American Journal of
Environment Studies
(AJES)

Dugongs in Kenya – a survey on status and Trends.

Asma Hadi Awadh

Dr. Maarifa A. Mwakumanya

Dr. Mohamed Omar

American Journal of Environment Studies
ISSN 4520-4738 (Online)
Vol.4, Issue 1, pp 76 - 87, 2021
www.ajpojournals.org

Dugongs in Kenya – a survey on status and Trends

[1*]Asma Hadi Awadh
Post Graduate Student: School of Environment and Earth Sciences
Pwani University
*Corresponding Author's E-mail: asmabinsaad@gmail.com
[2]Dr. Maarifa A. Mwakumanya
Lecturer, School of Environment and Earth Sciences
[3]Dr. Mohamed Omar
Scientist, Kenya Wildlife Service

Abstract

Purpose: The purpose of this study was to assess Dugongs' status distribution of dugongs (*Dugong dugon*) in Kenya. A dugong is a herbivorous marine mammal of the tropical and subtropical Indo-West Pacific and the Indian Ocean. Globally, IUCN classified the Dugong as rare; Kenya has done the same under the Wildlife Conservation and Management Act 2013, thus making Dugongs a conservation priority. The study's main objective was to assess dugongs' distribution and status for conservation in Kenya since the 1960s.

Methodology: The study employed a concurrent triangulation design to corroborate findings from three methods. The study used a literature review, semi-structured questionnaires, guided interviews, and focus group discussions with respondents on obtaining socio-economic data. Data was collected in fishing villages with documented and or anecdotal records of the availability of dugongs. Experiences 378 fishers were reached for the study. The study aggregated the number of dugongs sited by decades from the six sampled study sites and presented the data on a line graph. Further, the study computed the rate of change in dugongs from one decade to the next.

Findings: More than 100 dugongs occurred in the Kenyan waters in the 1960s; their population has declined considerably since then. The dugong habitat and feeding area have also shrunk over the same period, further aggravating the situation. There were more than thirty known dugong feeding areas in the study areas; only 10 of them are still known to host dugongs. An estimated 20 dugongs are known to be present in the Kenyan marine waters in the current times.

Unique contribution to theory, practice and policy: This study confirmed the presence of dugongs in Kenya. Further, the dugong numbers are very small, thus showing an urgent need for their conservation. Dugongs are found in Kiunga and Kisite Marine Protected Areas (MPAs) and their immediate surroundings; this amplifies the conservation value of the MPAs.

Keywords: *Dugongs, Kenya, Population, Trend*

1. BACKGROUND

The Dugong (*Dugong dugon*) is a herbivorous marine mammal found in the coastal waters of the tropical and subtropical Indo -West Pacific and the Indian Ocean (Marsh et al., 2012). It is one of the four living species of the order *Sirenia*, considered the risk of extinction. The other member of the *Dugongidae*, Stellers, is the sea cow (*Hydrodamalis gigas*), which is extinct due to over-exploitation for meat (Marsh et al., 2012), demonstrating the vulnerability of species under the order *Sirenia*. Historically, the global population of dugongs have declined over the last few decades (Muir et al., 2012; Nasr et al., 2019; Pusineri et al., 2013; Rajamani & Marsh, 2010; SURAPPA, 2013). In Kenya, large herds were reported in the 1950s and '60s, with a group of 500 dugongs sighted in (EAME & Ecoregion, 2004). Dugongs are the most endangered large mammal on the African continent (Cockcroft, 1995), with the imminent danger of extinction in East Africa unless conservation measures are taken (Muir et al., 2012).

Dugongs are obligate foragers of seagrass, with seagrass beds determining their spatial distribution (Adulyanukosol & Poovachiranon, 2006; Budiarsa et al., 2021). However, the current population has a patchy distribution over broad spatial scales (Waycott et al., 2009). The increasing degradation and disintegration of seagrass habitats and poor fisheries technologies have made the Dugong spatially vulnerable (Muir *et al*., 2004). Dugongs are threatened worldwide by loss and degradation of seagrass, fishing pressure, indigenous use and hunting and coastal pollution (WWF, 2004;(Marsh et al., 2005). The IUCN has listed dugongs as vulnerable to extinction. Dugongs have declined markedly across the Western Indian Ocean (WIO) range (coastal waters between Kenya and Mozambique, and in the Island Nation coastal waters) over the last 30 years (Dutton, 1998), with a small population of the threatened dugongs existing in Mozambique (WWF, 2004).

