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Photo-identification of Dugongs in Marsa Alam and Wadi El Gemal National Park, Egypt

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Using photo-identification techniques, 30 dugongs were recorded at the southern Egyptian Red Sea coast between December 2015 and October 2017, 16 at Marsa Alam and 14 at Wadi El Gemal National Park (WGNP). Males were recorded seven times more frequently than females and calves were also recorded. A Photo ID catalogue was prepared for the dugongs with records of their occurrence among sites. We confirmed the presence of particular dugong specific sites. Long- and short-distance movements within the study sites were recorded for eight different dugongs. This is the first study to document the number of dugongs in inshore areas of the Egyptian Red Sea coast. Further studies are recommended for offshore sites in WGNP for better documentation of this group of animals.

[Keywords: *Dugong dugon*; Photo ID; Site fidelity; Red Sea; Marsa Alam; Wadi El Gemal National Park]

Introduction

Red Sea dugongs have been studied by Gohar⁷, based on observations of 16 specimens (10 females and six males) caught over 14 years in the Strait of Jubal (northwest corner of the Red Sea proper and the entrance to the Gulf of Suez) in several places between Hurghada and Ras Giemsa in the north (70 km). Another study was undertaken in 2000-2003⁸, focused on the distribution and relative abundance of dugongs along the coast from Hurghada, immediately south of the Gulf of Suez, to Shalateen, about 200 km north of the Sudan border. A low-density population occurred throughout the area, but the maximum and minimum numbers reported were 17 in 2002 and 12 each in 2001 and 2003.

Photo-identification based on body markings and colouration has been used to examine numerous free-ranging marine mammal species¹. The images have become important means for wildlife monitoring, from individuals to populations and communities across large marine ecosystems². This technique has been used effectively in studies on marine mammals such as the ecology and behaviour of dolphins³ and dugongs⁴. For a long-term Photo-identification study of populations, dedicated and continued monitoring and photo-documentation is necessary, as the acquisition of any new features could alter an individual's appearance, potentially making it difficult or impossible to reidentify the animal at a later date⁵.

Information on calving intervals/reproductive rates and age at sexual maturity as determined from resightings of individuals is a useful measure for evaluating recovery of the species⁶.

In the present paper, photo-identification was used to identify dugongs inhabiting the Wadi El Gemal National Park (WGNP) and Marsa Alam; information regarding their occurrence, distribution and abundance were documented, and an identification catalogue was created. This is the first study to shed some light on the status of the population of dugongs using this technique in the western coasts of the Egyptian Red Sea. In this paper, we use repeat observations on naturally-marked animals to provide:

- Information on the persistence of scars, flipper and tail notches and their use for obtaining longitudinal data on individual dugongs.
- An estimate of the minimum number of dugongs known alive in the coastal waters of the Marsa Alam and WGNP regions of the Egyptian Red Sea.
- Insights into the population composition and movements of habituated, marked animals.

Materials and Methods

Study sites

The study was undertaken between December 2015 and October 2017. The data was collected from 22 different sites located in two regions: Marsa Alam

and WGNP (Fig. 1). The 14 sites selected in Marsa Alam were: Marsa Tondoba, Marsa Alam Harbour, Marsa Assalaya, Marsa Egla, Marsa Gabal Elrossaas, Marsa Shagra, Marsa Hermez, Marsa Abou Dabbab, Marsa Moreen, Marsa Shooni Elsoghayar, Marsa Shooni Elkebeer, Fayroz Plaza Jetty, Marsa Mobarak and Port Ghaleb Harbour (Fig. 1). The eight sites in WGNP included Marsa Alfokeiri, Gorgonia Beach, Shams Alam, Ras Baghdady, Marsa Om Elabbas, Abou Ghossoon, Hamata Harbour and Marsa Wadi Lahmy (Fig. 2). These sites were selected based on previous observations of seagrass beds and dugong occurrence.

Methods

Underwater observations: Survey sites were accessed from the shore or by boats. Observation was carried out by snorkelling and SCUBA diving one hour before and after the high tide. Hamata Harbour was an exception where observation was made from the surface of the boat due to the fast swimming motion of dugongs. Underwater photographs were taken using an HD camera Go Pro Hero 4 with a red filter. Images from the surface were taken using a Nikon Camera D7000 SLR with a 30-70 mm lens.

