



Biodiversity Assessment in Prek Angkorl, Kampong Trach district, Kampot province, Cambodia

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Abstract

There is limited research on biodiversity resources in Cambodia, particularly within peatland ecosystems. This study investigates the biodiversity of the small riverine peatland area in Svay Tong Khang Cherng Commune, Kampong Trach District, Kampot Province. The objectives were: (1) to identify and document the types of biodiversity resources present in the peatland area, and (2) to assess threats to these resources. Field research was conducted in the mangrove forest near the river mouth, using five randomly selected corner plots (5 m × 5 m, 25 m² each). Forest conditions, plot locations, plant species composition, forest density, and bird species presence were assessed through field surveys. Additionally, group discussions with local residents, village leaders, and rangers provided supplementary information. A total of 39 major plant species were recorded, including 16 tree species. Notable deciduous mangrove species included *Lumnitzera littorea*, *Rhizophora mucronata*, *Rhizophora apiculata*, and *Lumnitzera racemosa*. Bird diversity was assessed using five randomly selected transect lines, with 29 bird species observed. Commonly encountered bird species included *Muscicapa dauurica*, *Streptopelia chinensis*, *Ixobrychus cinnamomeus*, and *Ixobrychus sinensis*. The findings highlight the rich biodiversity of the Svay Tong Khang Cherng peatland and emphasize the urgent need for ongoing conservation efforts.

Keywords: Biodiversity assessment, Flora species, Bird species, Species richness

1. Introduction

The planet is currently facing severe environmental challenges, particularly climate change and global warming, driven by both natural and anthropogenic factors such as greenhouse gas emissions, deforestation, and land-use changes (IPCC, 2021; NASA, 2023, Kim et al., 2023). Among the ecosystems most affected by these issues are wetlands, which play a crucial role in maintaining ecological balance and supporting the livelihoods of local communities through the sustainable use of natural resources (Chhon, 2011; Ramsar Convention Secretariat, 2018; Sarun, 2025a). The effective management and conservation of these ecosystems require the active participation of all stakeholders, especially local communities who have deep-rooted connections to their environment (Berkes, 2004; Pretty & Smith, 2004). When given a meaningful role in resource management, local residents are more likely to use, protect, and conserve these resources sustainably (Ostrom, 1990), which can also lead to socio-economic benefits such as improved food security, ecosystem services, and income from ecotourism and sustainable harvesting (FAO, 2020; UNDP, 2019). Understanding current wetland management practices and conservation challenges is essential to improving development planning and ensuring biodiversity protection (Ministry of Environment, 2019; Wetlands International, 2021).



Cambodia, a country rich in natural resources, retains much of its original ecological character despite being a developing nation. Its wetlands provide food, shelter, fuel, and other vital resources, and support wildlife habitats, including many species classified as endangered, rare, or critically endangered by the Ministry of Agriculture, Forestry and Fisheries. These include 10 endangered mammal species, 6 endangered bird species, and 23 wildlife species listed on the IUCN Red List as globally threatened. Wildlife and biodiversity contribute significantly to agriculture, medicine, scientific research, and tourism while helping maintain ecological balance (Forestry Administration, 2010). In response to biodiversity threats—such as habitat loss, overhunting, pollution, and disease—the Cambodian government has adopted conservation measures as outlined in the second phase of the Royal Government's Quadrangular Strategy. These include creating protected areas, suppressing illegal trafficking, and fulfilling international obligations under agreements like the Convention on Biological Diversity (CBD) and CITES. Institutions such as the Fisheries Administration and the Ministry of Environment collaborate on these efforts. Mangrove forests, especially those found in coastal provinces like Koh Kong, Preah Sihanouk, Kampot, and Kep, are particularly important. These forests consist of diverse species (35 genera, 53 families, and 74 species) and provide critical ecological functions for both fisheries and local communities (Mengsrun, 2012; Ministry of Environment, 1999). Mangroves support fish reproduction, nutrient cycling, construction material supply, and traditional practices such as net dyeing using *Rhizophora* and *Cerip* bark (Sarun, 2021). Wildlife in Cambodia, classified as state property, is managed and conserved under national authorities, excluding aquatic species. Wildlife is divided into endangered, rare, and vulnerable species groups, all of which contribute to the forest ecosystem and cultural heritage. Given the abundance and ecological importance of wetlands and biodiversity resources in areas like Svay Tong Khang Cherng commune, Kampong Trach district, Kampot province, this study aims to: (1) understand the types of biodiversity resources in the wetlands; and (2) identify the key factors threatening these biodiversity resources. By doing so, the research supports conservation efforts and sustainable development for the benefit of both the environment and local communities.

