MANGROVE STATUS OF SETSE, MON STATE

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Abstract

This study recorded a total of 18 mangrove species, comprising 12 true mangrove species and 6 mangrove associates. In terms of relative dominance, *Avicennia alba* and *A. officinalis* were the most dominant species across all transect lines. *Avicennia alba* had the highest importance value index (IVI) at 145.22, while *Sonneratia apetala* had the lowest IVI value at 1.57. The application of Google Earth Pro was used to assess the loss and recovery status of the mangrove area from 2011 to 2023. According to historical images from Google Earth Pro, 3.51 acres (2011-2014), 13.37 acres (2014-2017), 0.65 acres (2017-2019), and 7.74 acres (2019-2023) were recovered, while 3.73 acres (2017-2019) and 2.54 acres (2019-2023) were lost.

Keywords: relative dominance, loss and recovered status

Introduction

Mangroves are a group of trees and shrubs belonging to several families of flowering plants (Santisuk, 1983). Mangroves host a large array of associated floral and faunal communities by providing food, habitats, and shelter for their survival (Spalding *et al*., 2010).

Myanmar has a high mangrove diversity, with 44 species of true mangrove plants. It holds the 8th largest mangrove forest in the world (4% of the world's mangroves) and stands 3rd largest in Southeast Asia (8.8% of Southeast Asia's mangroves) (Spalding *et al*., 2010). Myanmar's mangrove forests have been depleted and degraded over the last few decades due to urbanization, charcoal production, agricultural expansion, and conversion to fishponds, shrimp ponds, and rice paddies (Zockler and Cherry Aung, 2019).

Globally, several studies on mangrove identification and diversity have been conducted. However, there have been few studies in Myanmar. Although mangroves are distributed in Mon State, their ecological roles are unclear. Setse is located in the southern part of Mon State and is the location of the Marine Science Aquaculture Research Centre (MSARC). There were no prior studies on the status of mangrove forests in Setse. To address this gap, the present study was carried out with the following objectives: (1) to evaluate the relative dominance of the forest and (2) to compare the status of mangrove forests in 2011, 2014, 2017, 2019, and 2023.

Materials and Methods

The study area

The study was conducted in the mangrove areas of Setse (Lat. 15° 56′ N and Long. 97° 35′ E), Thanbyuzayat Township, Mon State (Figure 1). It is located in the southern part of Mon State, in the southern region of Myanmar. The total mangrove area is approximately 60 hectares (148.26 acres). It is adjacent to Damin-Seik Village. This mangrove area experiences semi-diurnal tides (two high tides and two low tides), with a tidal range of 4 m from the bottom of the tidal creek.

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Figure 1. Map showing the study area

Methodology

The present study area was divided into three areas (Area 1, Area 2, and Area 3) (Figure 3.1). Within the present study site, 13 transect lines (TLs) were established perpendicular to the tidal creek (6 transect lines in Area 1, 7 transect lines in Area 2, and no transect line in Area 3). There were no mangroves and reservoirs were present for grow-out farms in Area 3. Hence, sampling cannot be done in Area 3. Using a transect tape, 100-meter-long transect lines were established, with 100 meters between transect lines during the fieldwork. Five quadrats were plotted on each transect line, each plot having an area of 100 m^2 (10 x 10), with 5 m intervals among them (totally of 65 quadrats in the whole study area). The length of the transect lines was recorded using the transect tape, and the coordinates of each transect line were taken by the Global Positioning System (GPS).

Data Collection and species identification in the study area

The mangrove species and associate species within each quadrat were recorded. All specimens were photographed digitally in color and recorded. For species composition purposes, the plants were identified to species level if possible, during the fieldwork following Giesen *et al*. (2007), Reddy (2008) and Primavera (2009).