The dugong population has gradually declined in Kenya, with only occasional sightings (Wamukoya, 1997; WWF, 2004). In 1994 and 1996, only ten and six individuals, respectively, were sighted in Lamu (Cockcroft, 1995). This decline in Kenya's Dugong population is attributed to poaching for food, fats, and accidental and targeted capture in nets (Marsh, 2003).

2. MATERIALS AND METHODS

This section presents the methodology used by the researcher to find answers to the research questions. It covers the areas of study, research design, target population, sampling procedure, methods of data collection, and data analysis.

2.1 The Area of study

Kenya's coastline lies in the Western Indian Ocean Region. "It extends for about 640 km, from Ishakani on Kenya - Somali border at to the North on 1.6° S, 41.5° E to Vanga on

Kenya - Tanzania border at the south at 4.6 ° S, 39.4° E" (Abuodha, 1993). This study was conducted along the Kenyan coast. Administratively, the shoreline touches five counties of Kwale, Mombasa, Kilifi, Tana River and Lamu. The region is roughly 150km by 450 (Tychsen et al., 2006). It is inhabited by more than 4 million people or about 10% of the national population. About 60% of the coastal population live in rural parts of the coast and are still mainly reliant on natural resources for their livelihoods (Matsue et al., 2014).

Figure 1: Map showing the study sites on the coast of Kenya

2.2 Research Design

The study employed a concurrent triangulation design (Terrell, 2012). This design was used because the study wanted to collect and analyze quantitative and qualitative data separately on the same phenomenon. This design was used because the study wanted to corroborate, confirm and validate quantitative findings with qualitative results. Questionnaires were administered to 192 fishers who had some dugong knowledge used to collect quantitative data. Qualitative data was collected through interviews and Focused Group Discussions (FDG). Thirty-eight interviews were conducted with identified village dugong experts, and 48 more fishers participated in FGDs. Purposive and snowballing techniques were used to select the respondents for the study.

2.3 Population and sampling size

2.3.1 Socio-cultural data

Socio-economic and cultural data was collected from fishing villages identified based on specific spatial dimensions. The fishing villages identified were those that had fishing

villages adjacent to the beach and the sea. The fishing villages should also have had a history of anecdotal, scientific or documented information on Dugongs. The selected fishing villages had 1,167 active fishers distributed in each village, as shown in Table 1 below.

The total number of registered fishers in each fishing village was used to derive the sample size.

The formula on Biostatistics by *Zaied et al. 2006* was used to calculate the sample size at the 90 per cent confidence level and 5 per cent margin of error.

$$sample\ Size = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p(1-p)}{e^2 N}\right)}$$

Where;

z = 1.65 at 90 per cent confidence level

p= is the sample proportion (50%)

E= 0.05

N is the population size.

The sample size from each fishing village is shown in Table 1; therefore, the study sampled a total of 378 respondents.

Table 1: Study Sample size and distribution

Fishing village	**Mode of data collection**		
	Questionnaire	**Key informant Interview**	**FDG discussants**
Vanga	34	8	30
Shimoni	18	4	20
Msambweni	**30**	4	30
Matondoni	39	8	20
Kizingitini	39	6	20
Kiunga	32	8	28
	192	**38**	**148**

2.4 Analysis of the historical and Dugong distribution across the range in Kenya

The study aggregated the number of dugongs sited by decades from the six sampled study sites and presented the data on a line graph. Further, the study computed the rate of change in dugongs from one decade to the next. ANOVA was conducted to check for a change of

dugong numbers within fishing villages at a significant level of 0.05. The hypothesis (H_o), "There was no difference in the mean number of dugongs seen between different decades in the study site", was tested in each site.

Results

3.1 History and Distribution of Dugongs in Kenya

This study shows that Dugongs were seen in large numbers in all study sites from the 1960s to 1969, between 10 to more than 30 Dugongs (Table 5). The study also found out that dugong numbers have dwindled. On the South coast, the number sighted decreased from more than 20 dugongs in Vanga and Shimoni in 1960-1969 to only one (1) Dugong in Shimoni and Msambweni waters between 2010 and 2017 (Table 2). Between the year 1980 and the year 1989, there was no Dugong see at all. In the south (Vanga, Shimoni and Msambweni), Dugongs were seen on several fishing grounds, including Anziwani, Mtakashari, Panga za ng'amba, Kifungu, Mundu, Navy, Chale, Doa, Sii island, Majoreni, Kigomeni, Miyaani, Mwarembo and Mbayai, Kichwa cha nyati and Funzi creeks.

