Asian Journal of Conservation Biology, July 2026. Vol. 15 No. 1, pp. 92–101 AJCB: FP0285/86433
ISSN 2278-7666 ©TCRP Foundation 2026 https://doi.org/10.53562/ajcb.86433

Research Article

The Vegetation Structure of the Basin Mangrove in Songkhla Lake Basin of Peninsular Thailand

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(Received: April 8, 2025; Revised: September 7, 2025; Accepted: December 26, 2025)

ABSTRACT

Studying of the basin mangrove remnants in Songkhla Lake basin. A vegetation profile diagram was created for each site to illustrate the structural aspects of the vegetation, including plant heights and species composition. Salinity and pH measurements of the water regime were recorded monthly over one year, from September 2023 to September 2024. The study identified 21 plant species across 19 families and 21 genera. These included trees (52.4% 12 ,species) ,herbs (19.0% 4 ,species) ,and both lianas and ferns (9.5% each, 2 species). The predominant species in this study were *Rhizophora apiculata Blume* and *Lumnitzera racemosa Willd.*, *Melaleuca cajuputi* Maton & Sm. ex R.Powell was found to be dense in disturbed areas. Salinity measurements across the three study sites indicated brackish water conditions. The pH values indicate a neutral environment 6).2-7.2). The soil in these areas contains undecomposed organic matter periodically influenced by saline water but unaffected by tidal movements. All basin mangrove remnants in Songkhla Lake are on private land/or under local administration and have limited ecological knowledge. High land taxes on unused land drive landowners to drain and convert these areas for agriculture, which could soon lead to the permanent loss of basin mangroves in the Songkhla Lake Basin.

Key words: Basin Mangrove; Plant communities; Remnants; Songkhla lake basin; Salinity; Water regime.

INTRODUCTION

Mangroves form extensive communities of trees and shrubs comprising various species. Mangroves have successfully colonized vast coastlines, rivers, creeks, and inland depressions across numerous countries and islands using floating seeds and propagules. Mangrove forests are categorized into the following types: over-washed mangrove forests, fringe mangrove forests, dwarf mangrove forests, riverine mangrove forests, basin mangrove forests, and hammock mangrove forests. (Ludo and Snedaker,1974)

Basin mangrove forests are partially enclosed depressions that experience occasional flooding during the dry season and regular flooding throughout rainy season with no tidal influence. In the arid season, water levels in these basins, like ponds, gradually decrease due to groundwater flowing towards the open sea, driven by the difference in water levels located between the basin and the sea, these areas often have soil with high salinity. Basin mangrove forests, commonly found in swamp interiors or drainage depressions, tend to have stunted growth. Water in these forests is typically stagnant or moves very slowly, and they are often dominated by *Avicennia* and *Rhizophora* species.)Miththapala, 2008)

The geomorphological evolution of the Songkhla Lake system and the Satingphra Peninsula is closely interconnected. Songkhla Lake originated as a coastal lagoon system during the Holocene, when longshore sediment transport and sea-level changes led to the formation of sand barriers that gradually enclosed marine embayments along the Gulf of Thailand (Jiwarungrueangkul *et al*., 2022). This process created a chain of three interconnected basins—Thale Noi, Thale Luang, and Thale Sap Songkhla—separated from the open sea by a narrow sand spit.

Concurrently, the Satingphra Peninsula was formed through coastal progradation processes, whereby offshore islands such as Khao Daeng and Khao Ko Yai acted as nuclei for sediment accumulation. Over time, alternating bands of ancient beach ridges (regosols) and marine clays developed, producing a narrow sub-peninsula that now serves as the sand barrier isolating Songkhla Lake from the Gulf of Thailand. The peninsula's low-lying terrain, poor natural drainage, and seasonal monsoonal rainfall created environmental constraints, yet fertile alluvial soils and access to the lagoonal ecosystem provided the basis for early rice cultivation and settlement once hydraulic management techniques were introduced (Stargardt, 1976). The formation of the Satingphra Peninsula and the Songkhla Lake lagoon system represents a coupled geomorphological history, in which coastal sediment dynamics not only shaped the physical landscape but also set the environmental stage for the development of basin mangrove forests.

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Table 1 List of study sites

No.	Study site	District	Province	Position
1	Huai Luek	Khuan Niang	Songkhla	UTM 47N 653063 E, 804051 N
2	Tha Tien	Pak Phayun	Phatthalung	UTM 47N 649837 E, 811952 N
3	Khlong Vuen	Pak Phayun	Phatthalung	UTM 47N 650040 E, 809573 N

Soil, Water, and Climate Conditions

The soils in the Songkhla Lake Basin are diverse, generally consisting of clay and sandy soils with high water retention capacity, suitable for cultivating crops such as rubber, oil palm, and fruit trees (Siskawardani *et al*., 2016). However, the expansion of rubber and oil palm plantations into former mangrove and wetland areas has resulted in biodiversity loss and reduced the carbon sequestration potential of the ecosystem (Phitthayaphinant *et al*., 2018).

The main water source in the basin is Khlong U Tapao, which is vital for agriculture, industry, and domestic use Nevertheless, water scarcity during the dry season, soil erosion, and land-use changes affect water quality and resource management.The region experiences a tropical monsoon climate, with an annual average temperature of 27–28 °C and annual rainfall of approximately 2,000–2,500 mm (Suwanrath *et al*., 2021). Climate change, including rising temperatures and altered rainfall patterns, affects agricultural production by reducing yields, altering flowering times of crops, and increasing the incidence of diseases in aquatic animals (Phitthayaphinant *et al*., 2018).

Despite their ecological importance, basin mangroves are increasingly threatened by anthropogenic activities, including urban expansion, aquaculture, and agricultural encroachment, which can lead to fragmentation, secondary succession, and shifts in vegetation composition (Dahdouh-Guebas *et al*., 2021). Previous research in southern Thailand has largely focused on coastal mangroves or specific taxa (Thampanya *et al*., 2006, Pumijumnong, 2014, Pungpa and Chumkiew, 2025) leaving a significant gap in understanding the structure and composition of basin mangrove vegetation. To address this knowledge gap, the present study aims to: (1) document the species composition and vegetation structure of basin mangroves in the Songkhla Lake Basin, (2) analyze the influence of environmental gradients on vegetation patterns, and (3) provide insights for sustainable management and conservation strategies for these critical ecosystems.

