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Preliminary Findings on the Movement and Habitat Preferences of Moza, a Rescued Green Sea Turtle (*Chelonia mydas*) in Fujairah, UAE, through Satellite Tagging

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Abstract

Background: On May 14, 2022, Moza, a sub-adult green turtle (*Chelonia mydas*), was discovered injured on the eastern coast of the United Arab Emirates, in the Gulf of Oman. Later, it got rehabilitated and released back to sea with tracker and given the title “Moza”. Given the increasing concerns about marine animal behavior and habitat preferences, this study sought to track and analyze Moza's movements.

Methods: The tracking of turtles was conducted using SPOT-5 back-mount tags supplied by Wildlife Computers, a company based in Seattle, USA. These tags establish communication with the Argos satellite system (<http://www.argos-system.org>) anytime they rise above the water, and a satellite is within their reach. To preserve battery life and prolong the period of tracking, the tags were set to restrict the number of broadcasts to 250 per day, which were scheduled exclusively during daylight hours (06:00–18:00). The SPOT-5 tags not only communicated location data for the Argos system but also provided temperature information. The investigation was conducted from June 16 to July 31, 2022, along the shoreline near Deira Island, Palm Island, and Dubai World Island. Moza was initially released from Palm Island on June 16, 2022.

Results: The satellite tracking revealed that Moza was located at Dubai World Islands on June 18, 2022, and by June 19, 2022, she had moved to Deira Islands, where she remained for the rest of the study period. Over a tracking period of 45 days (1077.86 hours), Moza traveled a total of 86.3 kilometers in a southwesterly direction from the starting point.

Conclusion: The findings suggest that Moza ceased long-distance movement and remained in the Deira Islands area, likely due to the presence of a suitable habitat. However, ongoing tracking studies with other rehabilitated turtles may provide further insights into habitat preferences and movement patterns.



Introduction

The green turtle, known scientifically as *Chelonia mydas*, is currently classified as an endangered species. This species is one of the seven types of sea turtles that can be found worldwide [1]. Various threats endanger their survival, including habitat destruction, climate change, pollution, and fishing activities [2].

Habitat degradation, notably from coastal development and tourism, has substantially limited their viable habitats. Climate change also poses a threat to these turtles, since rising temperatures might influence the sex ratio of hatchlings [2,3].

Moreover, plastic debris in the ocean is a significant danger to green turtles. Plastic bags are frequently confused with jellyfish by them, a common item in their diet. Consuming plastic can result in internal injuries, blockage in the intestines, and potentially fatal consequences.

The utilization of nets and longlines in fishing operations often leads to the inadvertent ensnarement or entanglement of green turtles, resulting in physical harm or death by suffocation [4].

By enforcing regulations and laws, the United Arab Emirates has undertaken numerous conservation initiatives to protect sea turtles, including the green turtle, in its coastal waters. As is common knowledge, UAE Federal Law No. 23 of 1999 regarding the exploitation, protection, and development of living aquatic resources and Federal Law No. 24 of 1999 for the protection and development of the environment conduct public awareness regarding the protection of sea turtles and their habitats.

Satellite tracking is essential for monitoring the movement of rescued sea turtles, aiding in tracking migration patterns, habitat use, behavior, identifying threats, and collecting data [5]. By employing satellite tracking technology, significant insights can be obtained regarding the behaviors and post-release movements of rescued turtles.

This information is vital for the continued conservation and protection of these turtles, as well as for the advancement of knowledge and understanding regarding sea turtles in the United Arab Emirates.

This preliminary study aims to gather information on the turtle rehabilitation efforts and turtle's movement patterns to evaluate the effectiveness of the rehabilitation process [6].

Methods

Study Animal, Rehabilitation and Release

Moza is a sub-adult green turtle (*Chelonia mydas*) weighing 7.22 kg. The turtle's measurements are 43 cm CCL (curved carapace length) and 36 cm CCW (curved carapace width), as indicated in Table 1.

The specimen was discovered on the eastern coast of the United Arab Emirates (specifically, the Gulf of Oman) near the Fairmont Fujairah Beach Resort on May 14th, 2022. It exhibited the presence of barnacles and displayed signs of debilitation. Afterwards, it was transported to the Dubai turtle rehabilitation center, located at Burj Al Arab.

The process of rehabilitating her took a total of 33 days, during which the barnacles were forcefully removed, antibiotics were administered, and she received care from veterinarians and special food to aid in her recovery.

Following surveillance, Moza was subsequently released on the western coast of the United Arab Emirates (Arabian Gulf), but not in the same vicinity where she was initially discovered on June 16, 2022.

Moza was equipped with a satellite tag before being released to monitor her activities.

The tracking of turtles was conducted using SPOT-5 back-mount tags supplied by Wildlife Computers, a company based in Seattle, USA. These tags establish communication with the Argos satellite system (<http://www.argos-system.org>) anytime they rise above the water and a satellite is within their reach.