Observations were made maintaining a distance of 1 to 3 m from each dugong, whose size, sex, notches, scars on the different body parts were noted and photo-documented. Observations and photography also focused on the right and left flippers as well as the tail flukes. Notches were mostly used in identification since they are more permanent than scars that can heal in a couple of months or more (personal observation). Sex was determined by observing the distance between the genital slit and the anus; in males, the two openings are far apart while in females they are close together (almost touching). Nipple size is also a factor, being very small in males (< 2 cm) and usually >5.0 cm long in females (Plate 1). In cases where sex could not be determined due to observation difficulties, individuals were recorded as “unidentified.”

All dugongs were assigned a five-digit identification number based on the location of initial sighting (Koelsc 1998). The first letters of the site name were followed by the number of the individual dugong. For example, the code of a dugong in Hamata Harbour would be HHA03 while that of Marsa Abou Dabbab would be MAD18. Notes on the date, location and re-sighting instance were also taken.

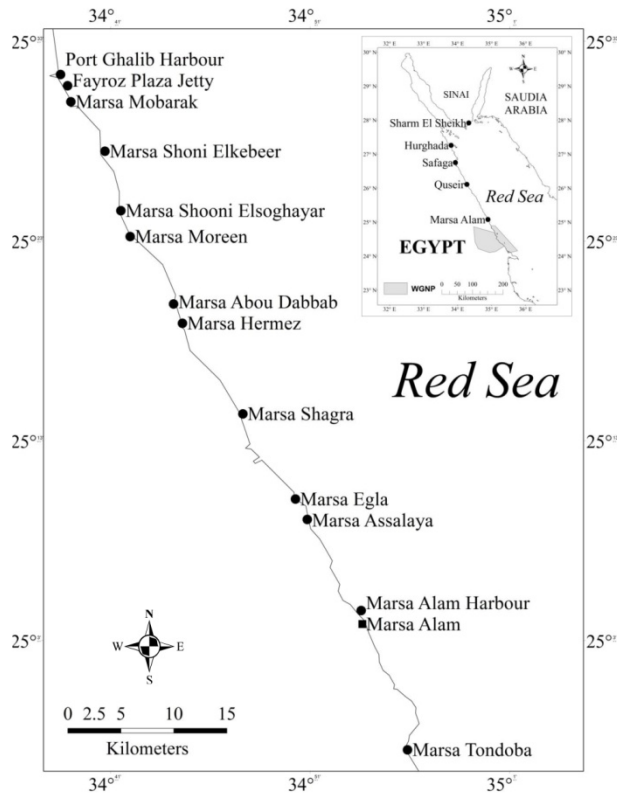


Fig. 1 — Map showing Egyptian Red Sea and Marsa Alam sites.

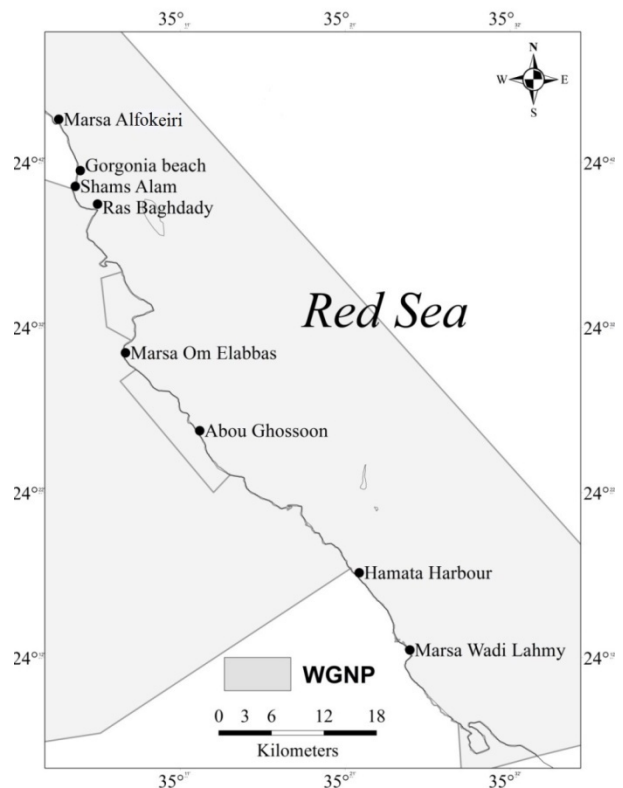


Fig. 2 — Map showing WGNP sites.