MATERIALS AND METHODS

Study site

The Songkhla Lake Basin is divided into Four major sections: Thale Noi (a freshwater lake in the north), Upper Songkhla Lake (Thale Luang), Middle Songkhla Lake (Thale Sab,brackish zone), and Lower Songkhla Lake, which connects directly to the Gulf of Thailand (Figure 1.) Survey the vegetation around the Songkhla Lake basin to select sample sites for the study. The criteria for plot selection also considered the presence or absence of remnant natural patches, and areas with minimal disturbance to vegetation, determined by the presence of alien species and human-related disruptions (Table 1, Figure 2 and Plate 1).

Figure 1. Map of Songkhla lake basin.
(Sompongchaiyakul and Sirinawin, 2007)

Study plots and sampling technique

Twenty-seven study plots were subjectively selected. At each site plots size 20 m × 20 m were outlined. Each site of plots will vary based on the area's size. Study sites Huai Luek, Tha Tien and Khlong Vuen had 9, 6, and 12 plots laid out respectively, across all 27 plots to assess the composition of plant species. The classification of families, life forms, and groups was revised in alignment with the Royal Botanical Garden (Kew) database (https://powo.science.kew.org/) as a reference. Plant specimens from the study plots will be preserved at the PSU Herbarium. Vegetation structure at each study site was depicted in vegetation profile diagrams, highlighting plant species heights and species composition across the various study locations.

Physical properties

Water regime Salinity and pH measurements were taken over one year, once a month from September 2023 to

Plate 1. Study site. A. and B. Huai Luek site; A. 2 m. high from the ground., B. Top view 20 m. high. C and D. Tha Tien site; 2 m. high from the ground. E. and F. Khlong Vuen site; E. 2 m. high from the ground., F. Top view 20 m. high. Photos were taken by DJI-mini2se

September 2024. Salinity and pH were measured by a Mettler Toledo Seven2Go S3 and a Mettler Toledo Seven2Go S2, respectively

RESULTS

Floristic study

The study recorded 21 plant species belonging to 19 families and 21 genera (Table 1). Comprising Tree 52.4% (12 species), Herb 19.0 % (4 species), Liana and Fern 9.5% (2 species), as shown in Figure 3. The most dominant species of each study site, concerning the number of plant species. Huai Luek site dominant species were *Melaleuca cajuputi* Maton & Sm. ex R.Powell. and *Rhizophora apiculata* Blume as shown in Figure 4-6 and Plate 1 A. and B.

Figure 2. Map of Songkhla Lake Basin site for data collection. (https://geoportal.landportal.org/)

Tha Tien site dominant species were *Rhizophora apiculata* Blume and *Lumnitzera racemosa* Willd. as shown in Figure 7-8 and Plate 1 C. and D. Khlong Vuen site dominant species were *Lumnitzera racemosa* Willd., *Rhizophora apiculata* Blume and *Acrostichum aureum* L. as shown in Figure 9-11 and Plate 1 E. and F. The edge of this site is nearby palm plantation, where the prominent species is *Melaleuca cajuputi* Maton & Sm. ex R.Powell as shown in Figure 12-13.

Physical properties

The salinity measurements of the three study sites revealed that they are brackish water (Salinity between 0 and 0.5 ppt is classified as freshwater. Salinity between 0.5 and 30 ppt is classified as brackish water, and salinity above 30 ppt is classified as seawater., Mitsch and Gosselink,1986). It was found that the salinity levels in Huai Luek and Tha Tein continually increased, and no freshwater salinity values were detected. However, in Khlong Vuen, there were periods when the salinity was within the freshwater range from December 2023 to February 2024. (Figure 14.).

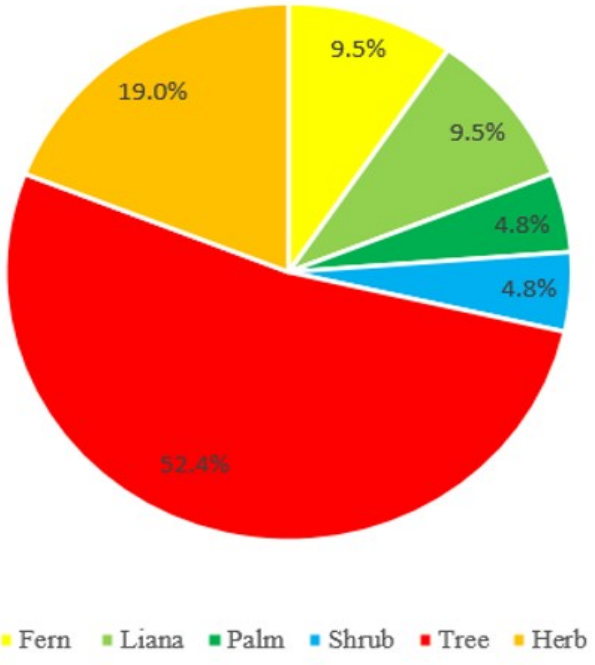

Figure 3. The plant species composition of Basin Mangrove in Songkhla Lake Basin shows the proportion of life forms Tree and herb were the most prevalent life forms recorded.