2. Materials and Methods

2.1 Study area

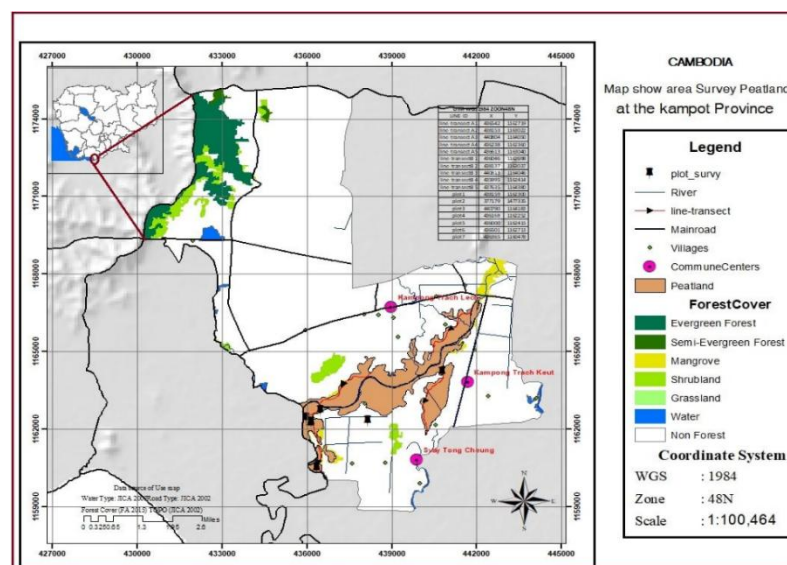


Fig.1 Map of research location for inventory survey in Svay Tong Kang Cherng commune, Kampong Trach district, Kampot province

This research was conducted in May-June 2023, Svay Tong Khang Cherng commune, Kampong Trach district: Bay Tea village and Chheu Teal Rang village. The total area of Svay Tong Khang Cherng commune is approximately 1,761.97 hectares, with about 421.24 hectares used as cultivated land.

2.2 Participant Selection and Group Interview Method

The study recruited participants from two villages: Bay Tea Village and Cheu Tea Ram Village. In each village, 5 to 10 individuals were selected for group interviews. The interviewees were all elderly community members with extensive knowledge of local plant and animal species, as well as a good understanding of the geographical features of the study area. During the interviews, questions focused on the biodiversity they had observed. In addition, books on plant and bird species found in Cambodia were shown to the participants to help them identify and discuss specific species.

2.3 Plot Inventory Method

In the study area located in Svay Tong Khang Cherng Commune, we conducted a survey to assess tree seedlings by dividing the site based on forest type. The focus was on identifying deciduous tree species among the seedlings. We used a quadrat sampling method, establishing square plots of 5 m × 5 m (25 m²) to distinguish between dry and wet areas (**Fig.2**). This approach allowed for effective measurement and counting of all plant species present within each plot.

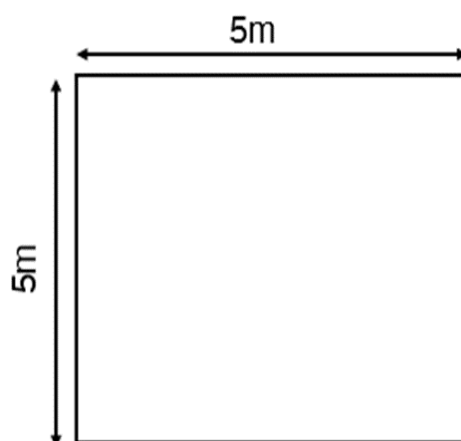


Fig.2 Representative plot layout for inventory

2.4 Data Recording and Measurement Techniques

Measurements and recordings were conducted using a standardized format across five separate worksheets, with each 5 m × 5 m plot recorded on an individual sheet. Tree data collected included species name, number of individuals, diameter, and height. The inventory encompassed various plant types such as shrubs, trees, native species, and both commercial and non-commercial tree species.

Table 1 Plot Setup and Data Recording Format

Plot level	plot size - sub-plot	Diameter class
Plot	5 m × 5 m	- Diameter ≥5 cm.
Sub-Plot 1	5 m × 5 m	- Tree 1 cm < diameter < 5 cm Sapling Vine and Shrub > 5 cm in diameter
Sub-Plot 2	5 m × 5 m	- Trees with a diameter of < 1 cm or no diameter Seedling vine and shrub 1 cm < diameter < 5 cm

2.5 Methods of Studying Bird Species

The presence of bird species was assessed using a linear survey approach. The research team employed a combined methodology, utilizing a Garmin 62S GPS device to accurately record the routes and specific locations where birds were seen, heard, or otherwise detected within and around the study area. To enhance data collection, direct interviews and group discussions were conducted to gather additional information. According to the research methodology, bird surveys were carried out during early morning and late afternoon periods in a single trip. Local resident's familiar with the area served as key guides, providing valuable knowledge and assistance throughout the survey.

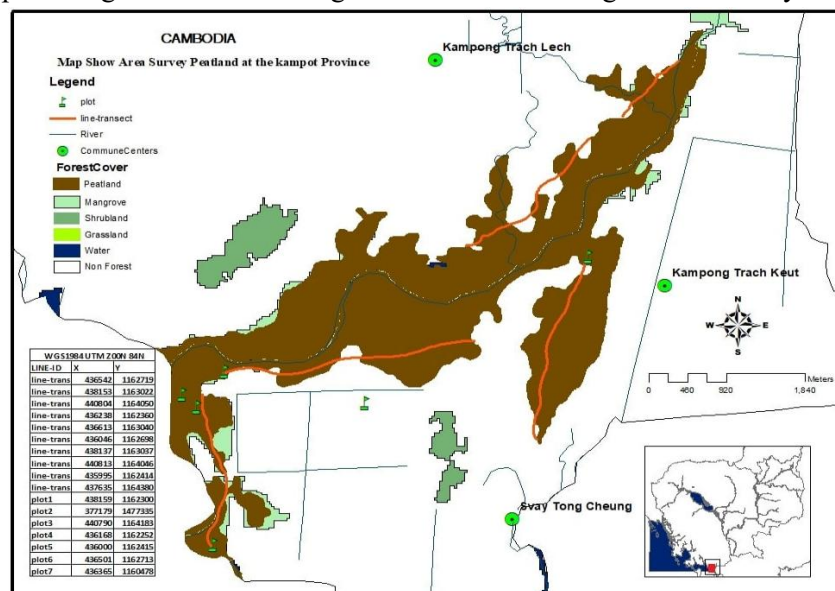


Fig.3 Location of the transect line study.

