aims to contribute to the emphasis on environmental pollution caused by human consumerism and the lack of environmental awareness and education, highlighting the importance of imaging for the assertive diagnosis and treatment of sea turtles and the lack of equipment in rehabilitation centers.

2 MATERIALS AND METHODS

This work was based on a search for specific literature in the databases of renowned institutions that treat and rehabilitate marine animals, registered with the federal government's environmental agencies, such as IBAMA and ICMBIO. These include the Gremar Institute, the Federal University of Paraná, the Institute of Marine Biology and the Environment and the Tamar Project. This project was submitted to the Bioceua-IBIMM Ethics Committee on August 4, 2023 and approved on August 14, 2023, under number 0031/2023.

3 RESULTS

After evaluating the use of the images, we can see the most important and common findings affecting this group of animals that were captured and underwent radiological evaluation in Rehabilitation Centers (RC) on the Brazilian coast. Figure 1 shows the presence of marine litter ingestion by the green turtle (*Chelonia mydas*).

Figure 1. X-ray - showing a sample of garbage found in the digestive system of a green turtle - *Chelonia mydas* (lighter part of the image - yellow circle) - Photo: Divulgação/UFPR.



In the image in Figure 2, x-rays show the presence of three fishing hooks, ingested by sea turtles and stuck in the animal's esophagus.

Figure 2 - X-ray examination of a sea turtle shows three fishing hooks stuck in its esophagus - Photo: Divulgação/Instituto Gremar.



Figure 3 shows the positioning and techniques for radiographing a specimen of loggerhead turtle (*Caretta caretta*) for complementary imaging tests.

Figure 3 - Loggerhead turtle (*Caretta caretta*) X-ray image examination. -Photo: Gremar Institute.



Figure 4 shows the techniques used for restraint, anesthesia and the use of X-ray images to aid in diagnostic therapy for surgery to remove a fishing hook stuck in the esophagus of a loggerhead turtle (*Caretta caretta*).

Figure 4 - X-ray and surgery to remove a fishing hook from the oesophageal cavity of a loggerhead turtle (*Caretta caretta*) - Photo: Tamar Project.



Figure 5 shows the use of X-rays to assess a deep lesion in the pectoral fin joint of a sea turtle.

Figure 5 - X-ray of the right fin of a sea turtle with a deep lesion in the joint.



Photo: Divulcation/UFPR.

4 CONCLUSION

It is well known that sea turtles can ingest fishing hooks, plastic or other foreign objects, which can cause internal injuries. X-rays can help identify the presence of these objects, bone fractures, internal damage or even digestive problems.

With this study, we have identified that in addition to the pollution caused by human consumerism, ghost fishing also has a major negative impact on the lives of sea turtles. Ghost fishing is caused by lost, abandoned or irregularly discarded equipment in the oceans - which continues to drift, catch fish and threaten the lives and well-being of thousands of marine species.

Because they are specific materials for fishing and catching, these gears are incredibly resistant and end up hurting, trapping and causing slow and painful deaths not only to Sea Turtles, but to the thousands of animals that accidentally become entangled.

In addition to clinical diagnosis and treatment, images are a valuable source of data for researchers studying sea turtles. They provide detailed information on the anatomy, physiology and pathology of these animals, helping to increase knowledge about their health needs and contribute to the conservation of the species.

Images of injured or sick sea turtles can be powerful educational and awareness-raising tools. They help raise public awareness of the challenges these animals face and the importance of conserving marine life. The results presented here could support the development of public policies to obtain X-ray equipment for the Rehabilitation Centers and more Environmental Education actions focused on the conservation of Sea Turtles and the Marine Ecosystem as a whole and that encourage communities, not just coastal ones.

There are many diagnostic limitations in the use of images to check for diseases that can affect these animals, as many species vary greatly in size, which makes it difficult to use radiological therapies, as the equipment available for these examinations is large and complex, not to mention the fact that most of the time the animals are in the marine environment, making it practically impossible to move them to an appropriate place to carry them out. Therefore, seeking mitigating measures to aid therapy and veterinary medical treatment is very important, not to mention the importance of environmental education in communities and interactive fishing by fishermen, especially with regard to the use of hooks and other tackle.

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