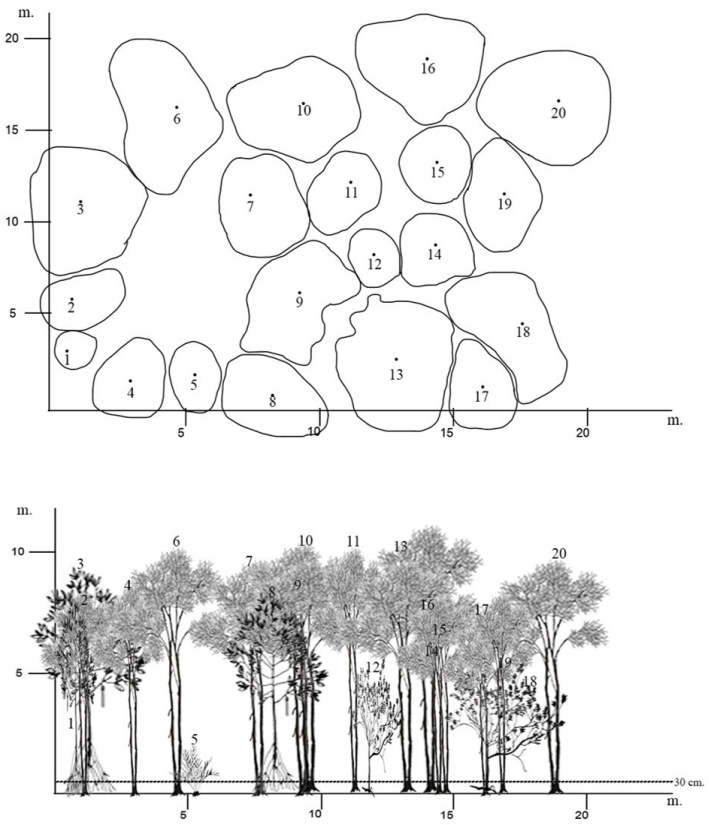

Figure 4. Profile of Huai Luek site, Top: Horizontal view, Below: Vertical view.

1,3,8 *Rhizophora apiculata* Blume
2,4,6,7,9,10,11,13-17,19,20 *Melaleuca cajuputi* Maton & Sm. ex R.Powell
5 *Acrostichum aureum* L.
12,18 *Lumnitzera racemosa* Willd.

Table 1. List of species

Family	Species	Vernacular	Habit
Acanthaceae	Acanthus ebracteatus Vahl	Ngueak Pla Mor	S
Arecaceae	Nypa fruticans Wurmb	Jak	P
Combretaceae	Lumnitzera racemosa Willd.	Fad Khao	T
Cyperaceae	Eleocharis ochrostachys Steud.	Jud Nu	H
	Lepironia articulata (Retz.)	Jud	H
Euphorbiaceae	Excoecaria agallocha L.	Tatoom Thale	T
	Shirakiopsis indica (Willd.) Esser	Khura	T
Fabaceae	Brachypterum scandens (Roxb.) Wight & Arn. ex Miq.	Thao Wan Priang	L
Lecythidaceae	Barringtonia acutangula (L.) Gaertn.	Jik Na	T
Lythraceae	Sonneratia alba Griff.	Lamphu	T
Malvaceae	Hibiscus tiliaceus L.	Po Thale	T
Malvaceae	Thespesia populnea (L.) Sol. ex Corrêa	Pho Thale	T
Myrtaceae	Melaleuca cajuputi Maton & Sm. ex R.Powell	Samet Khao	T
Nymphaeaceae	Nymphaea nouchali Burm.f.	Bua Phuean	H
Phyllanthaceae	Antidesma ghaesembilla Gaertn.	Mao Khai Pla	T
Poaceae	Cynodon dactylon (L.) Pers.	Yapraek	H
Pteridaceae	Acrostichum aureum L.	Prong Khai	F
Rhizophoraceae	Rhizophora apiculata Blume	Kongkang Bai Lek	T
Rubiaceae	Morinda citrifolia L.	Yor	T
Schizaeaceae	Lygodium microphyllum (Cav.) R.Br.	Li Phao Yung	F
Vitaceae	Parthenocissus quinquefolia (L.) Planch.	Thao Khan	L

Habit: F=Fern, H=Herb, L=Lianna, P=Palm, S=Shrub, T=Tree

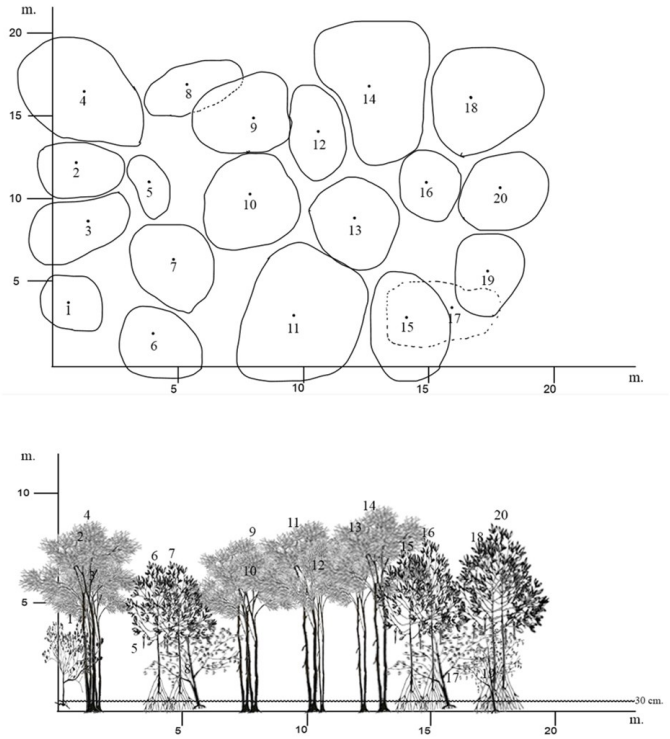

Figure 5. Profile of Huai Luek site, Top: Horizontal view, Below: Vertical view

1 *Lumnitzera racemosa* Willd.
2,3,4,9-14 *Melaleuca cajuputi* Maton & Sm. ex R.Powell
5,8,17,19 *Thespesia populnea* (L.) Sol. ex Corrêa
6,7,15,16,18,20 *Rhizophora apiculata* Blume

