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RESEARCH ARTICLE OPEN ACCESS

REHABILITATION OF A LOGGERHEAD SEA TURTLE (*Caretta caretta*) IN THE PROGRAMA TARTARUGA VIVA, RJ, BRAZIL

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ABSTRACT

The Loggerhead Sea Turtle (*Caretta caretta*) case study presented herein, rescued and rehabilitated within the *Programa Tartaruga Viva*, sheds light on the severe threat posed by anthropogenic solid waste and particularly plastics to marine species. The ingestion of plastic residues resulted in significant complications, including intestinal obstruction, positive buoyancy, and feeding difficulties. A multidisciplinary approach, involving radiographic examinations, veterinary procedures, and an effective treatment and rehabilitation protocol, proved instrumental in the successful recovery of the turtle. This case underscores the pressing need for integrated efforts from society, science, industries, and the government to address and mitigate the environmental impact of anthropogenic waste on marine life.

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INTRODUCTION

The coast of the state of Rio de Janeiro plays a crucial role in the conservation of sea turtles, either by hosting the boundary (latitudinal) areas of reproduction or various feeding areas scattered throughout its coastal extension, including the Ilha Grande Bay. This bay, located south of the state of Rio de Janeiro, is officially considered a marine biodiversity hotspot on the Brazilian coast, characterized by its preservation status of natural marine ecosystems. Anthropogenic pressure sources in the region are also well-known (Bastos & Callado 2009; Inea 2015;UERJ/TRANSPETRO, 2015; Rocha *et al*., 2016, FAO, 2018, Corrêa-Silva *et al.*, 2021; Corrêa-Silva *et al.*, 2023). Among these sources, the presence of an oil and derivatives transfer and storage terminal (TEBIG), a shipyard, a growing real estate occupation of the coastline, and the presence of two nuclear power plants (Angra I and Angra II), with a third under construction, stand out. The populations of sea turtles in the Ilha Grande Bay region have been experiencing various impacts. Interactions with fishing residues, ingestion of solid waste, and collisions with vessels have been identified as major causes of mortality for these animals (Corrêa-Silva *et al.*, 2023). The *ProgramaTartaruga Viva*, conducted by *Eletronuclear*, and executed by the Oceanography Institute at the State University of Rio de Janeiro, was requested by the *Centro Nacional de Conservação e Manejo de TartarugasMarinhasdoInstituto Chico Mendes de Conservação da Biodiversidade* (National Center for the Conservation and Management of Sea Turtles of the Chico Mendes Institute for Biodiversity Conservation) — TAMAR-ICMBioof the Ministry of the Environment (MMA). This request was made in compliance with the requirements outlined in conditions 2.16 of ALA No. 06/2013 issued by ICMBio, and 2.1.9.1 of LO No. 1217/2014 - 2nd Amendment issued by Ibama. The Program monitors sea turtles in the influence area of the *Central Nuclear Almirante Álvaro Alberto* (Almirante Álvaro Alberto Nuclear Power Plant) – CNAAA, with actions involving population sampling and rescues of turtles triggered through a remote network. The activities aim to elucidate any behavioral or distributional changes in populations and assess potential environmental impacts on these animals. This article aims to report a case of rescue, treatment, and rehabilitation of a *Caretta caretta* turtle.