Results

Sighting records:

A total of 396 sightings were recorded during 510 field days carried out across the 22 sites during which 30 individuals were sighted (13.2 sightings/individual) (Table 1). At WGNP, from December 2015 to September 2016, 14 individuals across 116 sightings (8.3 sightings/individual). At Marsa Alam, from October 2016 to October 2017, 16 individuals in 280 sightings for Marsa

Alam within 14 sites (Average = 17.5 sightings/individual).

Sex determination:

Of the 30 individuals; 22 were males (73%), three were females (10%) and three calves (10%) and two unidentified (7%) (Table 2). Results of the photo-identification effort are summarized in Appendix (1).

Description of notches used in photo-identification

The four dugongs which were most reliably identified via the notches were: ID#SAL10,

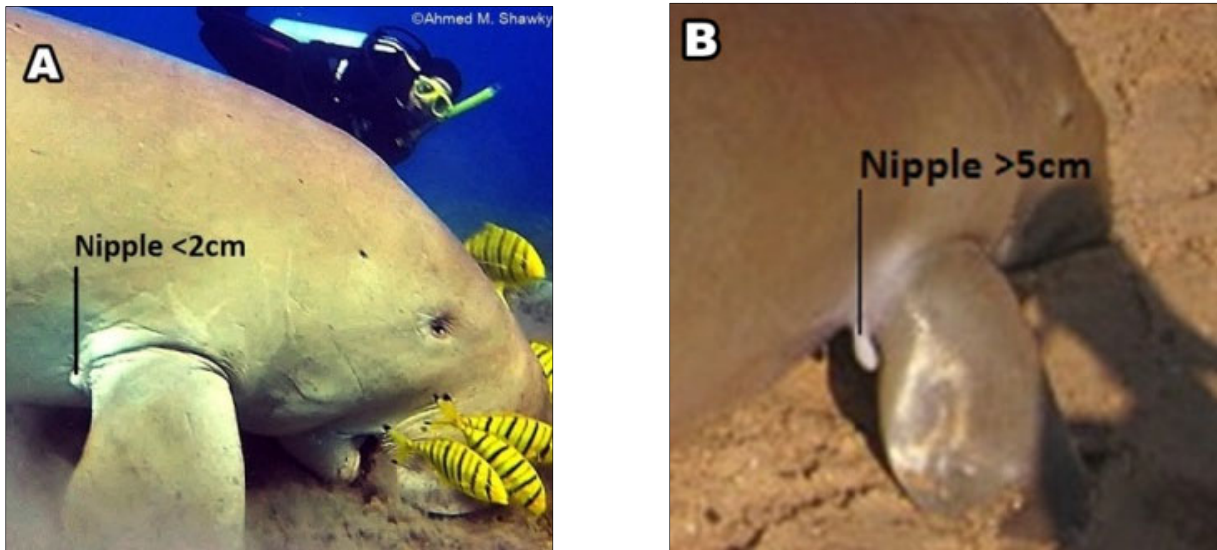


Plate 1 — (A) Male and (B) female dugong showing different nipple size.

Table 1 — Dugong sightings and numbers at the studied sites.

Region	Location		Site	Number of sightings (n= 396)	Number of days (n= 510)	Number of individuals	
	Latitude	Longitude					
WGNP	24.755°	35.066°	Marsa Alfokeri	5	4	1	
	24.450°	35.201°	Abou Ghossoon	4	13	1	
	24.285°	35.379°	Hamata Harbour	12	20	3	
	24.518°	35.137°	Marsa Om Elabbas	2	5	1	
	24.664°	35.110°	Ras Baghdady	2	13	2	
	24.689°	35.087°	Shams Alam	85	65	3	
	24.704°	35.091°	Gorgonia Beach	4	5	2	
	24.213°	35.428°	Marsa Wadi Lahmy	2	5	2	
	Marsa Alam	24.960°	34.938°	Marsa Tondoba	6	15	1
		25.080°	34.894°	Marsa Alam Harbour	1	9	1
25.173°		34.843°	Marsa Egl	72	65	5	
25.155°		34.853°	Marsa Assalaya	6	10	3	
25.205°		34.809°	Marsa Gabal Elrossaas	1	5	1	
25.320°		34.747°	Marsa Hermez	15	15	5	
25.338°		34.740°	Marsa Abou Dabbab	87	105	7	
25.395°		34.702°	Marsa Moreen	2	8	2	
25.244°		34.797°	Marsa Shagra	1	37	1	
25.417°		34.695°	Marsa Shooni Elsoghayar	1	5	1	
25.467°		34.679°	Marsa Shooni Elkebeer	2	15	1	
25.510°		34.653°	Marsa Mobarak	84	45	3	
25.533°	34.640°	Port Ghaleb Harbour	1	45	1		
25.522°	34.650°	Fayrouz Plaza Resort	1	1	1		

