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Case Report

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Treatment of Red Sea Hawksbill Turtle, *Eretmochelys Imbricata* Suffered from Floating Syndrome Using Activated Charcoal-Simethicone Combination

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Abstract

The hawksbill turtle, Eretmochelys imbricate, is one of the most critically endangered marine turtle species worldwide. A juvenile Hawksbill Sea turtle, *Eretmochelys Imbricata* was admitted to the diagnosis and treatment unit of the National Institute of Oceanography and Fisheries (NIOF), Hurghada in June 2022. It suffered from dehydration, generalized weakness, external injuries, and floating syndrome. Rehydration therapy was immediately initiated, followed by a treatment plan which included aspiration of the gases accumulated in the coelomic cavity. Even though temporary relief was achieved after each aspiration, the floating relapsed after 48h. Using a combination of activated charcoal and simethicone in parallel to the aspiration protocol, together with a broad-spectrum supporting antibiotic and anti-inflammatory therapy, achieved restauration of the gastric motility, decreased the accumulated gases, and allowed a complete recovery of the turtle.

KEYWORDS
Hawksbill, Floating syndrome, Aspiration, Simethicone, Activated charcoal

INTRODUCTION

Five out of seven existing sea turtle species of the world are inhabiting the Red Sea waters. These are the green turtle (*Chelonia mydas*), the hawksbill turtle (*Eretmochelys imbricate*), the leatherback turtle (*Dermochelys coriacea*), the loggerhead turtle (Caretta caretta), and the olive ridley (Lepidochelys olivacea) (Mancini *et al*., 2015). Hawksbill turtles belong to the family Cheloniidae and have been classified as critically endangered, according to the IUCN Red List of Threatened Animals (Baillie and Groombridge, 1996). When turtles are found washed up on the shore or floating, they are referred to as stranded turtles. Stranding of turtles is considered a risky case with a usually low survival rate (Mann-lang *et al*., 2020). The floating syndrome, also referred to as buoyancy disorder, is one of the most serious medical conditions affecting sea turtles. This condition occurs when a sea turtle loses its ability to submerge due to several causes such as (i) pulmonary disorders caused by penetration of the upper respiratory system with a foreign body, or by a bacterial infection (Ciccarelli *et al*., 2020); (ii) excessive gas accumulation in the stomach and/or intestine, resulting from injuries by a foreign body or secondary to gastrointestinal inflammation (Manire *et al*., 2017); (iii) nerve damage due to spinal cord injury (Wyneken *et al*., 2006). Treatment of buoyancy disorder relies on an accurate diagnosis of the triggering cause(s). No studies were previously published on the rescuing and treatment of Red Sea turtles. The current case study reports the strategy followed to restore health in a specimen of juvenile hawksbill turtle stranded in poor condition at the Egyptian Red Sea coast of Hurghada, followed by a rehabilitation program to increase the turtle's ability to swim and dive before releasing it to its normal habitat.

CASE HISTORY

Handling, treatment, and rehabilitation of the hawksbill turtle were done under observation and after agreement of the Ethics Committee of the national institute of Oceanography and Fisheries, NIOF Committee for Ethical Care of Marine Organisms and Experimental Animals (NIOF- IACUC) (2022/No: AQ2022R021)."

The turtle was received by the teamwork of the National Institute of Oceanography and Fisheries (NIOF), Hurghada branch. It was brought to the institute by members of the Red Sea Marine Park Authority (RSMPA) and was tagged with the code EG 0289. The specimen was found stranded near the shore and was recovered by a fisherman who delivered the turtle to RSMPA. Upon reception at NIOF, a first examination and biometry of the turtle were carried out.

The external morphology of the turtle was studied to identify the species, and an ID profile was created to ensure that monitoring of the turtle's health is possible after its release.

The turtle was identified as a juvenile hawksbill turtle (*Eretmochelys Imbricata*) according to Eckert *et al*. (1999). The specimen weighed 12 kg and measured 30cm in length x 40 cm in width. The ID profile, RSTPH1, was created using the methods described

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in Berger-Wolf *et al.* (2017) with the use of WildME's wildbook "Internet of Turtles". This wildbook uses an algorithm known as HotSpotter which enables researchers and conservationists to track and monitor individuals through the use of photography (Crall *et al.*, 2013). the algorithm focuses on texture analysis to identify different patterns. With the use of photo-identification, a non-invasive method, we therefore be able to follow its movement patterns in the Red Sea but also around the world.