The North Coast situation is similar, with over thirty Dugongs being sighted at a time in the 1960-1969s. The number of dugongs sighted declined to only one in Matondoni, two in Kizingitini and ten in Kiunga (Table 2). The 1980-1989 decade was worse with no Dugong sighted in Matondoni and Kizingitini and about twenty in Kiunga. Kiunga seems to have a relatively high number of Dugongs over the decades than all study sites (Table 2). In the North (Matondoni, Kizingitini and Kiunga), dugongs were sighted at Kipini, Pezali, Ziwayuu, Tenewi and Manda toto *Mlima wa nguva*[1], Upilu wa papa, Konani, Shadi, Ndia-mbili, Mwamba-mkuu, Mlango-wa- huseni, kui and Bomani. Table 2 below shows the estimated dugongs sited in the fishing sites.

[1] Mlima wa Nguva is Swahili meaning Dugong hill

Table 2: Estimated Dugongs sighted in study area over the decades

Decades	Fishing villages					
	Vanga	Shimoni	Msambweni	Matondoni	Kizingitini	Kiunga
1960-1969	20	20	10	>30	>30	>30
1979-1979	0	4	3	20	10	>30
1980-1989	0	0	0	0	0	20
1990-1999	0	0	2	0	5	10
2000-2009	0	2	1	0	2	10
2010-2017	0	1	1	1	2	10

(Source: Asma Awadh, 2021)

The results show a small and scattered dugong population in Kenya (Table 2). (EAME & Ecoregion, 2004) suggest that the Northern areas, predominantly within Kiunga Marine National Reserve (KMNR), consistently hosted higher numbers of Dugong population than the southern region Msambweni Shimoni and Vanga.

This study established that the sharp decline was attributed to increased Illegal Unlicensed and Unregistered (IUU) fishing and damaged habitats on the South coast. Furthermore, the setting up of the marine park increased tourist infrastructure and boat activities, which the noise from all the activities scared away the Dugongs to other feeding areas. The few sighted dugongs are believed to feed in the grass meadows of Msambweni through the lagoons and bays in Funzi to the wide creeks and bays of the Mpunguti reserve.

In the North coast (Matondoni, Kizingitini and Kiunga), the population of dugongs declined drastically because of the growing town of Lamu, which has experienced an increase in transport activities in its creeks and meadows. It is also attributed to the increased use of IUU in the area. Kiunga is generally protected from intensive human activities and maintained minimal activities, with more Dugongs sighted over the decades compared to the rest. Fig. 9 below demonstrates the dugong decline in the Kenyan coast from the 1960s.

The study revealed a gradual decline of about 52% between the first and second decade of reporting (1960-1969 and 1970-1979). A steeper decline of 70% was experienced between 1971 and 1989. From the estimation given, about a 17 % increase of dugongs in Kenya was

reported between 2000 and 2010 (Fig. 4)