The attachment and programming of these tags were conducted according to the protocols described in Robinson *et al.*, [6]. In brief, we used a slow-curing, low-temperature epoxy for bonding, then followed the manufacturer's instructions for applying many coats of antifoul paint. To preserve battery life and prolong the period of tracking, the tags were set to restrict the number of broadcasts to 250 per day, which were scheduled exclusively during daylight hours (06:00–18:00). The SPOT-5 tags not only communicated location data for the Argos system but also provided temperature information [7].

The study was carried out along the coastline near Palm Island, Dubai World Island, and Deira Island, spanning from 16th June to 31st July. Moza turtle was set free into the ocean at Palm Jumeirah. Moza was initially launched at Palm Island and remained active in the vicinity until June 17th, 2022. She was discovered in Dubai World Islands on June 18, 2022. Subsequently, on June 19th, 2022, her location was discovered to be the Deira Islands, where she has remained ever since as depicted in figure 1.

Turtle name	Transient / resident	Sex / life stage	Rehab Duration (days)	Release date	Release weight (kg)	Curved carapace length (cm)	Curved carapace width (cm)	Tracking duration (days)	Distance travelled (km)
Moza	Resident	Female / sub-adult	33	16-jun-2022	7.22	43	36	45	86.3

Table 1: Measurement information and transmission data obtained from the turtle Moza tracked in this study.

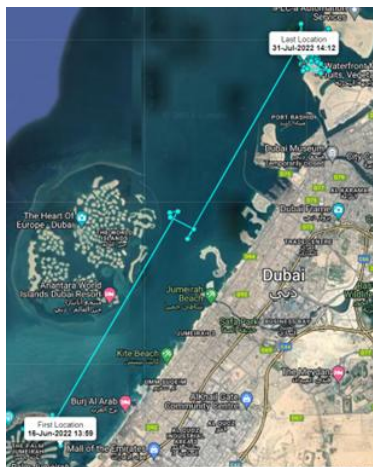


Figure 1: Satellite Tracking of Sea Turtle Moza's Journey: This map illustrates the movement of Turtle Moza, tracked via satellite from Palm Island to World Island and finally to Deira Island, revealing key locations in her migration within Dubai

Results

Tracking and Movement

We obtained a total of 78 locations from the satellite tag. The turtle was found in waters close to the shore in all locations. The duration of 'Moza' tracing is 45 days, 4 hours, 36 minutes, and 25 seconds (1077.86 hours) from June 16th, 2022, to July 31st, 2022. The track followed a southwest direction and ended after covering a distance of 86.3 kilometers from the starting point. She stayed within the waters of the UAE for the entire duration of the track. The turtle location trace was analyzed using satellite tracking data, which yielded valuable insights. This is illustrated in Figure 1, where a map is displayed. The transmission of tags was not consistently received on a daily basis. Instead, it only sends a transmission once the turtle comes to the sea surface. It is believed that the tag ceased transmitting towards the end of the deployment, possibly due to the battery depleting or the turtle dislodging the tag. The findings revealed that turtle Moza embarked on a leisurely journey from Palm Island, Dubai. After spending approximately two days there, she proceeded to World Island, Dubai within a day. Subsequently, Moza ventured towards Deira Island, where she resided from 19-Jun to 31-Jul. The data on the distance and speed covered during each site can be found in table 2.

The average speed during the initial travel period to World Island was 0.49 km/h. This was significantly higher than the speed observed in the final residential area at Deira Island (0.0506 km/h), bringing the overall average speed for the entire journey to 0.08 km/h. – as determined by equation 1.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}} \dots \text{equation (1)}$$

Location	Duration (h)	Distance (km)	Speed (km/h)
The Palm Island, Dubai	48.75	20.2	0.4143
World Island, Dubai	24.19	15.2	0.6283
Deira Island, Dubai	1004.92	50.9	0.0506

Table 2: Summary of statistics of movements (duration (hours), distance (km), and average speed (km/h)).

Moza created a tiny core habitat on Deira island (Figure 2). During her journey, she made a directional trek to Deira island in the Arabian Gulf. The journey lasted for 3 days, with a subsequent 42-day stay on island. The tracking was completed on July 31st.

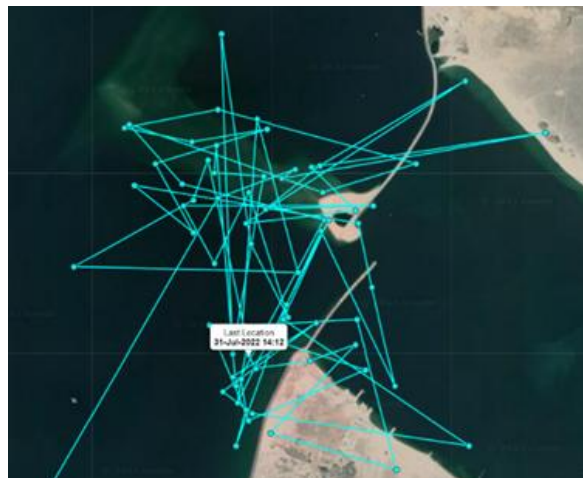


Figure 2: The Map shows the hidden island in Deira Island. The Figure shows the movement of Moza around this area for 42 days which is considered as preferred habitat of turtle Moza in this study.