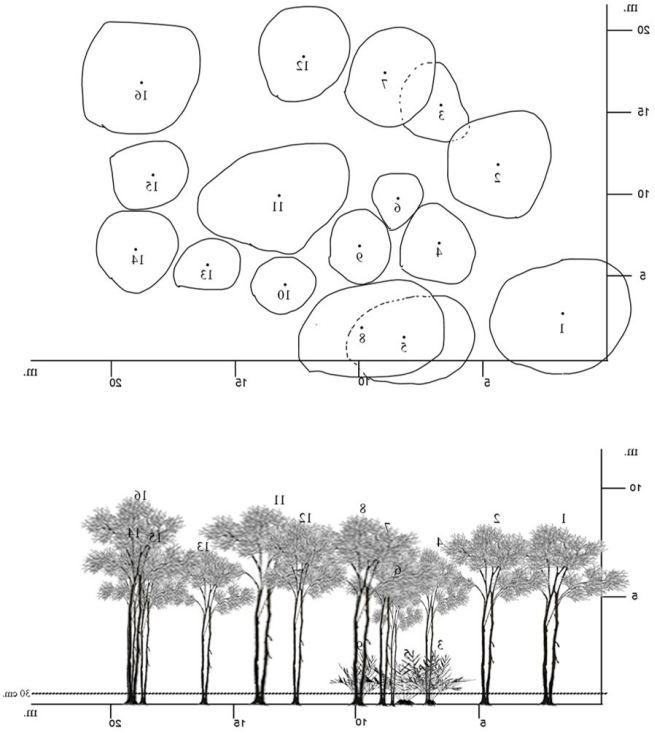

Figure 6. Profile of Huai Luek site, Top: Horizontal view, Below: Vertical view

1,2,4,6-8,11-16 *Melaleuca cajuputi* Maton & Sm. ex R.Powell
3,5,9,10 *Acrostichum aureum* L.

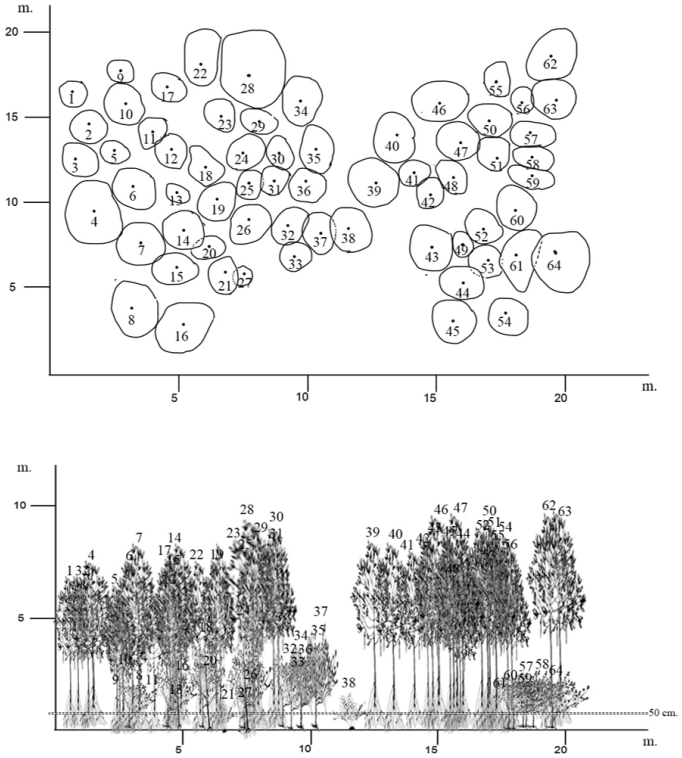

Figure 7. Profile of Tha Tein site, Top: Horizontal view, Below: Vertical view

1-7,9-12,14,15,17,19,22,23,25,28-31,39-56,62,63 *Rhizophora apiculata* Blume
8,16,20,26,27,32-37,57-61,64 *Lumnitzera racemosa* Willd.
21,38 *Thespesia populnea* (L.) Sol. ex Corrêa
13,18,24 *Acrostichum aureum* L.

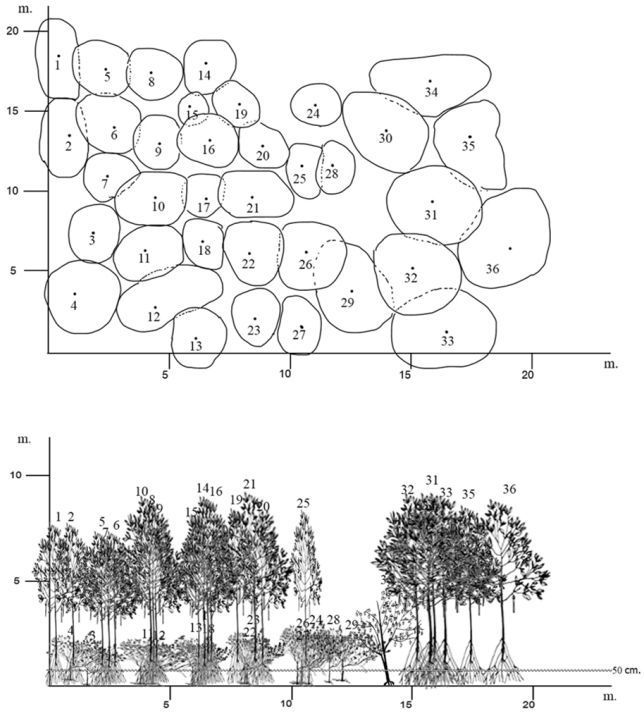

Figure 8. Profile of Tha Tein site, Top: Horizontal view, Below: Vertical view

1,2,6-10,14-17,19-21,25,31-36 *Rhizophora apiculata* Blume
3,4,11-13,18,22-24,26-29 *Lumnitzera racemosa* Willd.
30 *Thespesia populnea* (L.) Sol. ex Corrêa