METHODOLOGY

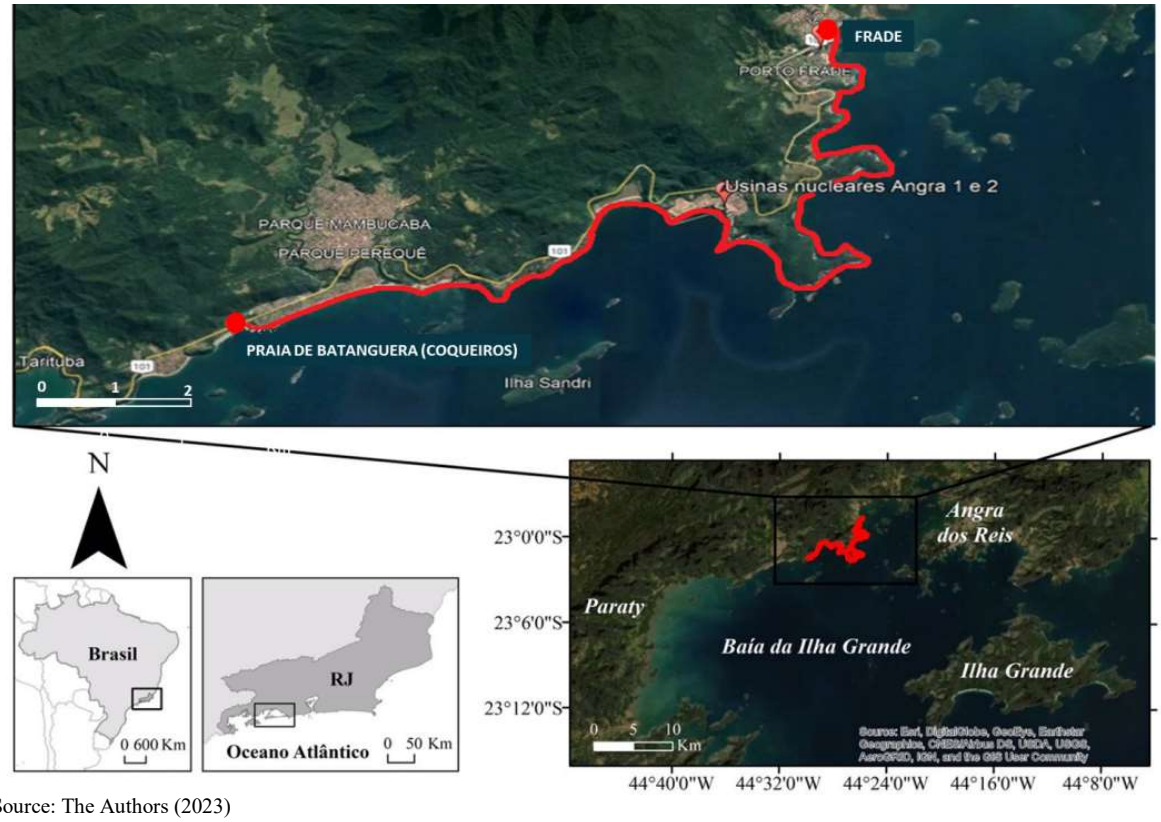
The monitoring of stranded occurrences of sea turtles is conducted through the Remote Network and beach monitoring routines. This

network comprises awareness campaigns, including the installation of 44 informative signs on 21 beaches and the distribution of posters in key establishments near the covered beaches (Figure 1). The Remote Network provides a toll-free number (0800-204-4041) for activations. Deceased rescued animals are sent for necropsy to determine the cause of death. Live debilitated animals are directed to the Program's base for veterinary clinical care, aiming for the full rehabilitation of the animal. The protocol for the containment and transport of these animals is implemented to prevent further damage to their physiology. Measures include temperature control during transport (between 21°C and 27°C), mitigation of physical impacts, proper body positioning (plastron down), and hydration of the animal.

disinfection of marks and pliers used in the marking of sea turtles" from the TAMAR-ICMBio Center (TAMAR-ICMBio, 2016). All actions involving biological material necessary for the implementation of the *ProgramaTartaruga Viva* are authorized by ABIO nº 142/2022 (IBAMA Process No. 02001.003272/2011-48).

CASE REPORT – RESULTS

On March 27, 2023, at 9:00 AM, the Program received a call for the rescue of a *Caretta caretta* sea turtle. The animal was found floating in the Piraquara de Fora region, easily rescued without any resistance.



Source: The Authors (2023)

Figure 1. Location of the study area. CNAA – *Almirante Álvaro Alberto Nuclear Power Plant*

Source: The Authors (2023)

Figure 2. Rescue of PTV-184

The Program's base is equipped with a treatment and rehabilitation area with fiberglass tanks filled with seawater for individual containment and rest of the collected debilitated animals. The facility includes differentiated environments for animals with fibropapillomatosis. All handling follows the protocols: "Protocol for handling sea turtles with fibropapillomatosis" and "Instructions for

It was registered as PTV-184 and entered into the database. Upon initial assessment, the turtle appeared active with a thin body score, a large amount of epibionts (algae and barnacles), positive buoyancy (floating), without swimming ability,dehydration, and painful and cloacal reflex. There was also a small fibropapilloma observed on the left front flipper (Figure 2).