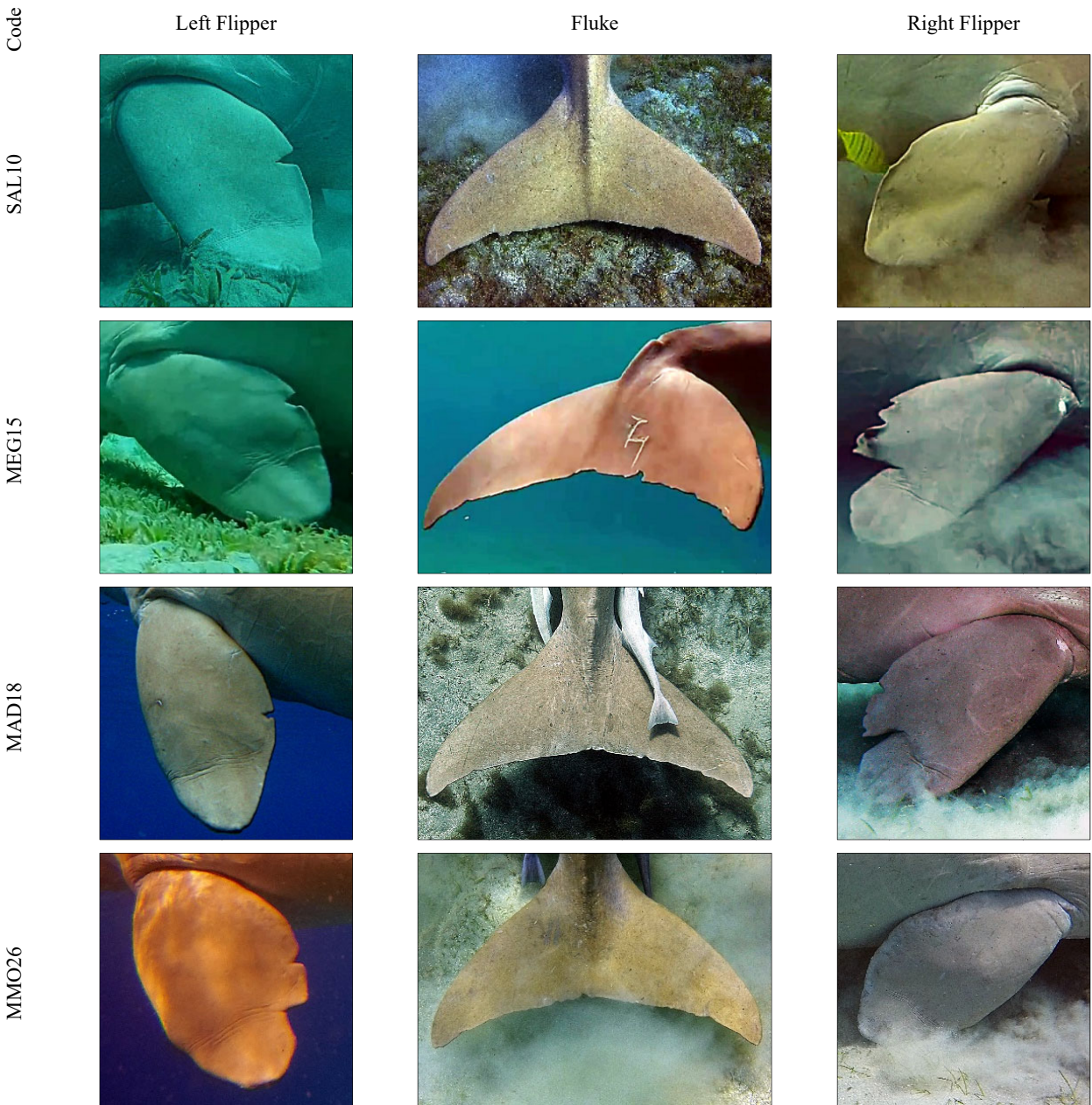
ID#MEG15, ID#MAD18, ID#MMO26 (Table 3). The first dugong was observed opposite the Shams Alam Resort (24.689°N and 35.087°E). The average depth of sighting was 6 m at a distance of 250 m from shore, although the dugong was sometimes seen at 2 m and 100 m from shore. This individual was about 2.5 m long with one distinct V-shaped notch on the middle edge of the left flipper. Other notches occurred along the left fluke margin including a prominent crescent-shaped one. The second dugong was sighted mainly on Marsa Egla (25.173°N and 34.843°E). The average