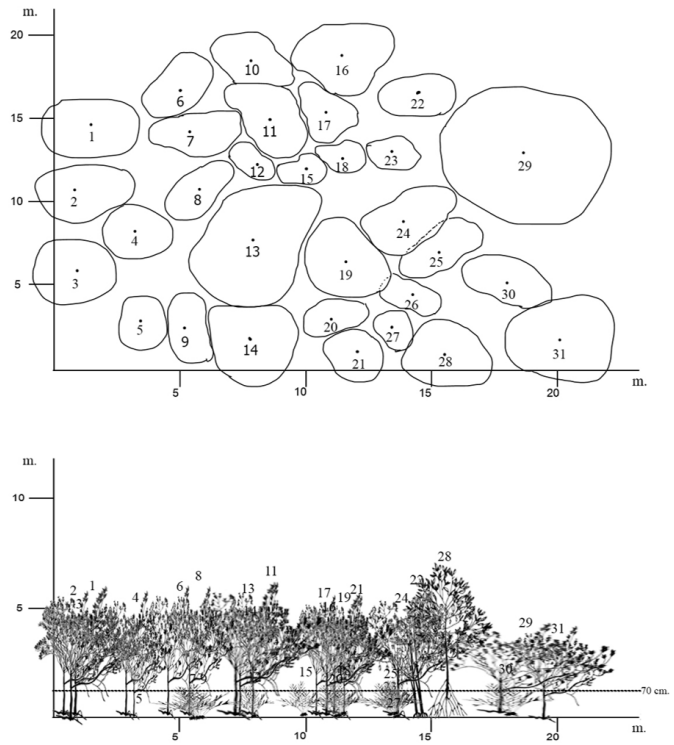

Figure 9. Profile of Khlong Vuen site, Top: Horizontal view, Below: Vertical view

1-6,8,10,11,13,14,16,17,19,21,24,29,31 *Lumnitzera racemosa* Willd.
7,9,12,15,18,20,23,25,30 *Acrostichum aureum* L.
22,26 *Thespesia populnea* (L.) Sol. ex Corrêa
28 *Rhizophora apiculata* Blume

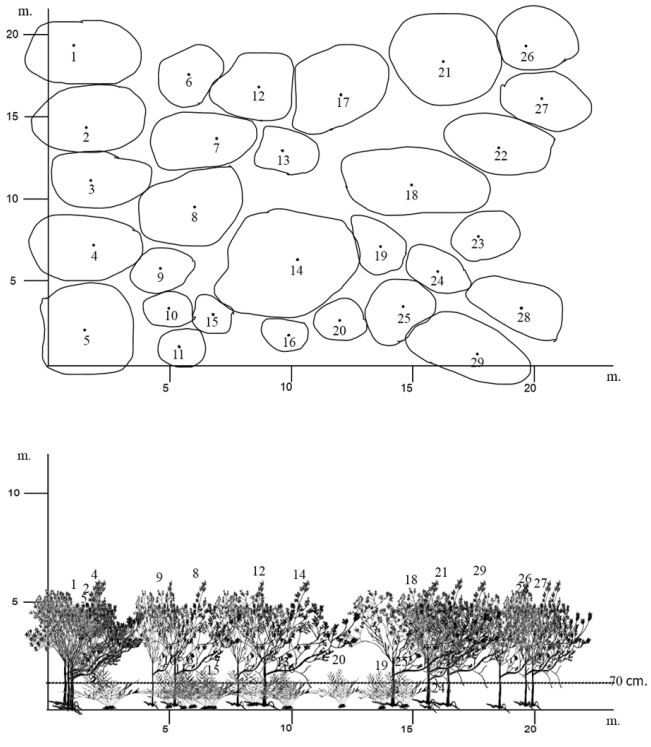

Figure 10. Profile of Khlong Vuen site, Top: Horizontal view, Below: Vertical view

1,2,4,5,8,9,12,14,17,18,21,24,26-29 *Lumnitzera racemosa* Willd.

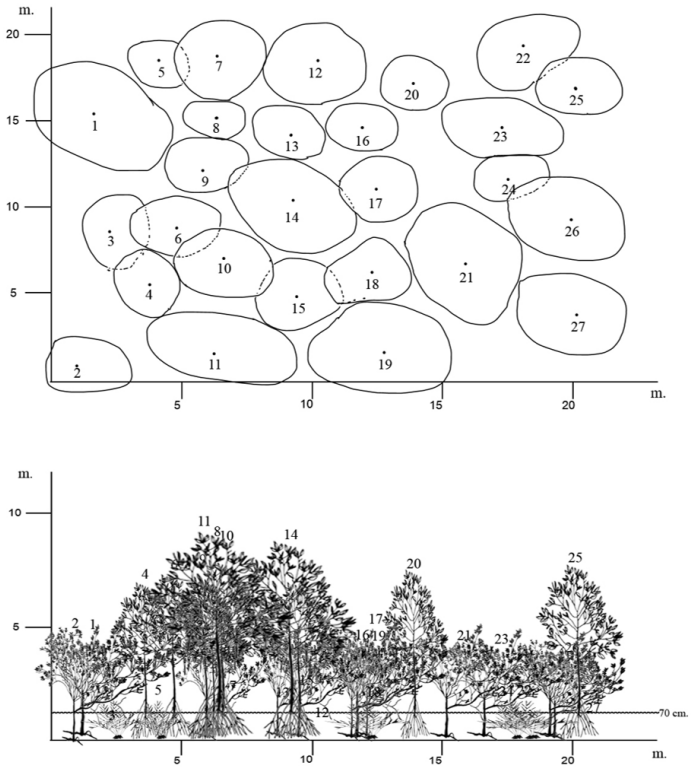

Figure 11. Profile of Khlong Vuen site, Top: Horizontal view, Below: Vertical view
1,2,7,12,13,16,17,19,21,23,26,27 *Lumnitzera racemosa* Willd.
3,5,18,22,24 *Acrostichum aureum* L.
4,6,8-11,14,15,20,25 *Rhizophora apiculata* Blume