Morphometric data were collected, recording a weight of 39 kg, a curved carapace width (CCW) of 62.2 cm, and a curved carapace length (CCL) of 74 cm (Figure 3). The turtle showed no ocular injuries, presence of oil, or oil ingestion (Table 1).

Source: The Authors (2023)

Figure 3. Record of PTV-184

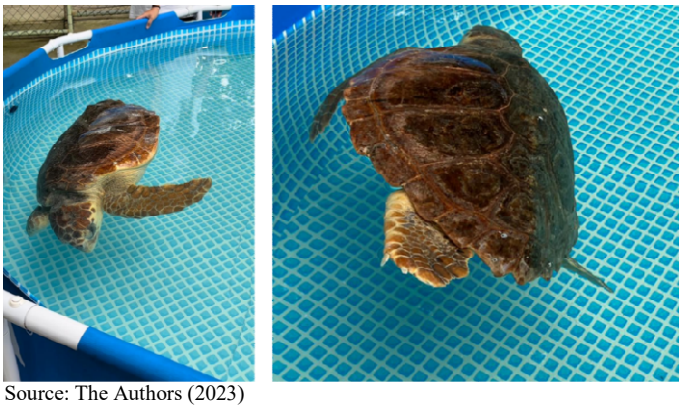
Table 1. Clinical and Morphometric Data – Input Data

Data for PTV 184	
Animal ID: PTV-184	Species: *Carettacaretta*
Date: March 27, 2023	Time: 9:00
Levelofconsciousness	(X) Alert ( ) Depressed ( ) Unconscious ( ) In shock
Body score	( ) Excellent ( ) Good (X) Thin ( ) Emaciated
Pupillaryreflex	( ) Yes ( ) No (X) N/A
Palpebral reflex	(X) Yes ( ) No ( ) N/A
Cornealreflex	( ) Yes ( ) No (X) N/A
Painfulreflex	(X) Yes ( ) No ( ) N/A
Cloacal reflex	(X) Yes ( ) No ( ) N/A
Degreeofdehydration	( ) Extremely dehydrated (X) Dehydrated ( ) Normohydrated
Weight	39Kg (X) Real ( ) Estimated
Curvilinearcarapacewidth– CCW	62.2 cm
Curvilinearcarapacelength– CCL	74 cm
Externalexamination	Animal with a large amount of epibionts (barnacles) and small fibropapilloma on the left front flipper
Ocular injury	( ) Yes (X) No
Presenceofoil	( ) Yes (X) No
Oilcoverage	( ) Up to 25% ( ) Up to 50% ( ) Up to 75% ( ) Above 75% (X) N/A
Depthofcoverage	( ) Superficial ( ) Medium( ) Deep( ) Burn (X) N/A
Oilingestion	( ) Yes (X) No
Clinical suspicion	Gastrointestinal tract

*N/A = NotApplicable
Source: The Authors (2023)