sighting depth was at 3 m at a distance of 230 m from shore. This individual was about 3 m long with a distinct v-shaped notch on the middle edge of the left flipper. The right flipper had four notches on the middle margin, one big V-shaped, two U-shaped and one little notch above the larger one. A clear v-shaped

Table 2 — Numbers of males, females, calves and unidentified individuals in the studied regions.

Region	Male	Female	Calf	Un-identified	Total number
WGNP	10	1	1	2	14
Marsa Alam	12	2	2	-	16

Table 3 — Identified dugongs with reliable notches. ©Ahmed M. Shawky.



notch was seen on the right fluke together with some very small ones on the tail margin. The third dugong was sighted in Marsa Abou Dabbab (25.338°N and 34.740°E). The average depth of was 7 m at a distance of 200 m from shore, with some sightings at 15 m depth and 500 m from shore. This individual was about 3 m long with one small v-shaped notch in the middle edge of the left flipper. The right flipper had one large deep notch together with another three above it. The fourth dugong was sighted mainly in Marsa Mobarak (25.510°N and 34.653°E). The average depth of sightings was 3 m at a distance of 230 m from shore. The individual was about 3 m long with two visible notches on the left flipper: The first was a large V-shaped notch located on the lower third of the flipper while the second was a slight V-shaped notch slightly above it. There was also one very small notch on the right fluke as well as a v-shaped notch on the tail in addition to two very small notches near the edge on the left. A photo catalogue of the 30 identified dugongs in WGPN and Marsa Alam is presented in Appendix 1.

Scars

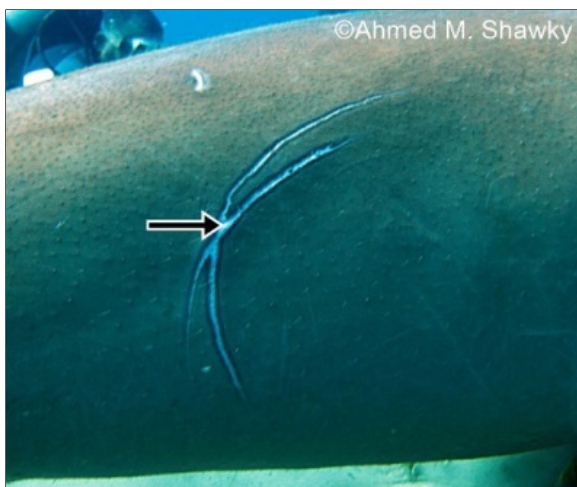
Scars were seen on the dorsal sides of the dugongs and varied in colour between white and dark brown. Superficial scars appeared as pale lines or patches. Scars observed on dugong ID#SAL10 on 15 October 2015 in Shams Alam had recovered by a second sighting on 14 February 2016 (Plate 2). Lines, as well as the white spots on the flukes, disappeared completely when the individual was seen during later sightings.