The turtle's physical examination revealed an inability to move the limbs, general asthenia, and external injuries such as wounds and bruises (Fig. 1). Unbalanced floating over the water surface was notorious, with a left side, floating more than the right side (Fig. 2). Wrinkled skin and dry appearance of the shell suggested severe dehydration of the specimen.

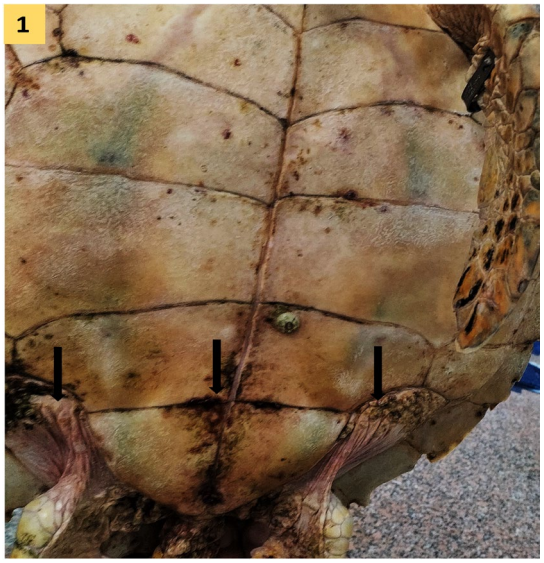

Fig.1. External wounds, and bruises (black arrows) in the investigated turtle.

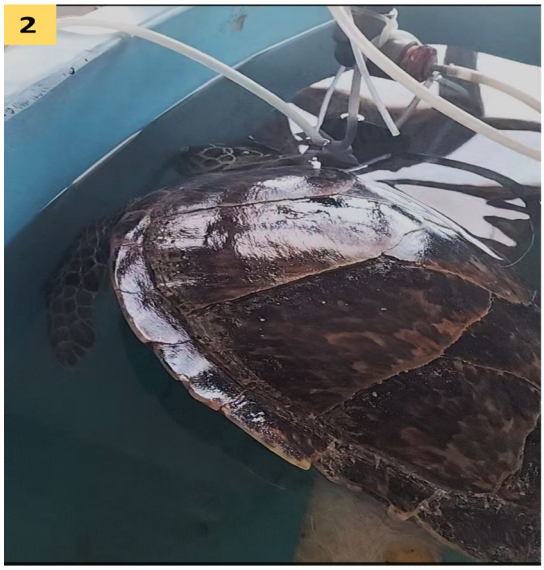

Fig. 2. Floating of the turtle over the water's surface.

TREATMENT AND MANAGEMENT

The turtle was rehydrated in a tank with the following dimensions: 2 m length, 1 m width, and 2 m depth filled with seawater. The water system with direct seawater pumped from the shore in front of NIOF was kept in an open continuous flow-through state. The turtle's health status and condition were continuously monitored in regard to its adaption, response to medication and feeding plans. Vallini *et al.* (2011) used rehydration therapy in addition to vitamin supplementation to treat a stranded loggerhead sea turtle, Caretta caretta, which enhanced the rapid recovery of the weakened turtle. A similar approach was successfully followed in this case, the turtle regained motility and activity after the rehydration process inside the marine water tank.

Once rested and rehydrated, several types of feed were tested. the turtle showed a positive response and appetite for all types of food introduced, although it favored homemadede mixture of chopped jellyfish, fresh fish pieces, and shrimps over other types of feeding. Preferential response to different types of food such as crabs, sea urchins, jellyfish, and other types of food has previously been studied and used to apply welfare enrichment strategies to marine turtles (Escobedo-Bonilla *et al.*, 2022). The food was administrated manually during the first week of the treatment. The turtle was progressively stimulated to catch the prepared food delivered to the tank as its condition improved. At the end of the treatment plan and during the pre-release plan, the turtle was transferred to aquarium exhibition tanks containing live small fish, jellyfish, sea cucumbers, bivalves, and sea urchins from which it preyed.