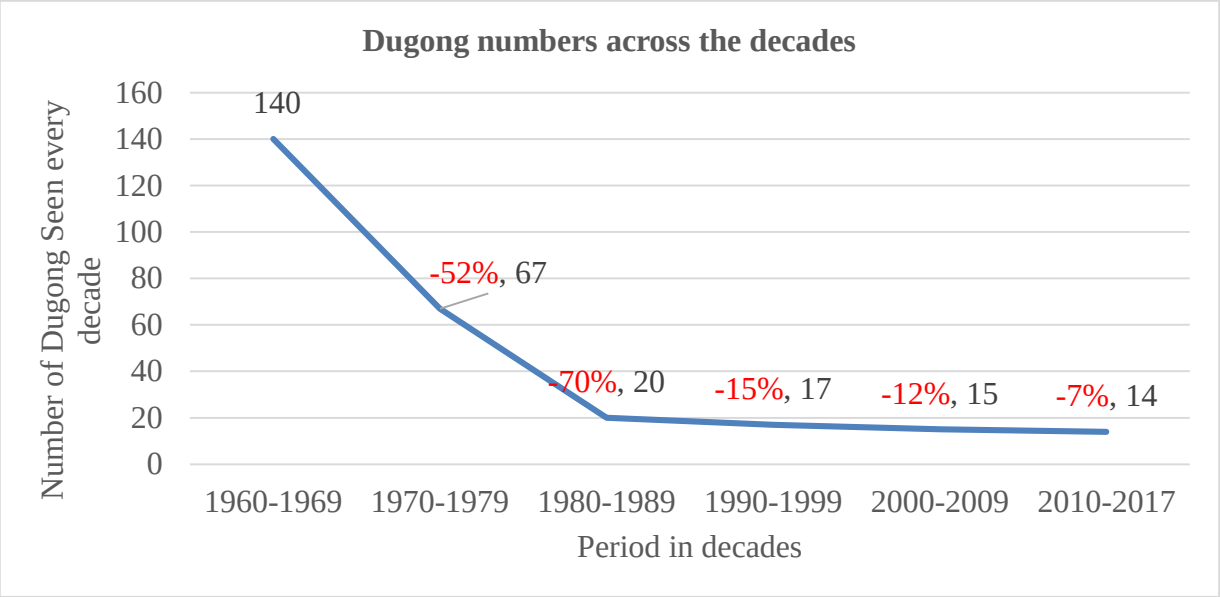

Figure 4: Rate of Dugong decline

An Analysis of Variance (ANOVA) was conducted to establish whether the variation in the sighted number of Dugongs between the decades and fishing villages along the coast had any significant connotation. The Null Hypothesis (Ho) that there is no significant variation in the number of dugongs across decades on the coast of Kenya was tested. The ANOVA analysis results show that at a significant level of 0.05, there is a significant difference in the number of dugongs sighted between different decades in the study area (Table 3) with a P-value 0.000060982.

At a significant level of 95%, the P-value from the ANOVA test indicates strong evidence to reject the null hypothesis and adopt the alternative hypothesis. There is significant variation in the number of dugongs across decades on the coast of Kenya. Further to this, at a significant level of 0.05, there is a difference in the mean number of Dugong seen between different decades in Kiunga.

American Journal of Environment Studies
ISSN 4520-4738 (Online)
Vol.4, Issue 1, pp 76 - 87, 2021
www.ajpojournals.org

Table 3: Single Factor ANOVA sightings between decades

ANOVA				
Source of Variation	***Probability***	***P-Value***	***F value***	***meaning***
Between Decades	0.05	0.000060982	8.123083475	The number of dugongs across decades is different

There is no difference in the number of dugongs seen in the Vanga, Shimoni, Msambweni, Matondoni and Kizingitini between the decades. However, in Kiunga (P is 0.00152), the number of dugongs seen between the different decades have different means. The sharp dugong decline in the study area is statistically significant therefore warranting conservation intervention. The results, therefore, give further evidence for Kiunga being a significant site for dugongs in Kenya.

3.2 Discussion

Dugongs are rare and elusive herbivorous marine mammals whose population is spread in forty-eight tropical and sub-tropical countries and territories in the Indian and Pacific Ocean (Kiszka & Muir, 2008). Eighty-five thousand of the world's dugongs, approximately three-quarters of their global population, are found in the inshore waters of northern Australia (Marsh & Lefebvre, 1994). The second-largest dugong population occurs in the Arabian Gulf, where approximately 7,000 remain (Al-Ghais & Das, 2001). The dugong population is steady in Australia (Delisle et al., 2018; Marsh et al., 2012), decreasing in the middle east and Asia (Nasr et al., 2019; Rajamani & Marsh, 2010; Sivakumar, 2013) and threatened in the western Indian ocean (EAME & Ecoregion, 2004; Muir et al., 2012; Wamukoya et al., 1997). In some areas, such as Mauritius, the Maldives and parts of Cambodia and Laos, dugongs may already have become extinct (Marsh et al., 2012).