Determination of relative dominance

To understand the situations in Setse mangrove forest and how many areas of the tree were occupied in each area during the current study, the basal area, total basal area, and relative dominance were approached using the following equations (Aheto *et al*., 2011).

$$\text{Basal Area } (m^2) = \frac{\pi}{4}\ (\text{DBH})^2$$

$$\text{Total basal area of all species } (m^2\, ha^{-1}) = \frac{\text{sum of all species basal area}}{\text{area of plot } (m^2)} \times 10000m^2$$

**Acanthus ilicifolius* was not considered for basal area because of shrub type.

Where DBH is the diameter at breast height. The breast height of the tree will be measured at 1.3 m of stem height from the bottom without buttress and at 0.3 m with buttress. To calculate the DBH of a tree, girth breast height (GBH) is divided by π (pi). Then, to calculate the relative dominance, the following equation will be used:

$$\text{Relative dominance (\%)} = \frac{\text{total basal area of a species}}{\text{basal area of all species}} \times 100$$

Importance value index (IVI) in the study area

The importance value index (IVI) indicates the ecological importance of a species in a specified ecosystem, which can be used for species conservation and management, through which species with a low IVI value require soar protection preference (Kacholi, 2013). The importance value index (IVI) for the species was determined as the sum of the relative frequency, relative density, and relative dominance using the formulas presented by English *et al*. (1997).

$$\text{Density (stems ha}^{-1}) = (\text{no. of living stems in a plot} \times 10000) / \text{area of the plot}$$

$$RD_1 = (\text{density of a species / total density of all species}) \times 100$$

$$RF = (\text{frequency of a species / total frequency of all species}) \times 100$$

$$RD_2 = (\text{total basal area of a species / total basal area of all species}) \times 100$$

$$IVI = RD_1 + RF + RD_2$$

Where RD_1 is relative density, RF is relative frequency and RD_2 is relative dominance

Mapping the degradation and recovered status of mangrove areas in the study area

The degradation and recovered status of the mangrove areas in 2011, 2014, 2017, 2019, and 2023 using Google Earth Pro. The historical images within the time zone were used to analyze their status.

Data analysis

The necessary figures were made in Microsoft Excel. For the variations in mangrove status of Setse in 2011, 2014, 2017, 2019, and 2023, Google ArcMap and Earth Pro were used.

Results

Species Composition

A total of **18 mangrove species** were identified within the transect lines, consisting of 12 true mangrove species and 6 mangrove associates, belonging to 11 different families (Table 1).

Table 1. Taxonomic classification list of the identified true mangrove and mangrove associates observed in the study area

Family	Genus	No.	Species	Common name	Local name
True Mangroves					
Acanthaceae	*Acanthus*	1	*Aanthus ilicifolius*	Sea holly	Kayar
Avicenniaceae	*Avicennia*	2	*Avicennia alba*	Gray mangrove	Thame-ywet-chon
		3	*A. officinalis*	Gray mangrove	Thame-ywet-wine
		4	*A. marina*	Gray mangrove	Thame-ywet-leit
Plumbaginaceae	*Aegialitis*	5	*Aegialitis rotundifolia*	Mangrove swamp	Sar-byat
Primulaceae	*Aegiceras*	6	*Aegiceras corniculatum*	River mangrove	Yae-kayar
Rhizophoraceae	*Bruguiera*	7	*Bruguiera cylindrica*	White Burma mangrove	Byu-kyet-tet
	Ceriops	8	*Ceriops decandra*	Flat-leaved spurred mangrove	Ma-da-ma
	Rhizophora	9	*Rhizophora apiculata*	Tall-silt mangrove	Byu-chay-dauk-ywet-chon

Family	Genus	No.	Species	Common name	Local name
Euphorbiaceae	*Excoecaria*	10	*Excoecaria agallocha*	Blinding tree	Thayaw
Sonneratiaceae	*Sonneratia*	11	*Sonneratia apetala*	Mangrove apple	Kant-ba-lar
		12	*S. alba*	Mangrove apple	La-mu
Mangrove Associates					
Verbanaceae	*Clerodendrum*	1	*Clerodendrum inerme*	The glory bower	Pinle-kyaung-pan
Fabaceae	*Derris*	2	*Derris trifoliata*	Common derris	Home-nwe
	Dalbergia	3	*Dalbergia spinosa*	Thorny liana	Byeik-su
	Pongamia	4	*Pongamia pinnata*	Indian beech	Thinn-win
Asteraceae	*Pluchea*	5	*Pluchea indica*	Indian pluchea	Kha-yu
Malvaceae	*Hibiscus*	6	*Hibiscus tiliaceus*	Sea hibiscus	Shaw-pin

Relative dominance of mangroves in the study area

Based on the basal area, the highest relative dominance values of *Avicennia officinalis* (70.57% in TL2, 47.49% in TL3, 44.22% in TL4, 70.10% in TL5, 77.11% in TL6) were estimated followed by *Avicennia alba*, *Excoecaria agallocha* and *Sonneratia alba* in Area 1 (Figure 2).