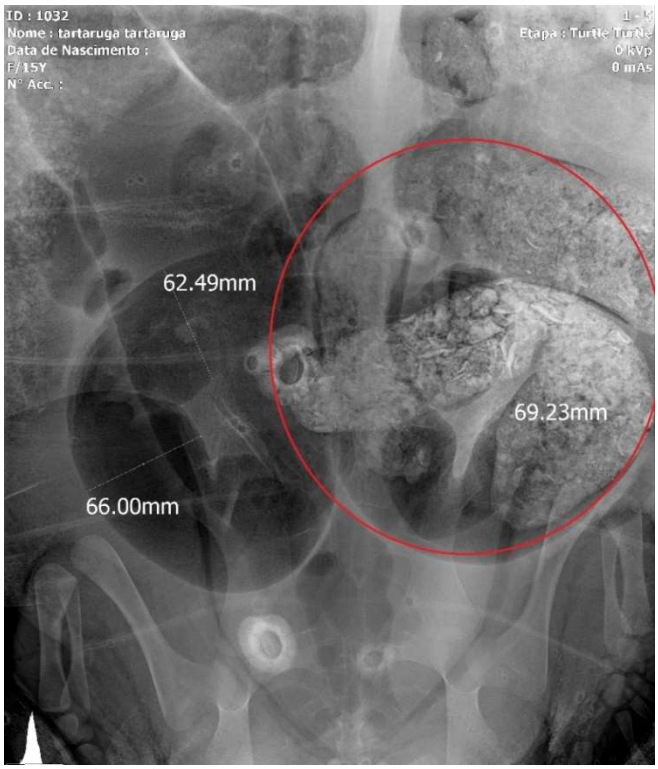
The animal was placed on a suitable transport stretcher and taken to the treatment and rehabilitation base of the Program, located in the Residential Village of Mambucaba. After the initial data recording, stabilization procedures were initiated with immediate fluid therapy using sodium chloride (NaCl 0.9%) (dose: 20 mL/kg/IV - 30 drops/min) to correct the dehydration of the animal + 3ml of bionew, and radiographic imaging, blood count, and biochemistry examinations were performed. After the initial procedures, the turtle was placed in a tank with a capacity of 5500 liters filled with seawater. It exhibited left lateralized positive buoyancy (Figure 4). It showed no interest in direct or indirect feeding initially. The radiographic image revealed the presence of a large quantity of fecalomas with radiopaque material, indicating the presence of anthropogenic waste in the gastrointestinal tract.

This evaluation confirmed significant obstruction and excessive gas production (Figure 5). Feeding procedures involved tube feeding with mineral oil initially, as the turtle did not accept voluntary feeding. The enema technique with physiological solution and mineral oil was also performed to soften concentrated and hardened feces (fecalomas) with the purpose of facilitating the excretion of the retained material. The medications enrofloxacin, meloxicam, simethicone, metoclopramide, and a vitamin complex, were administered. After 5 days of treatment, the animal began to show slight interest in directly offered food, in addition to tube feeding. Ten days after the rescue and the start of treatment, the turtle defecated a large amount of diluted feces in the water, with consistent pieces of rigid and flexible plastic. During the screening of the defecated material, residues of plastic bottle caps, remnants of plastic bags, pieces of rigid plastic, and fabric remnants were identified (Figure 6). The turtle excreted plastic residues for 26 days. Blood tests indicated an infectious condition (leukocytosis). After antibiotic treatment, the animal showed a significant improvement in the infection.



Source: The Authors (2023)

Figure 4. Lateralized positive buoyancy



Source: The Authors (2023)

Figure 5. Radiographic image of PTV-184 – Obstructed region

Source: The Authors (2023)

Figure 6. Procedures: A-Fluid therapy; B-Feeding tube placement; C-Enema; D-Anthropogenic residues in defecation

Biochemical examination did not reveal significant changes. Direct tube feeding of the turtle continued for 9 days until the animal started accepting direct feeding. After 58 days at the program's base for treatment, the turtle began indirect feeding with food placed at the tank's bottom in different positions. This feeding method marked the first step towards rehabilitation and release of the animal (Figure 7).

Source: The Authors (2023)

Figure 7. Evolution in feeding methods during treatment and rehabilitation. Direct tube feeding; direct feeding by offering; indirect feeding

Regarding buoyancy, improvements were recorded after 51 days of treatment initiation. The use of simethicone was intensified to enhance gas production and consequent improvement in buoyancy. Seventy days after the rescue, the turtle began to position itself at the tank's bottom for longer periods. After additional blood tests, radiographic images, and clinical evaluations, the turtle returned to the sea after 95 days of treatment and rehabilitation at the *ProgramaTartaruga Viva* base. It gained significant weight, increasing from 39 kg to 51 kg (Table 2).The release took place in a region away from urban concentrations, heavy boat traffic, and close to areas with abundant food supply. The turtle submerged, displaying normalized buoyancy (Figure 8).