The locations of transects were determined randomly, considering the geographical conditions of the area. The length and placement of transects varied due to terrain and accessibility, with some areas posing potential risks to the researchers because of unfavorable geographical features. Wildlife presence was surveyed primarily through direct visual observations along the transects. Additionally, indirect signs of birds such as calls or sounds, footprints, droppings, feathers, nests or shelters, and other evidence were recorded systematically in data tables. For the transect surveys, a team of five people participated: one local guide, one recorder, one cameraman responsible for photographing the wildlife, and two wildlife experts familiar with the species in the area. Five transect lines, each varying in length up to approximately 1000 meters, were established along and around the proposed study area. Surveys were conducted during two times windows, from 07:00 to 11:00 in the morning and from 15:00 to 17:00 in the afternoon. Observations were only made under suitable weather conditions, avoiding periods of heavy rainfall, strong winds, or strong currents. Sound cues were also used as an additional method for data collection.

2.6 Materials and Equipment Used in the Study

The research required several essential materials and equipment to ensure accurate data collection and analysis. A GPS device was used to locate the starting points of sample plot corners, determine control points, and measure elevations in the field. To measure height, distance, and slope, a Vertex laser device was employed. A compass helped in establishing plot angles and marking plot boundaries, while a tape measure was used to record the size and distances within plots. Data recording tables were utilized for systematically documenting all observations and measurements. For visual documentation, a digital camera and mobile phone were used to capture images of animals and various research activities. Binoculars facilitated observation of animals at a distance, enabling identification of species

that could not be seen clearly with the naked eye. Finally, software such as Microsoft Excel and Word was used for data management and report writing, and ArcGIS software supported spatial data analysis and mapping of the study area.

2.7 Calculation Method

Density, dominance, and diversity were calculated using the following formulas:

$$\text{Tree density per hectare } D = \frac{n}{s} \quad \text{where} \quad \begin{cases} D = \text{wood density per hectare} \\ n = \text{Number of trees in the nursery} \\ s = \text{Area of cultivated land in hectares} \end{cases}$$

The Simpson's Index of Dominance (D) of bird species

$$D = \frac{\sum n(n-1)}{N(N-1)} \quad \text{where} \quad \begin{cases} n = \text{total of organisms of a particular type} \\ D = \text{variety of species} \\ N = \text{total number of all types of organisms} \end{cases}$$

The Shannon's Diversity Index (H') is calculated as:

$$H' = - \sum_{i=1}^S p_i \ln p_i \quad \text{where} \quad \begin{cases} S = \text{total number of species (species richness)} \\ n_i = \text{number of individuals of species } i \\ N = \text{total number of individuals of all species} \\ \ln = \text{natural logarithm (base } e\text{)}. \end{cases}$$

2.8 Data analysis

The data collected during the study were carefully organized and categorized by data type to facilitate easier analysis and interpretation. Initially, all data were entered into Microsoft Excel, where frequency analysis was performed. Microsoft Excel was also used to create graphs and figures, allowing for flexible design tailored to the study's requirements. Finally, the results, including tables and visualizations, were compiled and presented in Microsoft Word for clear interpretation and reporting.

3. Results

3.1 Flora Species

The forest in the study area is a mangrove type located near the river mouth, characterized by a mixed community of one or more plant species. The study was conducted during the rainy season in June 2023, during which approximately 39 plant species were recorded across five plots. The number of species observed was relatively high, especially among understory seedlings such as sedges, ferns, grasses, and other herbaceous plants, which is why the study was timed for the rainy season. The plant inventory in the mangrove forest revealed 16 tree species, including three species of a specific tree type (tree number 3), while the remaining trees were not classified in detail. Other recorded species included three species of ants, six species of grasses, and fourteen species of ferns. Additionally, the area includes one national park and one species of notable flora. According to the IUCN Red List, 17 of the plant species identified in the study are globally threatened.