The study evaluated various environmental variables that could influence the path chosen by the turtle. These variables include current speed, wave height and period, and swell height and period. The results, as presented in table 3, indicate that there is no significant difference in these variables noticed between the moving path and Deira island.

Location	Significant wave height in ft	Wind wave height in ft	Wind wave Period in sec	Swell wave period in sec
Moving period	3.15	0.83	2.09	6.25
Deira island	2.99	0.60	1.95	5.55

Table 3: The table displays environmental conditions, including significant wave height, wind wave height, wind wave period, swell wave period, and ocean current speed, recorded during the turtle's movement. Data is provided for the active movement period and for the stationary phase near Deira Island, offering insight into the environmental factors influencing the turtle's behavior.

Turtle Moza stayed near the coast in Dubai. She was released during the summer months when the water surface temperature was 31 °C. Turtle Moza showed a preference for coastal, shallow water and secluded islands. The depth of the sea around the submerged island is around 12 meters. Table 4 displays the concentration of chlorophyll in seawater which was

acquired from E.U. Copernicus Marine Service Information (<https://doi.org/10.48670/moi-00015>).

Date	Chlorophyll a concentration	
	The Palm Island	Deira Island
16/05/2022	0.35	0.35
16/06/2022	0.27	0.27
16/07/2022	0.24	0.24

Table 4: The chlorophyll concentration in Palm Island (the place where turtle was released) and Deira Island (the place where she moved to).

Discussion

Tracking and movement

Previous satellite-tagging data on the movement of green turtles in the United Arab Emirates is scarce. One study presented the findings and analysis of a female/adult green turtle's which was observed to have been released from the Abu Dhabi, UAE, and traveled along the coastal waters of the western region of the UAE. It proceeded to enter Qatari waters, with the transmissions from its tag stopped at the end of this period. The study reports that the turtle's journey spanned 2320 km and lasted 141 days. A recent investigation conducted by researchers involved monitoring a group of eight fully-grown green turtles. Out of these, seven individuals were retrieved from the western coastline of the United Arab Emirates (UAE) and subsequently reintroduced into their original habitat, known as the Arabian Gulf. In contrast, one turtle was retrieved from the eastern coastline, specifically the Gulf of Oman, and was released back into its native environment. Notably, five of the tracked turtles exhibited a consistent presence within the waters of the UAE throughout the entire duration of the tracking study [6]. Previous studies showed the transient behavior of some turtles towards UAE waters, while some of them were found to be resident. The resident behavior might result in the incident of turtle being injured while moving through UAE waters on larger-scale migration, which they resumed after successful rehabilitation [7]. The turtle included in this study remain resident in the UAE, Arabian Gulf.

In this study, the subject Moza remained in UAE waters for the entire 45-day tracking period. The purpose behind her stay in this location remains unknown. It is suggested that Moza Turtle consider relocating from the densely populated commercial area known as 'Dubai Palm' to the comparatively less crowded area of 'Deira island'. The observed movement exhibited a pronounced sense of directionality, which is a noteworthy characteristic as there have been no prior reports of green turtles being observed on Deira Island. In a study conducted by Pelletier *et al.*, in 2003, two sub-adult green turtles were treated and tagged. The findings revealed that these turtles tended to stay close to the release site. The researchers proposed that this

behavior could be attributed to the abundant and sustainable habitat in the vicinity of the release site. According to a study by Mestre *et al.*, (2014), it was found that two green turtles, which were tagged after rehabilitation, adopted a coastal movement strategy to improve their chances of finding food [8].

The results in our study indicate that there was no statistically significant relationship between the concentration of chlorophyll and the path selected by the turtle, which shows consistency with the observation from previous studies. However, the chlorophyll values observed in the selected areas are consistent with those reported in previous studies [9, 10].

The case of Turtle Moza highlights the persistent anthropogenic hazards faced by wild turtles in UAE waters, despite legal protections. This study presents the successful rehabilitation of Turtle Moza, emphasizing the potential for rehabilitated animals in ecological tracking studies. The tracking data shows that Moza stayed within UAE waters, underscoring the country's significant contribution to green turtle conservation. Her movement patterns suggest a combination of innate navigational abilities and responses to environmental cues, highlighting the importance of understanding both inherent instincts and external factors in shaping green turtle behavior. Further ongoing research and more data can uncover the movement patterns of these turtles in greater detail, contributing to more effective conservation strategies.

Author Contributions

MA, FA, SA: Conceptualization, Methodology, Investigation, Writing - review & editing. SB & FL: Conceptualization, Methodology, Data curation, Investigation, and Supervision. Writing - review & editing.

Ethics approval

The current study has been done in line with the Local Experimental Animal Care Committee guidelines and approved by the Institutional Ethics Committee of Fujairah Research Center, UAE (FRC 002/2023).

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Conflict of Interest

The authors declare that there is no conflict of interest.

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