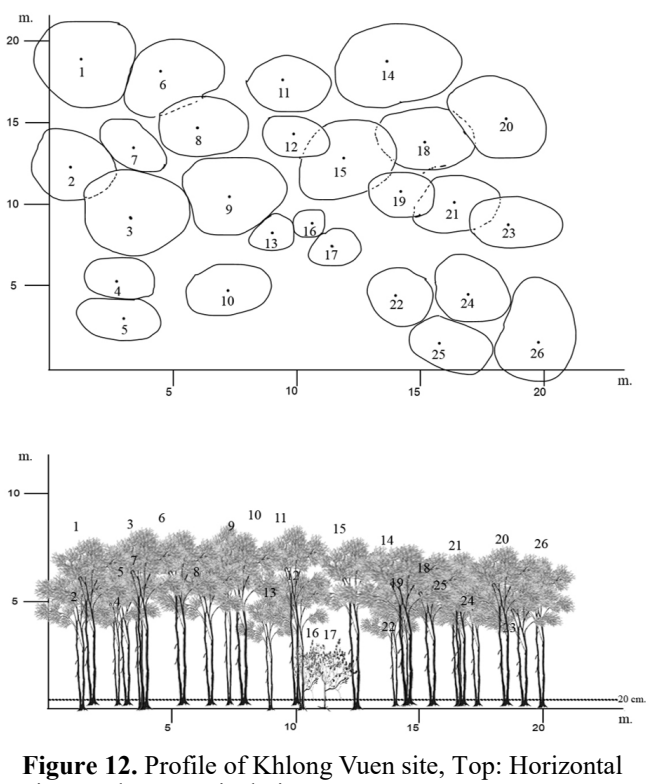

Figure 12. Profile of Khlong Vuen site, Top: Horizontal view, Below: Vertical view
1-15,18-26 *Melaleuca cajuputi* Maton & Sm. ex R.Powell
16,17 *Lumnitzera racemosa* Willd.

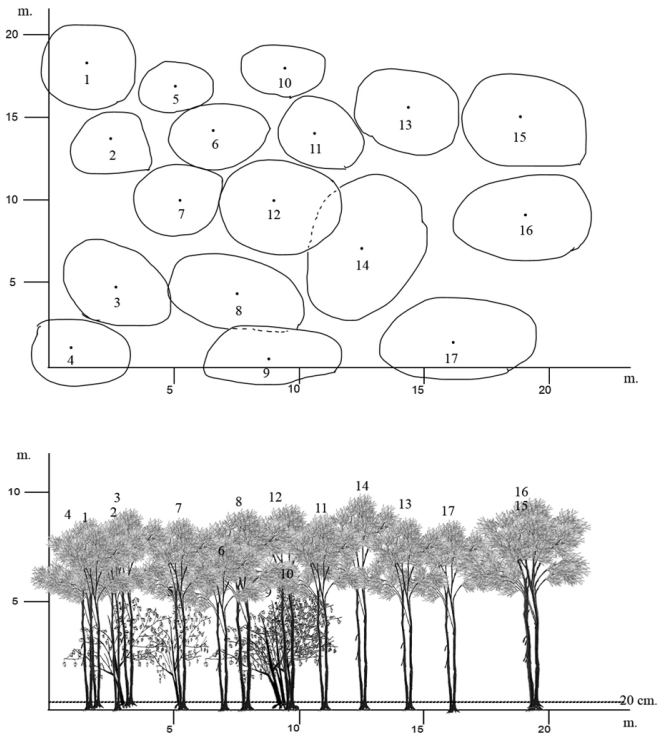

Figure 13. Profile of Khlong Vuen site , Top: Horizontal view, Below: Vertical view
1,2,4,6-8,11-17 *Melaleuca cajuputi* Maton & Sm. ex R.Powell
3,5,9,10 *Thespesia populnea* (L.) Sol. ex Corrêa

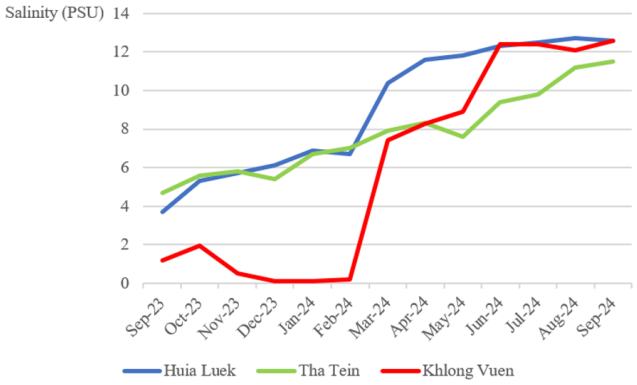

Figure 14. Salinity of all study sites from September 2023 to September 2024

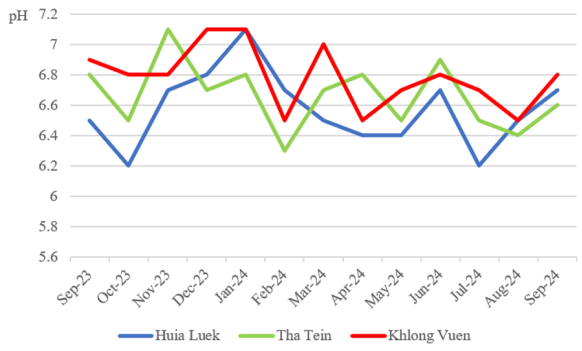

Figure 15. pH of all study sites from September 2023 to September 2024

The pH measurements of the three study areas, it was found that the pH values ranged from 6.2 to 7.1, which falls within the neutral range (Figure 15.).

The soil in the three studied areas contains undecomposed organic matter. The area is a swamp influenced by saline water periodically but not affected by tidal movements.

The water regime in Huai luek, the highest water level of 30 centimeters is observed during November, as it coincides with the rainy season in southern Thailand (from October to January). However, once the rainy season ends, the water level in this site decreases according to seasonal patterns. This differs from Tha Tein and Khlong Vuen sites, where flooding persists throughout the year. The highest water level in Khlong Vuen occurs in October (70 cm), while in Tha Tein it occurs in November (50 cm.), which is still within the rainy season. Nevertheless, a reduction in water levels is observed after the rainy season ends. This decrease is not influenced by tidal changes but is a result of groundwater levels. (Figure 16.)