According to the result of relative dominance, the most common species was *Avicennia alba* (64.25% in TL 7, 83.13% in TL 8, 69.09% in TL 9, 52.47% in TL 10, 79.65% in TL 11, 80.38% in TL 12, and 83.66% in TL 13), followed by *Avicennia officinalis* and *A. marina* in Area 2 (Figure 3).

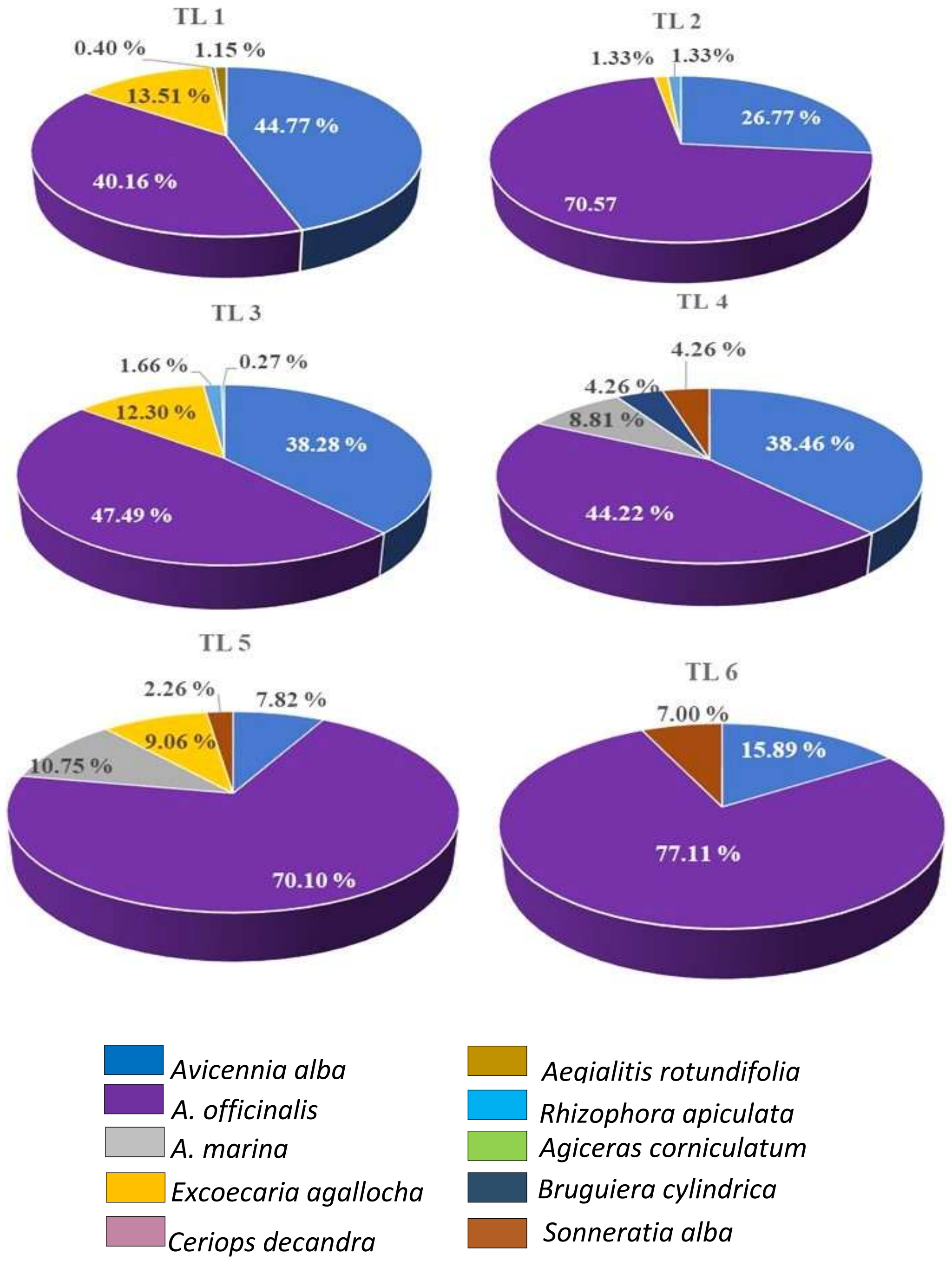


Figure 2. Relative dominance of each species found in different transect lines within Area 1