Table 2 type of local plant and each class of plant

No.	Khmer name	Scientific name	Life form	Class	IUCN Red List
1	Chher Chor	<i>Excoecaria agallocha</i>	Small tree	-	LC
2	Krakup Prek	<i>Scolopia macrophylla</i>	Small tree	-	-

3	Korng Kang Chhmorl	<i>Rhizophora mucronata</i>	Tree	3	LC
4	Korng Kang Nhey	<i>Rhizophora apiculata</i>	Tree	3	LC
5	Kranheb Sor	<i>Lumnitzera racemose</i>	Small tree	-	LC
6	Kranheb Krohorm	<i>Lumnitzera littoral</i>	Small tree	-	LC
7	Acacia	<i>Acacia auriculaeformis</i>	Tree	-	LC
8	Smes Sor	<i>Ceriops tagal</i>	Small tree	-	LC
9	Bassac	<i>Broguiera cylindrica</i>	Small tree	-	-
10	Am Pea	<i>Sonneratia ovata</i>	Small tree	-	NT
11	Ampou Krahorm	<i>sonneratia caseolaris</i>	Small tree	-	LC
12	Tracheak Kranh Samut	<i>Acanthus ilicifolius</i>	Shrub	-	LC
13	Bers	<i>Hibiscus tiliaceus</i>	Small tree	-	LC
14	Angkea Sis	<i>Ochna integerrima</i>	Shrub	-	LC
15	Smach Teuk	<i>Syzygium papillosa</i>	Small tree	3	-
16	DongKeab Kram	<i>Antidesma ghaesembilla</i>	Small tree	-	LC
17	Vor Lev Av	<i>Glochidion rubrum</i>	Shrub	-	LC
18	Kokoh Tek Prey	<i>India two-legged</i>	Tree	-	NT
19	Prong Samut	<i>Acrostic gold</i>	Fern	-	LC
20	Smao Plong	-	Grass	-	-
21	Smao Skas	-	Grass	-	-
22	Smao Dek	-	Grass	-	-
23	Smao Sambokmann	-	Grass	-	-
24	Smao Kum	-	Grass	-	-
25	Smoa AmBeng Chan	-	Grass	-	-
26	Preh Anluok	<i>Pluchea indica</i>	Herb	-	-
27	Vor Tmenh Trey	<i>Ichnocarpus oxypetalus</i>	Woody climber	-	-
28	Vor Dos Kun	<i>Tetracera indica</i>	Woody climber	-	-
29	Vor Vay	<i>Salacia chinensis</i>	Woody climber	-	-
30	Vor Yeprek	-	Vine	-	-

31	Vor Koksorm	-	Vine	-	-
32	Vor Taling	<i>Coptosapelta yellow</i>	Woody climber	-	-
33	Vor Ra	<i>Flagellaria indica</i>	Vine	-	-
34	Vor Chuy	<i>Streptocaulon juvenus</i>	Vine	-	-
35	Vor Phorm	<i>Paederia scandens</i>	Vine	-	-
36	Vor Chakseng	<i>Lygodium microphyllum</i>	Vine	-	LC
37	Vor Khmao	-	Vine	-	-
38	Vor Khnanh	<i>Lygodium flexible</i>	Vine	-	-
39	Vor Savmav	<i>Passiflora foetida</i>	Vine	-	-

LC = Least Concern

NT= Near Threatened

- = unknown

In addition to the plant species found directly within the five sample plots, several other salt-tolerant plant species were also observed in or near the study area. These include the jackfruit tree (*Artocarpus heterophyllus*), baobab tree (*Adansonia* spp.), nan tree, anche tree, and sea anemone tree, among others. In the 2023 survey of five sample plots, a total of 16 major tree species were recorded in the mangrove forest. Among these, the most dominant species were *Lumnitzera littorea* (red-flowered luminitzera), *Rhizophora mucronata* (male mangrove), *Rhizophora apiculata* (female mangrove), and *Lumnitzera racemosa* (white-flowered luminitzera). In addition to these, 31 other types of plant seedlings were identified and listed in the data table. The forest inventory results further revealed that the average tree density, considering individuals with a diameter at breast height (DBH) greater than 1 cm, was approximately 8,720 trees per hectare, Standard Error 2,034.23 across the five surveyed plots in the mangrove forest near the river mouth.

Table 3 Density of trees

No.	plot number	Trees per plot	Trees/ hectare	Standard Error
1	plot 1	16	6400	2034.23
2	plot 2	20	8000	
3	plot 3	27	10800	
4	plot 4	8	3200	
5	plot 5	38	15200	
Average total		22	8720	

3.2 Diversity of Flora (Species richness of trees)

The results of the study on tree species diversity revealed variation in the number of wood types across the five plots. In plot 1, three types of wood were recorded; plot 2 contained eight types; plot 3 had twelve types; plot 4 had fourteen types; and plot 5 had sixteen types of wood. To assess the overall diversity, new species found in each subsequent plot were cumulatively added to those found in the

previous plots. This step-by-step accumulation allowed for a clearer understanding of the increase in species richness across the study area.