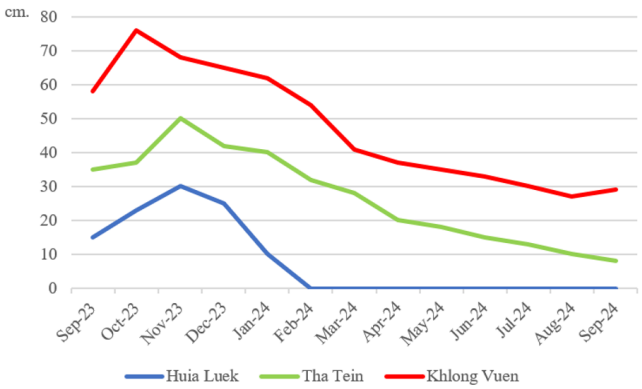

Figure 16. Water regime of all study sites from September 2023 to September 2024

DISCUSSION AND CONCLUSION

A Notice on plant species compositions

The plant community consists of *Rhizophora apiculata* Blume and *Lumnitzera racemosa* Willd., the predominant species studied in this research (Plate 1 C. and D.). Previous studies of basin mangroves by Coelho-Jr (1998) identified *Rhizophora mangle* L. as the main species, which exhibited limited structural development and low density due to a low flooding frequency, predominantly sandy sediments, and low salinity levels. This aligns with the current research, and the study by Cunha-Lignon *et al*. (2009) found Basin forests are linked to the rear sections of the mangroves, where species like Cyperaceae, *Hibiscus pernambucensis*, and *Acrostichum aureum* L. are found. This study also found species from these groups, including *Eleocharis ochrostachys* Steud. and *Lepironia articulata* (Retz.), *Hibiscus tiliaceus* L., and *Acrostichum aureum* L. were also present, with *Melaleuca Melaleuca cajuputi* Maton & Sm. ex R.Powell. being dense in disturbed areas (Plate 1 A. and B.) This study found three layers within the plant community: the lower layer, which includes *Acanthus ebracteatus* Vahl, *Acrostichum aureum* L., *Cynodon dactylon* (L.) Pers., *Derris scandens* (Roxb.) Benth., *Eleocharis ochrostachys* Steud., *Lepironia articulata* (Retz.), *Lygodium microphyllum* (Cav.) R.Br., *Nymphaea nouchali* Burm.f., and *Parthenocissus quinquefolia* (L.) Planch.; the middle layer consists of *Nypa fruticans* Wurmb and *Lumnitzera racemosa* Willd.; and the upper layer includes *Antidesma ghaesembilla* Gaertn, *Barringtonia acutangula* (L.) Gaertn., *Excoecaria agallocha* L., *Hibiscus tiliaceus* L., *Melaleuca Melaleuca cajuputi* Maton & Sm. ex R.Powell., *Morinda citrifolia* L., *Rhizophora apiculata* Blume, *Sapium indicum* Willd., Sonneratia alba Griff., and *Thespesia populnea* (L.) Sol. ex Corrêa. According to the research by Gillmore & Snedaker (1993), the mangrove plants in the basin mangrove forest were growing intermixed with terrestrial vegetation, mostly halophytes.

In the study by Twilley *et al*. (1986) on mangrove basins with minimal tidal fluctuations, it was found that there is a decrease in plant litter production, an extended duration of plant litter persistence, and an increase in nitrogen recycling.

Tides did not influence the area studied in this instance, as it was located far from the sea (Figure 2), and the changes in water levels were solely due to the groundwater level. The entire vegetation profile across Songkhla Lake is illustrated in Figure 17.

Tidal influences: the development of Songkhla Lake and its basin mangroves.

The basin mangroves of Songkhla lagoon are located in the deeper areas of the lagoon, beyond the reach of tidal influences. Thus, the water regime level depends on the level of groundwater, which varies according to the discharge of water from the sandbanks flanking the lagoon, the main structure of Songkhla Lake. This groundwater

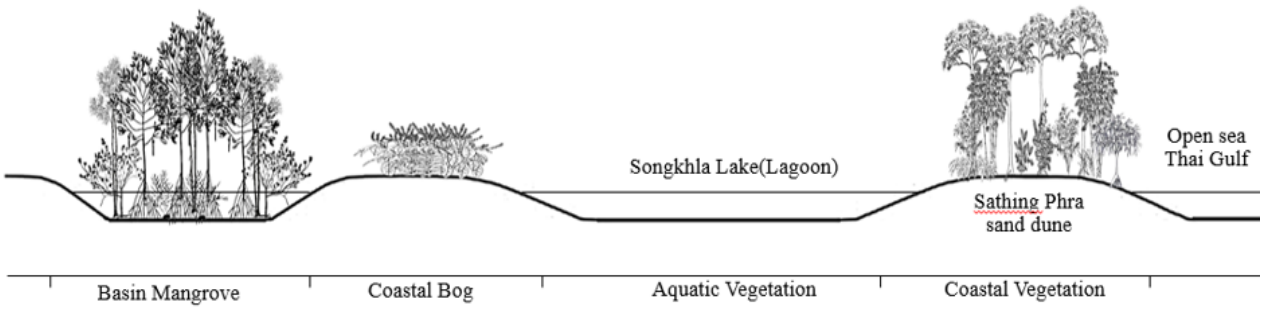

Figure 17. Schematic profile of the vegetation across Songkhla lake.

level is influenced by the amount of rainfall that accumulates in the sandbanks adjacent to Songkhla lagoon, as well as the water flow from the western mountain ranges, namely the Bantad range and the northern Nakhon Si Thammarat range, consisting of surface runoff and groundwater collecting in the coastal sand vegetation patches of the basin mangroves. These patches may have existed before the formation of the lagoon, as the natural distribution of mangrove elements relies on tidal influences to carry the reproductive components of the mangrove elements. The plant community hypothesized in this study likely developed before the formation of the lagoon; the mangrove forest in locations that were once estuaries was influenced by rising and falling waters, as the spread of mangroves disperses through a unique seed mechanism known as propagule. A propagule is a seed that begins germinating while still attached to the parent tree. When the propagule grows to a suitable size and drops into the water or sediment of the mangrove area, it can float along the currents and spread to different locations until it finds a suitable area. Once a seedling firmly attaches to the sediment, it will develop roots and grow into a new tree. This dispersal method allows mangroves to propagate to distant areas (Hogarth, 1999). Therefore, the mangroves in this study are likely to have originated during the formation of the lagoon. The morphology of the mangrove roots is relatively narrow (Plate 1 C. and D.), which differs from mangroves in general that typically have more comprehensive roots Mangrove plants have developed stilt roots for stability. These roots spread horizontally rather than penetrating deeply into the soil, offering support to the stem. (Miththapala,2008). This observation has yet to be studied concerning morphological characteristics and variations influenced by environmental factors; however, it can be inferred that this may be due to the sandy swamp floor, part of the extensive coastal dune system that includes the Songkhla Lake. The slowly decomposing organic matter makes the ground relatively firm. Thus, the mangrove roots in this basin do not spread wide but are closely grouped at the base, differing from mangrove roots in estuaries, where the substrate is mud from sedimentation carried by waters from inland areas.