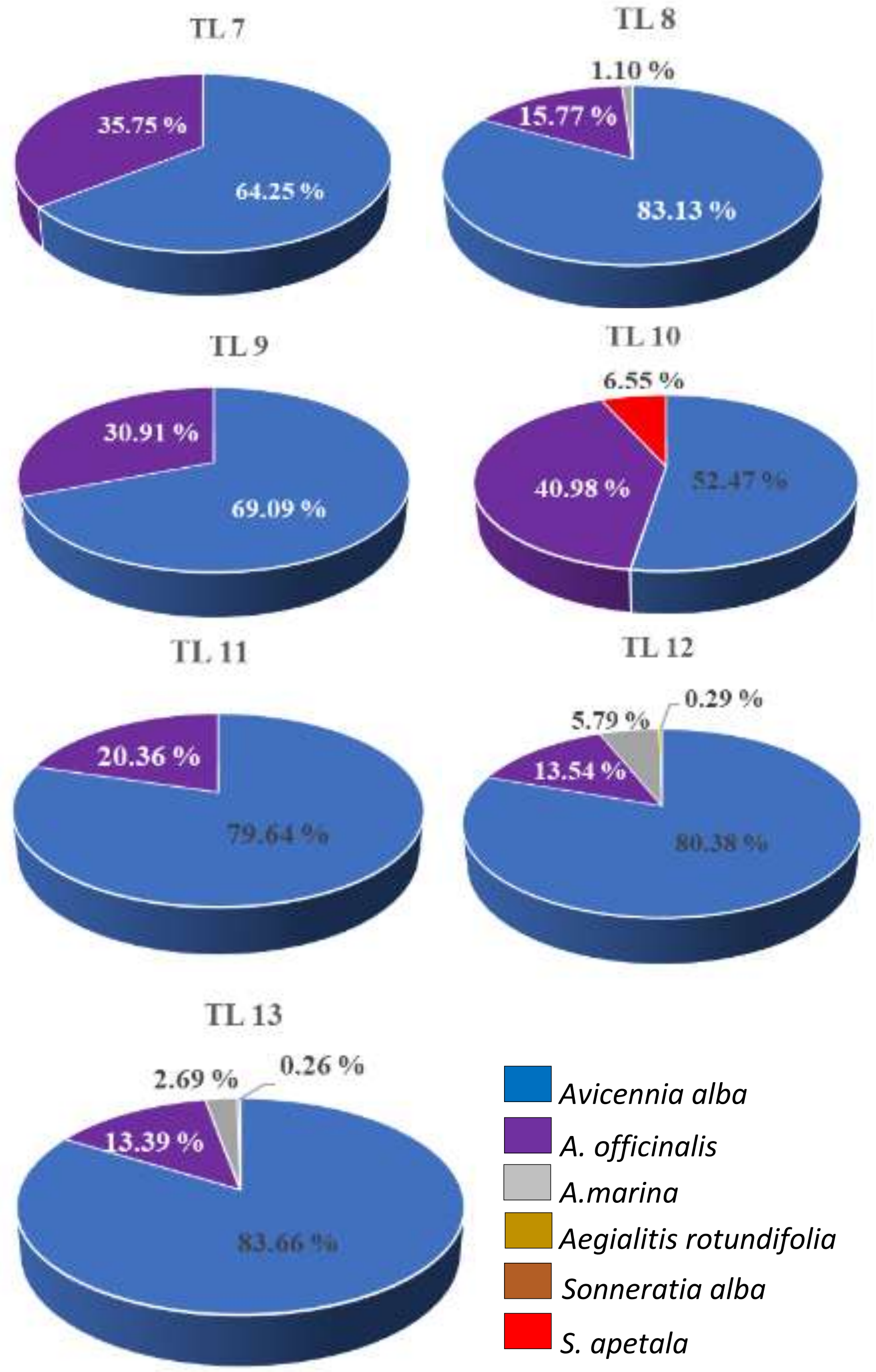


Figure 3. Relative dominance of each species found in different transect lines within Area2