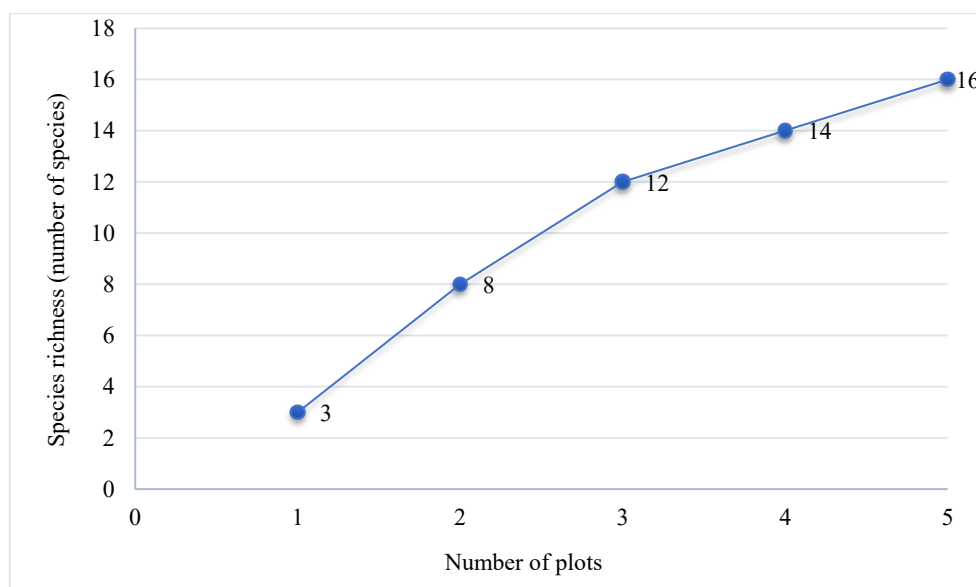


Fig.4 The accumulation of flora species with diameter greater than 1 cm

3.3 Study on the presence of birds

The results of the observation revealed a total of 29 bird species, comprising 216 individual birds, recorded along the transect lines through various methods such as walking, hiking, and boating in different locations. These observations were made through direct sightings, bird calls, and other identifying signs, as illustrated in the image below. Among the recorded species, 23 are listed on the IUCN Red List of globally threatened species, and 2 species are listed under CITES. Furthermore, group discussions with local residents indicated the presence of other significant and threatened bird species in the area, such as the Sarus crane (*Grus antigone*) and the great egret (*Ardea alba*), which were reportedly seen or heard.

Table 4 Bird species in the study area

No.	Khmer name	Scientific name	CITES	IUCN Red List	Number of birds recorded
1	Chab Krolorng	<i>Cinnyris jugularis</i>		LC	1
2	Lolork Trang	<i>Streptopelia tranquebarica</i>		LC	6
3	Broveuk	<i>Dendrocygna Javanese</i>		LC	2
4	Kok Bropes	<i>Grey heron</i>		LC	10
5	Kok Mtes Tum	<i>Ixobrychus cinnamon</i>		LC	2
6	Chab Sey Ruy	<i>Muscicapa dauurica</i>		LC	50
7	Popol Teuk	<i>Heliopais person</i>		CR	2
8	Torm	<i>Porphyrio indicus</i>		-	4
9	Kok Sambork Tropeang	<i>Ixobrychus sinensis</i>		LC	5
10	Chab Kroch	<i>Pycnonotus Goya</i>		LC	2
11	Clum	<i>Gallicrex cinerea</i>		-	1

12	Sarika Keo Ko	<i>Acridotheres tristis</i>		LC	21
13	Lolork Bay	<i>Streptopelia chinensis</i>		-	14
14	Kok Krorng Touch	<i>Egretta little egret</i>		LC	3
15	Kroling Kroloung	<i>Gracupica nigricollis</i>		LC	7
16	Stang Rolork	<i>Elanus caeruleus</i>	II	LC	2
17	Tak Msao	-		-	3
18	Tredewich	<i>Vanellus indicus</i>		LC	3
19	Popich	<i>Zoothera marginata</i>		LC	2
20	Laort Thom	<i>Centropus sinensis</i>		LC	1
21	Kok Kor	<i>Bubulcus Coromandel</i>	III	-	21
22	Teav	<i>Coracias benghalensis</i>		LC	2
23	Kaek Tek Touch	<i>Phalacrocorax niger</i>		LC	4
24	Kaek Tek Thom	<i>Phalacrocorax carbo</i>		LC	1
25	Laort Sbov	<i>Centropus bengalensis</i>		LC	3
26	Chab Doun Ta	<i>Lanius cristatus</i>		LC	8
27	Chab Tum Prak	-		-	1
28	Preap	<i>Columba livia</i>		LC	3
29	Trocheak Kam Kantoy Chhek	<i>Apus pacificus</i>		LC	35
The number of bird in the area					219
Number of recorded species					29

LC = Least of concern

CR = Critically Endangered

This study identified 29 significant bird species encountered during the mangrove forest survey. Among them, four species were noted as the most commonly observed or of particular conservation concern: *Muscicapa dauurica*, *Streptopelia chinensis*, *Ixobrychus cinnamomeus* (cinnamon bitttern), and *Ixobrychus sinensis* (yellow bitttern). The remaining 25 bird species recorded during the survey are detailed in **Table 4**.

Table 5 Species composition of bird

No.	Khmer name	Scientific name	T1	T2	T3	T4	T5	Total	Constancy	Frequency (%)	Class
1	Chab SeRoy	<i>Muscicapa dauurica</i>	1	1	1	43		46	4	80	1
2	Lolork Bay	<i>Streptopelia chinensis</i>	3		1		4	8	3	60	2
3	Sarika Keo Ko	<i>Acridotheres tristis</i>			1	10	10	21	3	60	2