Residence pattern along the study sites as indicated by the photo-identification technique

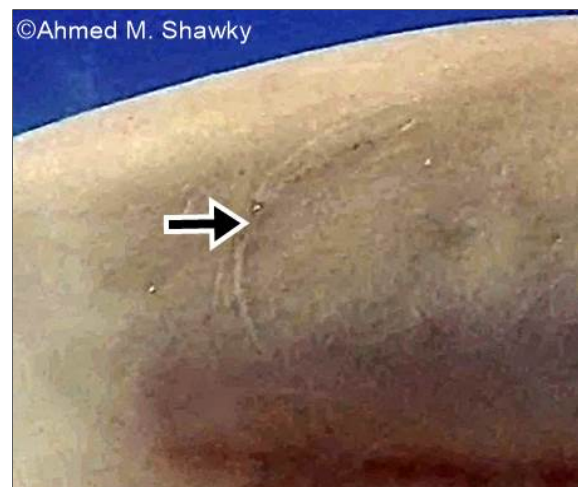
None of the dugongs was observed moving to or from WGPN and Marsa Alam. However, dugong ID#SAL10 was the only dugong from WGPN that was re-sighted between Gorgonia Beach Resort and Shams Alam Resort travelling a distance of 2.5 km. In Marsa Alam area, out of the 16 dugongs, only six were seen moving among different sites. The dugong with the least movement was ID#MEG17, which travelled a distance of 3 km between Marsa Eglia and Marsa Assalaya, while the greatest was by dugong ID#MEG18 which travelled 36 km from Marsa Abou Dabbab to Marsa Alam Harbour. For the six Marsa Alam dugongs, the mean distance travelled within at Marsa Alam was 16.6 ± 14 km.

Discussion

The photo-ID technique was used for the first time for the identification of dugongs inhabiting the Egyptian Red Sea coastline. Along the 180 km area surveyed during the present study, a total of 30 dugongs were identified. Previous studies are scarce; Gohar⁷ recorded 16 dugongs within 70 km between Hurghada and Ras Gemsha over 14 years. He obtained his specimens using specially made fishing nets. Hanafy *et al.*⁸ reported 12 to 17 dugongs between 2001 and 2003 based on interview surveys in the area of Hurghada and Shalateen. They reported eight adults and three juveniles in Marsa Alam and six adults and one juvenile in Wadi El Gemal. The authors stated that they “do not know if some individuals were observed at different sites in the same year.” The methodology



First sighting (15.10.2015)



Second sighting (14.02.2016)

Plate 2 — Dugong ID#SAL10 showing body scars during the first sighting (left) and recovered ones in the second (right). Sighting date is shown.

Appendix 1— Photo-identification catalogue of the identified dugongs. Male (M), Female (F), Calf (C) and (Un) un-identified.

Dugong Identification Code	Sites																No. of Re-sighting	Sex								
	Marsa Alfokeiri	Abou Ghossoon	Hamata Harbour	Marsa Om Elabbas	Ras Baghdady	Shams Alam	Gorgonia beach	Marsa Wadi Lahmi	Marsa Tondoba	Marsa Alam Harbour	Marsa Egla	Marsa Assalaya	Marsa Gabal Elrossaas	Marsa Hermez	Marsa Abou Dabbab	Marsa Moreen			Marsa Shagra	Marsa Shooni Elsoghayar	Marsa Shooni Elkebeer	Marsa Mobarak	Port Ghaleb Harbour	Fayrouz Plaza Resort		
MFU01	■																							5	M	
AGH02		■																							4	M
HHA03			■																						2	M
HHA04				■																					5	F
HHA05					■																				5	C
MOA06						■																			2	M
RBA07							■																		1	M
RBA08								■																	1	M
SAL09									■																1	M
SAL10										■															84	M
SAL11											■														3	M
SAL12												■													1	M
MWL13													■												1	Un
MWL14														■											1	Un
MEG15															■										73	M
MEG16																■									4	F
MEG17																	■								4	C
MAD18																		■							66	M
MHE19																			■						29	M
MAD20																					■				2	M
MAD21																						■			2	M
MHE22																							■		1	F
MHE23																								■	1	C
MHE24																								■	1	M
MMO25																								■	93	M
MMU26																								■	6	M
MMU27																								■	6	M
MMU28																								■	1	M
MTO29																								■	2	M
MEG30																								■	1	M

they used does not allow a determination of the actual number of individuals. Therefore, the present results, which are based on actual observation of individuals

under water, indicate that the areas of Marsa Alam and WGNP encompass a bigger population than previously recorded.