Importance value index (IVI) in the study area

The density values showed that *Avicennia alba* has the highest stem density (532.31 stems ha^{-1}) among 12 true mangrove species, followed by *A. officinalis* (329.23 stems ha^{-1}), while the lowest stem density was recorded for *Aegiceras corniculatum* (1.54 stems ha^{-1}). The IVI results revealed that *A. alba* has the highest IVI value (145.22), followed by *A. officinalis* (111.62), while the lowest value was for *Sonneratia apetala* (1.57), followed by *Bruguiera cylindrica* (1.91). Table 2 shows the results of the density, relative density, relative frequency, relative dominance, and importance value index (IVI) of mangrove species for each category.

Table 2. Mangrove density (stems ha^{-1}) and importance value index (IVI) of trees in the study area

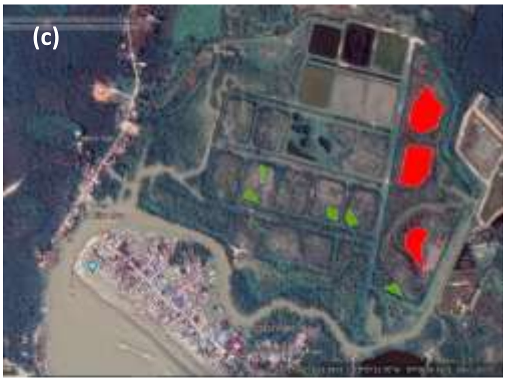
No.	Species name	Density (stems ha^{-1})	Relative density	Relative frequency	Relative dominance	IVI (%)
1	*Avicennia alba*	532.31	55.72	37.65	51.85	145.22
2	*A.officinalis*	329.23	34.46	37.65	39.51	111.62
3	*A.marina*	30.77	3.22	6.79	2.23	12.24
4	*Excoecaria agallocha*	29.23	3.06	1.23	4.09	8.38
5	*Rhizophora apiculata*	3.08	0.32	4.32	0.21	4.85
6	*Aegiceras corniculatum*	1.54	0.16	2.47	0.02	2.65
7	*Bruguiera cylindrica*	3.08	0.32	1.23	0.35	1.91
8	*Sonneratia apetala*	4.62	0.48	0.62	0.47	1.57
9	*S. alba*	9.23	0.97	1.23	0.95	3.15
10	*Ceriop decandra*	3.08	0.32	3.70	0.08	4.10
11	*Aegialitis rotundifolia*	9.23	0.97	3.09	0.24	4.29

Loss and recovered status of mangrove areas from 2011 to 2023 in the study area

An analysis of changes in mangrove areas was carried out from 2011 to 2023 using historical images from Google Earth Pro. From 2011 to 2014 and from 2014 to 2017, 3.51 and 13.37 acres were recovered. The trend of the recovered area continued from 2017 to 2019 and from 2019 to 2023, with an area of 0.65 and 7.74 acres, respectively. Meanwhile, loss of mangrove areas occurred in 2017–2019 and 2019-2023, with an area of 3.73 and 2.54 acres, respectively (Figure 4) (Table 3).

Table 3. Loss and recovered status of mangrove areas from 2011 to 2023

Year	Recovered (acres)	Loss (acres)
2011-2014	3.51	-
2014-2017	13.37	-
2017-2019	0.65	3.73
2019-2023	7.74	2.54



means Loss of mangroves and means Recovered mangrove

Figure 4. Changing of mangrove areas in: (a) 2011-2014, (b) 2014-2017 (c) 2017-2019 and (d) 2019-2023 using Google Earth Pro

Discussion

In the present study, the mangrove forest in the study area was found to be composed of **18 species from 11 different families**, with 12 true mangrove species and 6 associated species. The number of true mangrove species recorded was lower than the findings of San Mon Thu (2020) in the Myawyit coastal area, who recorded 13 species. The true mangrove species composition in the Myawyit coastal area differed from the present study area. In Myawyit, the family Rhizophoraceae was more dominant than in the current study area. However, in our study, the family Avicenniaceae was more dominant than others, which is likely due to the estuarine area receiving freshwater from the Thanlwin River, creating a suitable brackish water environment. Hsu Pyae Sone (2022) recorded 10 species of true mangroves in the Sepala mangrove forest, Bilu Island, a number nearly identical to our findings.