Table 2. Weight gain progression during treatment and rehabilitation

PTV.184	CCW (cm)	CCL (cm)	Total Length (cm)	Weight (Kg)
Admission March 27, 2023	74cm	62.2cm	90cm	39kg
Discharge June 22, 2023	74cm	62.2cm	90cm	51kg

Source: The Authors (2023)

Source: The Authors (2023)

Figure 8. Release of the *Caretta caretta* (PTV-184)

DISCUSSION

One of the primary causes of sea turtle mortality is a result of anthropogenic activities in the environment (Farias *et al*., 2019; Rizzi *et al*., 2019; Moreira *et al*., 2021).The ingestion of solid waste such as plastic, rubber, metals, or fibers has been identified as a significantly negative interaction in these populations (Gall & Thompson, 2015; Farias *et al*., 2019; Correa-Silva *et al.,* 2023). Gastrointestinal alterations such as constipation, obstructions, perforations, twists, and the presence of foreign bodies (Bugoni*et al*, 2001; Wynekene*t al*., 2013) have been associated with the ingestion of these materials.In the *ProgramaTartaruga Viva*, of which the present study is an integral part, the interaction and ingestion of solid waste are among the main causes of death in rescued animals (Correa-Silva *et al*., 2023). The consumption of such waste can lead to various health problems for sea

turtles. When ingested, the trash fills the space that would be occupied by food, causing a sense of satiety in the animal, which then eats less, resulting in dehydration and malnutrition. The passage of waste through the digestive tract is slow and complicated, remaining in the tract for an extended period (Lutz, 1990; Eriksen, 2017; Yaghmour*et al.*, 2018).Rigid plastics can injure the intestinal wall as they have sharp corners, posing a potential cause for other intestinal injuries such as volvulus and obstruction, which can lead to intestinal rupture, peritonitis, and systemic sepsis (Cappua, 2007).According to Lutz (1990) and Sinaei*et al*., (2021), the ingestion of solid waste has, as one of its consequences, the accumulation of gases due to digestive inefficiency. This factor leads to positive buoyancy, making sea turtles more vulnerable in the ocean, as they can be struck by vessels and are more prone to entanglement in fishing nets, resulting in drowning (Guebert, 2004). In the case presented in this study, the animal exhibited all the consequences of waste ingestion, such as severe dehydration and malnutrition, intestinal injuries, intestinal obstruction, and gas accumulation affecting the buoyancy of the animal. These aforementioned observations were linked to the quantity and characteristics of the ingested waste, leading to a complete obstruction of the animal's intestinal portion, resulting in feeding difficulties, excessive gas production, positive buoyancy, and an inability to submerge. Radiographic examinations were among the initial approaches used in the rescue of the Loggerhead Sea Turtle PTV 184, along with blood tests, due to the clinical characteristics presented by the animal (responsive, active, without apparent injuries). According to McArthur *et al*. (2004), radiography is of paramount importance in assessing the health of chelonians, as it is employed for examinations of the skeletal, gastrointestinal, and respiratory systems, and is the best tool for detecting foreign bodies. Radiographic examinations are generally the preferred choice for imaging diagnostics in sea turtles, as they are easily accessible and provide clear and highly informative results on the case (Di Bello *et al*., 2013; Oliveira *et al*., 2020; Moreira *et al*., 2021). This study aligns with this information, emphasizing that radiographic examinations were crucial in defining the clinical picture and treatment of the animal in question. The treatment and rehabilitation protocol applied to the Loggerhead Turtle PTV 184 proved to be effective and successful, culminating in the turtle's return to the ocean in excellent bodily condition and without buoyancy issues.

CONCLUSION

The issue of anthropogenic solid waste scattered in the sea is increasingly capturing society's attention. Among these, special attention is being given to the quantity of plastic waste found in the oceans. This attention is growing worldwide as it begins to cause significant economic and environmental damage, including harm to human health, with the increasing availability of byproducts of this type of pollution, such as microplastics. Cases like the turtle reported in this study are important indicators of environmental compromise and the urgent need for integrated actions involving society, science, industries, and the government. The success of the treatment and rehabilitation in the reported case highlights the importance of the existence of conservation programs capable of acting not only in prevention but also in the mitigation of the environmental impact generated by human actions.

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