Males outnumbered females in this study by a ratio of 7:1 in both areas. Calves were also recorded for the first time. From Hurghada to Ras Gemsha, Gohar⁷ recorded ten females and six males and no calves. Hanafy *et al.*⁸ did not determine the sex of the recorded individuals. However, they reported three juveniles (i.e., less than 2 m) in Marsala Alam and one in WGNP. The fact that females were not as common as males in our study suggest that females are inclined to visit those areas to feed at a much quieter time in the day, for example, early morning or late at night thus avoiding disturbances caused by human activities. Nocturnal foraging has been reported in dugongs by several researchers and explained as a means to avoid human activities, fishermen and hunters^{9,10,10}.

In this study, the dugong's sex was determined through observation of the genital parts. Lanyon *et al.*¹¹ studied sexing in sirenians using visual discrimination of sex by photographing the ventrum of dugongs that showed the relative distance between the anus and genital opening in Queensland, Australia. Gohar⁷ studied the anatomy of dugongs in the Red Sea, Egypt. He reported that in males, the distance between the anal and genital opening was approximately 1/7th of the total length of the animal while in females the distance between the vulvar and the anal clefts was between 2.5 to 3.5 cm. Nipple length is likely to be greater in more mature females¹¹. When females approach maturity, the nipples protrude until they become about 2.5 cm long and 1.8 cm in diameter at their base in adult non-pregnant females. During pregnancy, the nipples grow, and in a 2.88 m long lactating female they were cone-shaped, 8.5 cm long and 5.5 cm in diameter at their base⁷.

Notches were the main characteristics by which photo-identification was carried out in the present study. Würsig & Jefferson¹² reported that natural marks could usually be used for the identification of vertebrates. Hillman *et al.*¹³ used a matching process that depended on the pattern of nicks and notches usually found along the trailing edge of the dorsal fin of many delphinid species. Identification of dugong using scars and notches allowed re-sighting of the same individuals many times and in different sites¹⁴. The irregularity of the flukes' margins was used in the identification of dugongs in our study by photographing the tail when it was raised above the seabed during grazing on seagrasses. This is in agreement with Anderson¹⁵ who noted that flukes showed different shapes and scars and that the raised

flukes, though difficult to photograph, may provide another means of identification under favourable sea conditions.

Anderson¹⁶ also noted that most adult dugongs carried scars that permitted repeated identification of individuals and described their nine types in Shark Bay, Western Australia. In their study on dugongs of Andaman and Nicobar Islands, India, Souza & Patankar¹⁴ identified three immature sized individuals using their distinctive scars. In our study, the observation that scars have recovered and disappeared completely over a period of four months or less indicates that they cannot be used for the identification of dugongs over a long period. This observation was different from that of Anderson¹⁶, who assumed that deeper scars are permanent and could assist to identify individuals over periods of several years or throughout the remaining life of the individual. Scarring varies from light and irregular scars to heavy and from prominent to coalesced¹⁷. Newer scars are white and become darker with age. However, deeper scars may be expected to last indefinitely, although they may or may not be repigmented¹⁶.

Understanding the movement capabilities of dugongs is essential for their conservation, particularly as they relate population connectivity and re-colonization¹⁸. Dugong photo-identification studies can successfully document distinct dugongs during different seasons, and at different locations¹⁹. Our results documented the re-sighting of individuals more than once at different sites. The relative proximity of these sites and the short amount of time required for travel must have been a key to the movement of individuals. These observations are similar to that of Sheppard *et al.*²⁰ who recorded that male and female dugongs, including cows with calves, exhibited large-scale movements (< 100 km) in Queensland, Australia.

Dugongs were not re-sighted among different main locations. This finding might imply that dugongs have an implicit preference towards one location over another. The absence of some individuals from some sites for more than a month might be explained by their movement to another feeding area or to avoid disturbance. High site fidelity to areas of core habitat has been reported for of Florida manatees^{21,22}, and these movements appeared to be influenced by seasonal and regional fluctuations in biomass and nutritional content of their principal forage plants²⁰.

More information is not known about the dugongs in the offshore habitats of coral reef environment in Egypt. Earning this information is critical to confirm that future conservation plans in Egypt are sufficiently managed and developed on the coastal environment increased. This study is the first step to address this gap. The goal of this study was to understand the ecology and behaviour of dugongs in Egyptian Red Sea coast and to notify decisions concerning dugong conservation and management locally and regionally.

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