In Kenya, (Wamukoya et al., 1997) documented large herds of dugongs being seen along the coast in the 1960s. It is estimated that in the 1960s, Kenya hosted hundreds of dugongs. Aerial surveys conducted in 1994 and 1996 show a strong downward trend. In the broader Lamu archipelago, ten and six dugongs were counted from the surveys, respectively. Three dugongs were recorded on the South coast of Kenya in the same aerial surveys. They reported two and six dugongs being seen in the Siyu channel and Kiunga in 2002. There is a possibility of two discreet and small dugong populations; this is seen because of the spatial separation between sightings on the country's north coast and south coast. The far north and far south of Kenyan marine waters are national MPAs (EAME & Ecoregion, 2004).

This study confirms that in the 1960s, more than 100 dugongs were estimated to live in the inshore area of the Kenya Indian Ocean. The south coast (Msambweni, Shimoni and Vanga) has extensive coastal development activities, which are not favourable for dugong survival. Some community members in Mkwiro and Shimoni reckon that the dugong population went down with increased tourism activities in the Kisite Marine Park as intensified fishing by motorized boats and canoes. In Kipungani, Kizingitini and Kiunga, the dugong population has been affected by intensive IUU activities. Kiunga has the highest dugong numbers compared to all study sites. The area is protected as the Kiunga Marine National Reserve and sheltered from dugong threats.

The Kenyan marine waters are rich in sustainable species diversity that is relied upon for ecological subsistence and commercial by the coastal people. Dugong sites decreased from more than thirty sites documented by this study (Pezali, Ziwayuu, Tenewi, Manda toto, *Mlima wa nguva*, Upilu wa papa, Konani, Shadi, Ndia-mbili, Mwamba-mkuu, Mlango-wa-huseni, kui and Bomani Anziwani, Mtakashari, Panga za ng'amba, Kifungu, Mundu, Chale, Doa, Sii island, Majoreni, Kigomeni, Miyaani, Mwarembo and Mbayai, Funzi creeks) to about ten areas (Pezali, Konani, Ndia-mbili, Mlango-wa- huseni, kui Doa, Sii island, Mwarembo and Mbayai, Funzi creeks). Dugong numbers being slightly higher in the north than in the south, possibly linking to the higher development and accessibility of the marine and coastal spaces in the south compared to the north. Kiunga has the highest dugong numbers compared to all study sites. The area is protected as the Kiunga Marine National Reserve and sheltered from dugong threats.

4.1 Conclusion

This study reveals that a dugong population does exist still currently occur in Kenya. The past data and recent sightings indicate that dugong numbers are declining. Anecdotes given by fishermen suggest that dugongs existed in large numbers in the lagoons and creeks of northern and southern Kenyan. The decline of the population is most likely the result of both incidental and targeted captures in fishing nets, increased human activity in the inshore reef areas, and degradation of the habitats, particularly the seagrass beds.

This study confirmed the presence of dugongs in Kenya, whose population is scattered, with a few dugongs in the south and north. The estimation of the population abundance is not possible because the sightings were low. However, this study's estimates from the available information are about twenty dugongs in Kenyan waters. The population is small; it will be challenging for the remaining dugong population to sustain itself under the existing threats. Results confirm that while they may no longer live in all studied sites, a small remnant population still exists just south from Msambweni to Funzi creeks and north from the Siyu channel through Kiwayuu to Kiunga. Of the twenty dugongs, at least ten are known to exist in Kiunga, making Kiunga the most significant dugong conservation site.

Recommendation

Dugongs thrive in areas where their natural habitat is completely undisturbed. Kiunga currently has fewer motorized boat activities compared to all sites investigated in this study. At the same time, Kiunga is one site that has a small but stable dugong population in Kenya. The Kiunga marine reserve or a section of it should be managed as a strict wilderness reserve to improve the dugong population. Efforts should be intensified to restore and maintain a healthy seagrass cover, including spatial mapping of dugong sites like Kui. Mlango wa huseni in Kiunga can be done to focus conservation efforts. In the south Key seagrass habitat areas that hosted dugongs in the past and could potentially be their feeding sites Sii, Doa, Chale should also be prioritized for conservation.

References

Abuodha, P. (1993). Geomorphology of the Kenyan coast: Not as a Result of Sea-Level Change alone.

Adulyanukosol, K., & Poovachiranon, S. (2006). Dugong (Dugong dugon) and seagrass in Thailand: present status and future challenges. Proceedings of the 3rd international symposium on SEASTAR2000 and Asian bio-logging science (The 7th SEASTAR2000 workshop),

Al-Ghais, S., & Das, H. (2001). Conservation of Dugongs in the UAE. *2nd Annual Report of the study submitted to Total Abu Al-Bukhoosh, 32pp*.