In terms of **relative dominance**, *Avicennia alba* and *A. officinalis* cover a large basal area in the study area. Relative dominance and basal area are primarily influenced by the girth and density of mangroves (Samson and Tubias, 2015). Therefore, the species *Avicennia alba* and *A. officinalis* occupied a larger area than other species. This is consistent with the previous studies by Hsu Pyae Sone (2022).

The **importance value index (IVI)** provides an overview of the influence or role of a mangrove species in the community; the higher the IVI value of a certain species, the more important its role in the community (Matatula et al., 2021). In the study area, the highest IVI value was recorded for *A. alba* (**145.22**), making it the most dominant species due to its high relative density, relative frequency, and relative dominance. It was followed by *A. officinalis* (**111.62**) and *A. marina* (**12.24**). Therefore, the family Avicenniaceae was the dominant family based on the species importance value index. Vijayan et al. (2015) also obtained the highest IVI values for Avicennia species in mangrove forests on the southwest coast of Kerala, India, with *A. officinalis* (**64.19**) followed by *A. marina* (**59.78**). This is likely because both study areas are located along the banks of estuarine water bodies, and the family Avicenniaceae is well adapted to the estuarine environment.

Cherry Aung (1999) studied the mangrove community of the Setse coastal area from 1997 to 1998, revealing a community with 17 true mangrove species and 15 species of mangrove associates. When compared to this previous study, the floral diversity in the present study was lower. Five true mangrove species—*Nypa fruticans*, *Xylocarpus granatum*, *Bruguiera gymnorhiza*, *Sonneratia griffithii*, and *Heritiera fomes*—were not found during the current study.

The absence of these species indicates the **degradation of the mangrove forest** in the Setse area.Although there are no charcoal kilns in this area, a few local people use the mangrove forest for firewood. Additionally, over the last twenty years (1999-2024), some areas of the mangrove forest have been degraded by **conversion to aquaculture** (shrimp ponds). In these instances, operators used machinery to clear the mangrove forest and build dikes with sluice gates to retain water. This alteration of the Damin Creek's hydrology led to the loss of some mangrove plants and species. Thus, the greatest threat to mangrove species loss was the rapid expansion of shrimp aquaculture.

From 2000 to 2002, 148.26 acres of mangrove forest were converted into shrimp ponds. However, according to historical images from Google Earth Pro, 25.27 acres of mangrove areas were recovered from 2011 to 2023. Prior to 2011, Google Earth Pro images were unclear and cloudy, so the situation could not be properly assessed. The mangroves recovered after the conversion of mangroves into marine aquaculture ponds because the sluice gates of the shrimp pond and seawater reservoir broke. Water thoroughly entered these areas, and the natural flow of water facilitated mangrove seed dispersion. Therefore, hydrology is a crucial factor in the distribution of mangrove species. However, from 2017 to 2019, the mangrove forest lost 3.73 acres. This was because shrimp pond operators once again implemented seawater reservoirs for their ponds. As a result, people cut down mangroves and created small channels that connected the shrimp ponds with irrigation systems. The mangrove forest also lost 2.54 acres from 2019 to 2023. During that time, shrimp pond operators killed the mangroves with continuous flooding. This is because aerial roots are especially sensitive to long periods of flooding; these specialized roots were covered for extended periods by water, and the mangroves died due to a lack of oxygen in the plant tissues.

Conclusion

The mangrove forest of Setse is composed of 18 species from 11 different families. Based on field observations, *Avicennia alba* and *A. officinalis* had the highest relative dominance values and were found in all transect lines. According to historical images from Google Earth Pro, 25.27 acres of mangroves were recovered and 6.27 acres were lost from 2011 to 2023. Therefore, this study provides basic information on the current situation of mangrove forests in Setse and establishes baseline data for rehabilitation, replantation, and conservation and management strategies.

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