Due to the limited availability of facilities, the diagnosis was based on the symptoms and the therapeutic response to the treatment regimen designed. Pulmonary disorders were excluded due to the absence of respiratory manifestations and because the positively buoyant section was caudally located. Percussion testing on its shell evidenced the presence of gas accumulations at the left caudal lateral side of the body. The aspiration of gases is of the utmost importance for treating floating syndrome in sea turtles (Norton and Walsh, 2012). In the present case, the aspiration regime began on the 2nd day after admission, and it was performed every 3 days. A disposable 10 ml syringe was used every 3 days for 3 weeks to aspirate gases accumulated in the coelomic cavity. The aspiration area was determined by percussion testing with gentle knocking on the turtle's shell. Approximately 1500 ml of gas was removed during the whole treatment. The turtle showed signs of good prognosis after each coelomic gas aspiration, but the floating relapsed after 48 hours. It has been suggested that activated charcoal can absorb systemic gases and toxins, which allows then allows their excretion from the body (Soonmin *et al.*, 2022). Simethicone is an effective antiflatulent, widely used in human and veterinary medicine. It prevents aggregation and consistency of gases, in addition to reducing the surface tension of gas molecules (Rahman *et al.*, 2016). Consequently, in the third week, a daily dose of 5 ml of simethicone syrup mixed with one tablet of activated charcoal medicine was orally applied in parallel with the aspiration protocol. This combination was effective and stopped refloating of the turtle which progressively increased swimming activity levels and improved condition. Normal gastric motility was evidenced by regular defecation, which was commonly observed. Several therapies were administrated using different routes of administration (Table 1). Doses of medications were calculated according to Norton and Mettee (2020).

The use of antibiotic therapy in turtles exposed to stress and immune suppression is an important line of treatment to prevent secondary infections (Savage and Cazabon-Mannette, 2020). During this study, the combination of a prophylactic daily dose of 250 mg of broad-spectrum Amoxicillin, 0.25mg/kg subcutaneous injection of dexamethasone as an anti-inflammatory, and 5 ml of alpha-amylase as an antiedematous syrup contributed to the recovery of the turtle from bruises and external wounds, restoring its ability to move its limbs normally.

Vitamins and hydrotherapy have also been used to treat debilitation in loggerhead sea turtles (Vallini *et al.*, 2011). In this

Table 1. Medication used for the treatment of a hawksbill turtle suffering from a floating syndrome

Drug	Dose	Route of administration	Objective	Company
Amoxicillin	250 mg/one time daily/7 days	*PO*	Broad-spectrum antimicrobial	Egyptian international pharmaceutical industries company, EIPICO, Egypt.
Dexamethasone	0.25 mg/kg/one time daily /5 days.	*SC*	Anti-inflammatory	AMRIYA pharmaceuticals, Egypt.
Alpha-amylase	5 ml/ one time daily/ 7 days	*PO*	Anti-edematous	SANOFI, Egypt.
Simethicone	5ml/ one time daily/10 days	*PO*	Anti-gases	AMRIYA pharmaceuticals, Egypt.
Activated charcoal	1 tablet/one time daily/10 days	*PO*	Anti-gases	MARNYS, Spain.
Multivitamins	1 tablet/day	*PO*	Vitamins	Smithkline Beecham, SB, Egypt
Vitamin B complex	0.1 ml/Kg/every 72 hours	*SC* after dilution with 2 ml of distilled sterile water.	Vitamins	AMRIYA pharmaceuticals, Egypt.

SC: subcutaneous; PO: per os

case, vitamin B complex was subcutaneously injected after dilution with high-pure water twice a week, in addition to a daily dose of oral multivitamin formula that was prescribed to tackle the debilitation that occurred during the stranding time.

After 28 days of treatment, the rehabilitation plan was initiated by allowing daily physical exercise as the turtle was transferred to the NIOF exhibition aquarium facilities. The first week of rehabilitation was conducted in a large seawater tank with 60 Red Sea seabream (Diplodus noct) which are known for their tight schooling behaviour. In the following week, the turtle was transferred to a tank containing 2 sea turtles (one green sea turtle and one other hawksbill sea turtle) and several live Jellyfish. Additionally, a daily exchange to another tank containing live small fish, jellyfish, sea cucumbers, bivalves, and sea urchins was performed.

During the pre-release plan, the turtle displayed normal swimming and increasingly fast movements during its stay in a large tank with a school of Diplodus noct, which stimulated the turtle's activity with its tight schooling behaviour. In the following week, the turtle was transferred to a tank with other turtles, where it showed its ability to compete for its food. Finally, the turtle was transferred to a tank containing live small fish, jellyfish, sea cucumbers, bivalves, and sea urchins, where it exhibited the ability to discover and feed on sea urchins and jellyfish, as well as bite the bivalves. After the end of the pre-release plan, the turtle was able to eat, move, dive, and catch live prey normally.

CONCLUSION

Treatment of Red Sea hawksbill turtles suffering from floating syndrome was performed using the aspiration of gases accumulated in coelomic fluids in parallel to the activated charcoal-simethicone combination, the rehabilitation plan helped the specimen to gain its ability to swim, dive and catch live prey. Treatment of sea turtles from floating syndrome is an important step to save the species from being extinct and to conserve the marine animal environment in the Red Sea.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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