Budiarsa, A. A., De Iongh, H., Kustiawan, W., & van Bodegom, P. M. (2021). Dugong foraging behavior on tropical intertidal seagrass meadows: the influence of climatic drivers and anthropogenic disturbance. *Hydrobiologia*, 1-14.

Cockcroft, V. (1995). Dugongs of coastal Africa. *African Wildlife Update*.

Delisle, A., Kim, M. K., Stoeckl, N., Lui, F. W., & Marsh, H. (2018). The socio-cultural benefits and costs of the traditional hunting of dugongs Dugong dugon and green turtles Chelonia mydas in Torres Strait, Australia. *Oryx*, *52*(2), 250-261.

EAME, W., & Ecoregion, E. A. M. (2004). Towards a Western Indian Ocean dugong conservation strategy: the status of dugongs in the Western Indian Ocean region and priority conservation actions. *WWF Eastern African Marine Ecoregion, Dar es Salam, Tanzania*.

Kiszka, J., & Muir, C. (2008). Status of a marginal dugong (Dugong dugon) population in the lagoon of Mayotte (Mozambique Channel), in the western Indian Ocean. *Western Indian Ocean Journal of Marine Science*, *6*(1).

Marsh, H., De'Ath, G., Gribble, N., & Lane, B. (2005). Historical marine population estimates: triggers or targets for conservation? The dugong case study. *Ecological Applications*, *15*(2), 481-492.

Marsh, H., & Lefebvre, L. W. (1994). Sirenian status and conservation efforts. *Aquatic Mammals*, *20*(3), 155-170.

Marsh, H., O'Shea, T. J., & Reynolds III, J. E. (2012). *Ecology and conservation of the Sirenia: dugongs and manatees*. Cambridge University Press.

Matsue, N., Daw, T., & Garrett, L. (2014). Women fish traders on the Kenyan coast: livelihoods, bargaining power, and participation in management. *Coastal Management*, *42*(6), 531-554.

Muir, C. E., Kiszka, J. J., & Aragones, L. (2012). Eastern African dugongs. *Sirenian conservation: issues and strategies in developing countries. University Press of Florida, Gainesville*, 84-90.

Nasr, D., Shawky, A. M., & Vine, P. (2019). Status of Red Sea Dugongs. In *Oceanographic and Biological Aspects of the Red Sea* (pp. 327-354). Springer.

Pusineri, C., Kiszka, J., Quillard, M., & Caceres, S. (2013). The endangered status of dugongs Dugong dugon around Mayotte (East Africa, Mozambique Channel) assessed through interview surveys. *African Journal of Marine Science*, *35*(1), 111-116.

Rajamani, L., & Marsh, H. (2010). Using parallel regional-and local-scale initiatives to inform conservation management of rare wildlife: a case study of the dugong Dugong dugon in Sabah, Malaysia. *Endangered Species Research*, *13*(1), 17-23.

Sivakumar, K. (2013). Status and conservation of Dugong dugon in India: strategies for species recovery. In *Ecology and conservation of tropical marine faunal communities* (pp. 419-432). Springer.

SURAPPA, M. (2013). Conservation of Dugong dugon (sea cow) in Gulf of Mannar. *Current science*, *105*(2), 149.

Terrell, S. R. (2012). Mixed-methods research methodologies. *Qualitative report*, *17*(1), 254-280.

Tychsen, J., Geertz-Hansen, O., & Kofoed, J. (2006). KenSea–development of an environmental sensitivity atlas for coastal areas of Kenya. *Geological Survey of Denmark and Greenland (GEUS) Bulletin*, *10*, 65-70.

Wamukoya, G., Ottichillo, W., & Salm, R. (1997). Aerial survey of dugongs in Ungwana Bay and the Lamu Archipelago, Kenya.

Waycott, M., Duarte, C. M., Carruthers, T. J., Orth, R. J., Dennison, W. C., Olyarnik, S., Calladine, A., Fourqurean, J. W., Heck, K. L., & Hughes, A. R. (2009). Accelerating loss of seagrasses across the globe threatens coastal ecosystems. *Proceedings of the national academy of sciences*, *106*(30), 12377-12381.