Relationship between Physical Properties and Biodiversity

The biodiversity patterns of basin mangrove forests in the Songkhla Lake Basin are strongly influenced by their physicochemical characteristics. Salinity levels play a crucial role in determining species distribution and composition. At Huai Luek and Tha Tein, where salinity values consistently remained within the brackish range, the vegetation was dominated by salt-tolerant mangrove species such as *Acanthus ebracteatus* Vahl, *Acrostichum aureum* L., *Excoecaria agallocha* L., *Lumnitzera racemosa* Willd., *Nypa fruticans* Wurmb, *Rhizophora apiculata* Blume and *Sonneratia caseolaris* (L.). Engl. (true mangroves). In contrast, Khlong Vuen occasionally experienced freshwater conditions between December 2023 and February 2024, which allowed for the establishment of freshwater-tolerant and transitional plant species alongside mangrove flora, including *Barringtonia acutangula* (L.) Gaertn., *Eleocharis ochrostachys* Steud., *Hibiscus tiliaceus* L., *Lepironia articulata* (Retz.) Domin, *Melaleuca cajaputi* Maton & Sm. Ex R.Powell, *Nymphaea nouchali* Burm.f., and *Thespesia populnea* (L.) Sol. Ex Corrêa, (mangrove associates). Although no recent studies clearly identify a salinity threshold for *Nymphaea nouchali*, general studies on aquatic macrophytes show that many are negatively impacted by salinities above 1 ppt, and seed germination in *Nymphaea* species is significantly reduced under elevated salinity conditions (Dalziell *et al*., 2020). In our study, *N. nouchali* disappeared when salinity exceeded 6 PSU, suggesting a possible tolerance limit worthy of further investigation (Figure 14). Most of the other plant species observed, including *Sapium indicum* Willd., *Brachypterum scandens (Roxb.) Wight & Arn. ex Miq.*, *Antidesma ghaesembilla* Gaertn., *Cynodon dactylon* (L.) Pers., *Morinda citrifolia* L., *Lygodium microphyllum* (Cav.) R.Br., and *Parthenocissus quinquefolia* (L.) Planch. (upland/terrestrial species), were able to tolerate occasional fluctuations in salinity at the mangrove fringe, thus maintaining the overall ecosystem structure despite environmental variations. This adaptability underscores the resilience of mangrove ecosystems to varying environmental conditions.

Hydrological regimes were also a determining factor. At Huai Luek, the seasonal fluctuation of water levels, peaking at 30 cm during the rainy season, creates dynamic successional stages that favor opportunistic species adapted to alternating wet and dry conditions (mangrove associates and amphibious species). Conversely, the perennial flooding in Tha Tein and Khlong Vuen (maximum 50–70 cm; Figure 16) provides more stable hydrological conditions, promoting the persistence of flood-tolerant plant communities (true mangrove species). These differences in water regimes, independent of tidal influence, act as ecological filters that shape community structure and overall species diversity. The presence of both opportunistic and flood-tolerant groups illustrates how hydrological variability drives species composition, with some plants thriving under alternating wet-dry cycles and others persisting in more consistently flooded conditions.Thus, the combined influence of physical properties explains the spatial heterogeneity of biodiversity within the basin mangrove ecosystems of the Songkhla Lake Basin.

Conservation measures

Basin mangroves are delicate ecosystems, distinct from conventional mangroves commonly found in estuarine areas (fringe mangroves). Basin mangroves are found in limited locations, often in areas undergoing coastal changes. Sandbars can close off former bays where streams have transported alluvial sediment, forming lagoons. These sandbars can transform the bays into swamps unaffected by tidal influences. The original mangrove is thus confined within the lagoon, as naturally, without tidal influences, the propagules of *Rhizophora* cannot be expected to arrive. Although basin mangroves are less biodiverse than fringe mangroves, they contain unique components, such as elements from freshwater swamps like *Nymphaea nouchali* Burm.f., *Eleocharis ochrostachys* Steud., etc., as the water regime is not dependent on tidal activity but rather on the groundwater table, which varies seasonally. Notably, specific communities of organisms, such as aquatic creatures and microorganisms, may exist in these plant communities that have yet to be studied in this region of the world. Environmental changes caused by fishing and shrimp farming through pumping and discharging saltwater will irrevocably alter this ecosystem.

Additionally, threats arise from water management issues, drainage, and the construction of canals linking the lagoon to the open sea, which alters the water dynamics in the lagoon. These actions are undertaken by Thai government agencies without regard for the area's biodiversity, destroying natural ecological data about changes. Furthermore, as basin mangroves in Songkhla Lake exist outside conservation zones and are often on private properties, typically under the care of local administrative organizations lacking in knowledge and understanding, combined with Thai land tax laws that impose high rates on unproductive land, these remnant patches of basin mangroves are in the process of being destroyed by landowners who drain the water and convert the land for agriculture to avoid high land tax rates. It is believed that soon, this remarkable Basin Mangroves will vanish from Songkhla Lake Basin forever.

ACKNOWLEDGMENTS

This research was generously supported by the Science Achievement Scholarship of Thailand (SAST) and the Division of Biological Science, Faculty of Science, Prince of Songkla University, Hat Yai, Songkhla Province, Thailand, provided all research facilities for the present study.

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