4	Trocheaka m Kantoy Chhek	<i>Apus pacificus</i>	10	10	15	35	3	60	2	
5	Kok Mtes Tum	<i>Ixobrychus cinnamon</i>	1	1		2	2	40	3	
6	Kok Sambok Tropeang	<i>Ixobrychus sinensis</i>		3	2	5	2	40	3	
7	Kaek Tek Touch	<i>Phalacrocorax niger</i>			1	3	4	2	40	3
8	Kroling Krolomng	<i>Gracupica nigricollis</i>			6	1	7	2	40	3
9	Chab Kroch	<i>Pycnonotus Goya</i>		1	1		2	2	40	3
10	Tak Msao	-	2		1	3	2	40	3	
11	Teav	<i>Coracias benghalensis</i>	1	1		2	2	40	3	
12	Lolork Trang	<i>Streptopelia tranquebarica</i>	4		7		11	2	40	3
13	Laort Sbov	<i>Centropus bengalensis</i>			1	2	3	2	40	3
14	Kok Ko	<i>Bubulcus Coromandel</i>				21	21	1	20	4
15	Kok Krong Toch	<i>Egretta little egret</i>		3			3	1	20	4
16	Krosar	<i>Grey heron</i>	20			20	1	20	4	
17	Clum	<i>Gallicrex cinerea</i>		1		1	1	20	4	
18	Kaek Tek Tum	<i>Phalacrocorax carbo</i>			1	1	1	20	4	
19	Chab Kanlong	<i>Cinnyris jugularis</i>	1			1	1	20	4	
20	Chab Daun Ta	<i>Lanius cristatus</i>			8	8	1	20	4	
21	Chek Tum Prak	-			1	1	1	20	4	
22	Tredewich	<i>Vanellus indicus</i>			3	3	1	20	4	
23	Thorm	<i>Porphyrio indicus</i>		4		4	1	20	4	
24	Brovek	<i>Dendrocygna Javanese</i>	2			2	1	20	4	
25	Popich	<i>Zoothera marginata</i>			2	2	1	20	4	
26	Popol Tek	<i>Heliopais person</i>	2			2	1	20	4	
27	Preap	<i>Columba livia</i>		3		3	1	20	4	
28	Steang Lolrok	<i>Elanus caeruleus</i>			2	2	1	20	4	
29	Laort Thom	<i>Centropus sinensis</i>			1	1	1	20	4	

T = Transect line

Table 5 presents the results of the bird species diversity survey, which revealed a clear increasing trend in species richness along the transect lines. Specifically, 3 bird species were recorded on the first transect line, 11 species on the second, 17 on the third, 24 on the fourth, and 29 species on the fifth

transect line. To evaluate cumulative species richness, newly identified bird species from each transect were progressively added from the first to the fifth line. This approach provided a comprehensive view of bird diversity throughout the study area.

The Simpson's Index of Dominance (D) for the bird community in the study area is 0.097, based on a total of 224 individual birds recorded across 23 species. This relatively low value of D, which ranges from 0 (infinite diversity) to 1 (no diversity), indicates a high level of species diversity and suggests that no single species overwhelmingly dominates the community. Such a distribution reflects a balanced avian assemblage and implies good ecological health and habitat heterogeneity within the surveyed mangrove ecosystem. The Shannon's Diversity Index (H') for the bird species data is 2.70, indicating moderate high to high biodiversity within the surveyed area. Since H' values typically range between 1.5 and 3.5 in ecological assessments, this result reflects a well-structured avian community with a relatively even distribution of individuals among species. The index suggests that the mangrove habitat supports a diverse bird population, contributing to the overall ecological integrity and conservation value of the site.

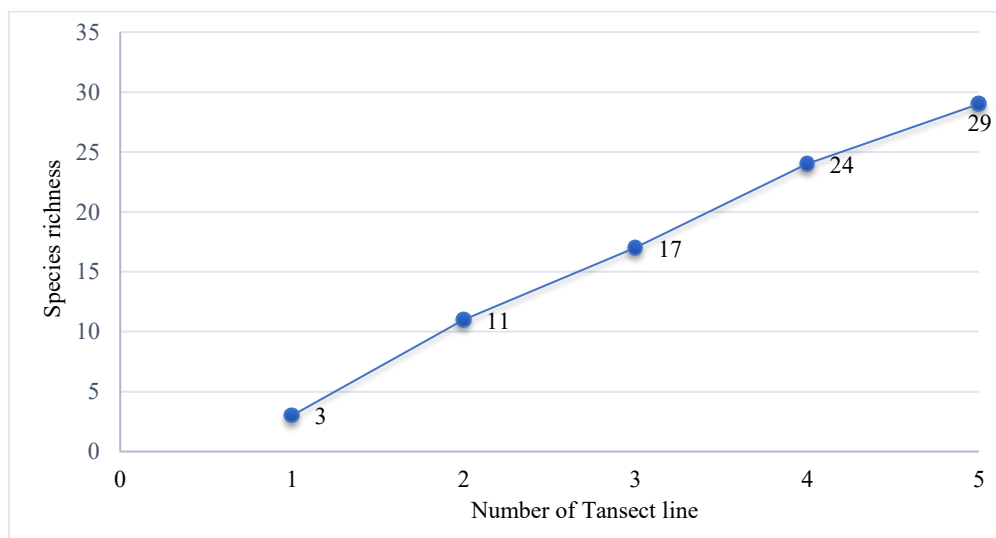


Fig.5 The accumulation species richness of birds

3.4 Threats to biodiversity

Although mangroves are of great biological, social, and economic importance to coastal communities, their survival is increasingly under threat due to several human and natural factors. One major cause is the conversion of mangrove forests into agricultural land. While the exact area of destruction is unclear, it is known that hundreds of hectares were cleared in places like Prek Banh Chruk in 1995 and Ma Ou in 1997 for jackfruit, mango plantations and rice cultivation. Similar patterns of encroachment for agricultural use have been observed in the current study area, contributing to the ongoing degradation of mangrove ecosystems. Another significant threat is land grabbing for shrimp and crab farming. In the study area, people have begun constructing houses and preparing ponds for aquaculture, which not only harms local livelihoods but also negatively impacts the biodiversity of nearby streams, creeks, and beaches. Hunting and poaching also pose a serious threat to wildlife, particularly bird species. Local communities engage in hunting birds and wild animals for consumption and trade. Some species, such as the small ibis, black-backed ibis, gray ibis, smooth ibis, and water ibis, are at high risk of extinction, with even their eggs being collected from nests. The use of hidden traps in forested areas further endangers birds and other animals. These traps are often used by poachers and kill countless animals every year. Birds are especially vulnerable when they are attracted to bait, such as fish placed by villagers. Habitat destruction through deforestation for agriculture, business development, forest fires, and residential expansion has also significantly reduced forest cover. This leaves many bird species without shelter, food, or safe nesting grounds, putting them at greater risk of

extinction. In addition, the loss of food sources is another critical issue. Illegal fishing methods and the use of toxic substances to catch fish in lakes, ponds, and canals reduce the availability of aquatic food. The destruction of seasonal grasslands and mangrove forest further worsens food scarcity for waterfowl and other birds. Finally, natural threats such as forest fires—especially common during the dry season—have devastating effects on bird populations. These fires often destroy nests and breeding habitats, leading to a significant decline in bird numbers. Without urgent conservation efforts, these combined threats could lead to the irreversible loss of biodiversity in mangrove ecosystems.

4. Discussion

The present study provides important insights into the floristic and avian biodiversity of a mangrove ecosystem near a river mouth, demonstrating a high degree of ecological richness and resilience. A total of 39 plant species were identified across five sample plots, with key taxa such as *Rhizophora apiculata*, *Lumnitzera racemosa*, and *Sonneratia caseolaris* dominating the vegetation structure. The prevalence of species such as *Lumnitzera littorea* and *Ochna integerrima*, along with a high seedling density (8720 seedlings/ha, DBH $\geq$ 1 cm), suggests a robust regenerative capacity and a relatively intact forest structure. These findings are consistent with earlier observations by Mengsrun (2012) and Sarun (2025b), who documented a similar pattern of dispersed vegetation and species heterogeneity in Cambodian mangroves.

The high seedling density observed in this study exceeds reported values from other Southeast Asian restoration sites, where early-stage mangrove rehabilitation efforts typically yield densities below 5,000 seedlings/ha (FAO, 2007). This contrast underscores the regenerative strength of the study area's natural system and may reflect limited anthropogenic disturbance or successful natural recolonization processes. Previous studies have emphasized that undisturbed mangrove stands maintain strong natural recovery mechanisms due to their propagule dispersal strategies and physiological adaptations (Alongi, 2008; Dahdouh-Guebas et al., 2005). Thus, the floristic data presented here further validate the resilience hypothesis for mature or semi-natural mangrove ecosystems in Cambodia.

In addition to floristic diversity, the study recorded 29 bird species across five transects, comprising approximately 224 individual birds. Among these, the presence of the black-winged kite (*Elanus caeruleus*) and the cattle egret (*Bubulcus coromandus*), both considered rare or locally threatened, adds significance to the avifaunal dataset. Notably, 23 out of the 29 recorded species (approximately 79%) are listed on the IUCN Red List (IUCN, 2023), suggesting a high conservation value of the site. The species composition aligns closely with regional accounts such as the *Field Guide to the Birds of Cambodia* (Cambodia Bird Guide Association, 2021) and mirrors species distributions reported in protected coastal areas in Preah Sihanouk and Koh Kong provinces (Birdlife International, 2018).

Compared with biodiversity studies in other Southeast Asian mangrove forests, the plant and bird species richness recorded in this study is within the expected range but reflects a particularly favorable conservation status. For instance, in degraded mangrove areas of southern Vietnam, Nam et al. (2016) reported lower plant diversity due to sustained anthropogenic pressures. Similarly, avifaunal surveys in fragmented or degraded habitats often report a reduced presence of threatened species (Yule & Yong, 2004). The relatively high representation of IUCN-listed species in this study indicates that the local habitat conditions remain suitable for both generalist and specialist bird taxa.

5. Conclusion

This study recorded 39 plant species, including three dominant tree species, and demonstrated healthy regeneration with an average seedling density of 8,720 plants per hectare (DBH $>$ 1 cm) in the mangrove forest near the river mouth. Avifaunal surveys identified 29 bird species, including two rare or endangered species, highlighting the ecological significance of the area. Despite the importance of

mangroves to local communities, ongoing threats such as agricultural expansion and aquaculture development are causing habitat loss and biodiversity decline. To address these challenges, we recommend strengthening local collaboration for restoration, clearly defining forest boundaries, raising community awareness, and promoting sustainable resource use. Effective mangrove conservation requires coordinated efforts among government, stakeholders, and local communities to ensure ecosystem resilience.

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References

- Alongi, D. M. (2008). Mangrove forests: Resilience, protection from tsunamis, and responses to global climate change. *Estuarine, Coastal and Shelf Science*, 76(1), 1–13.
<https://doi.org/10.1016/j.ecss.2007.08.024>
- Berkes, F. (2004). Rethinking community-based conservation. *Conservation Biology*, 18(3), 621–630.
<https://doi.org/10.1111/j.1523-1739.2004.00077.x>
- Bird Life International. (2018). *Important bird and biodiversity areas: Cambodia*. Retrieved from <https://www.birdlife.org>
- Cambodia Bird Guide Association. (2019). *Field guide to the birds of Cambodia*. Lynx Edicions.
<https://www.birdguideasso.org/field-guide-to-the-birds-of-cambodia-available-in-cambodia>
- Cambodia Bird Guide Association. (2021). *Field guide to the birds of Cambodia*. Phnom Penh: CBGA.
- Chhon, V. (2011). *Biodiversity conservation and community involvement in Cambodia*. Ministry of Environment.
- Dahdouh-Guebas, F., Jayatissa, L. P., Di Nitto, D., Seen, D. L., & Koedam, N. (2005). How effective were mangroves as a defense against the recent tsunami? *Current Biology*, 15(12), R443–R447.
<https://doi.org/10.1016/j.cub.2005.06.008>
- Food and Agriculture Organization [FAO]. (2020). *The State of the World's Forests 2020: Forests, biodiversity and people*. Food and Agriculture Organization of the United Nations.
<https://doi.org/10.4060/ca8642en>
- Food and Agriculture Organization (FAO). (2007). *The world's mangroves 1980–2005*. FAO Forestry Paper 153. Rome: FAO.
- Forestry Administration. (2010). *National Forest Program 2010–2029*. Ministry of Agriculture, Forestry and Fisheries.
- International Panel on Climate Change [IPCC]. (2021). *Climate change 2021: The physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (V. Masson-Delmotte et al., Eds.). Cambridge University Press.
<https://doi.org/10.1017/9781009157896>
- International Union for Conservation of Nature (IUCN). (2023). *The IUCN Red List of Threatened Species*. Retrieved from <https://www.iucnredlist.org>

- Kim, S., Horn, S., Sok, P., Sien, T., & Yorn, C. (2023). Ecosystem carbon stock assessment in upland forest: A case study in Koh Kong, Mondulokiri, Preah Vihear, and Siem Reap provinces. *Environmental and Rural Development*, 14(2) 61–67.
- Mengsrun, S. (2012). *Mangrove forest composition and structure in coastal Cambodia*. Phnom Penh: Ministry of Environment.
- Ministry of Environment. (2019). *Biodiversity and ecosystem services of peatlands: A review of the role of wetlands in climate resilience and sustainable livelihoods*. Ministry of Environment.
- Nam, V. N., Sasmito, S. D., Murdiyarso, D., Purbopuspito, J., & MacKenzie, R. A. (2016). Carbon stocks in artificially and naturally regenerated mangrove ecosystems in the Mekong Delta. *Wetlands Ecology and Management*, 24(2), 231–244. <https://doi.org/10.1007/s11273-015-9465-2>
- National Aeronautics and Space Administration [NASA]. (2023). *Global climate change: Vital signs of the planet*. <https://climate.nasa.gov>
- Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511807763>
- Pretty, J., & Smith, D. (2004). Social capital in biodiversity conservation and management. *Conservation Biology*, 18(3), 631–638. <https://doi.org/10.1111/j.1523-1739.2004.00126.x>
- Ramsar Convention Secretariat. (2018). *Wetlands for a sustainable urban future: World Wetlands Day 2018*. Gland, Switzerland: Ramsar Convention. <https://www.ramsar.org/resources/wetlands-for-a-sustainable-urban-future>
- Royal Government of Cambodia. (2002). *Law on forestry*. Ministry of Agriculture, Forestry and Fisheries.
- Sarun, H. (2021). *Biodiversity*. Research Creativity and Innovation Fund (RCI Fund) of Ministry of Education, Youth and Sport, the Kingdom of Cambodia.
- Sarun, H., Chanra, R., Meta, H., Linan, H., Pang, T., Savvong, C. (2025b). Assessment of species diversity, biomass, and carbon stock in mangrove forests of Prey Nop District, Preah Sihanouk Province, Cambodia. *Journal of Agriculture and Technology*, 1(1), 30–40. <https://doi.org/10.6084/m9.figshare.28407929.v2>
- Sarun, H., Meta, H., Somaly, S., Linan, H., Pang, T., Chanra, R. & Roth, K. (2025a). Carbon stock evaluation in upland forests: A case study in Santipheap commune, Siem Pang district, Virachey National Park, Stung Treng province. *Journal of Agriculture and Technology*, 1(1), 76–87. <https://doi.org/10.6084/m9.figshare.28427810.v1>
- UNDP. (2019). *Community-based natural resource management and climate change adaptation*. United Nations Development Program.
- Wetlands International. (2021). *Safeguarding peatlands for people and nature*. <https://www.wetlands.org>
- Yule, C. M., & Yong, H. S. (2004). *Freshwater invertebrates of the Malaysian region*. Kuala Lumpur: Academy of Sciences Malaysia.

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