



Regional Flyway Initiative · Site Study

DRAFT

November 2025

RFI Priority Site · Pak Thale-Laem Phak Bia coast

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General Site Information

Country	Thailand		
RFI Site Name	Pak Thale – Laem Pak Bia	ID127	
City/Municipality, Province, Region	Pak Thale, Ban Kaew, Laem Pak Bia subdistricts, Ban Laem district, Phetchaburi Province		
Geographical Coordinates	13.07° N, 100.07° E	Area (has)	8,666
Key species	Spoon-billed Sandpiper (CR), Nordmann's Greenshank (EN), Great Knot (EN)		
Key habitats (biomes)	Extensive salt pans coastal and inland ponds, intertidal mudflats, mangrove forest, coastal wetlands and open water, network of canals that drain into Gulf of Thailand		
Key ecosystem Services	Global and local climate regulation, coastal protection, food, water, genetic resources vital for research and conservation, cultural services, identity and heritage, recreation and ecotourism, traditional knowledge and livelihood systems and education		
Key drivers of Change	Land use change, sea-level rise		
Conservation Status (mark all that applies)	☒ Protected Area ☐ Ramsar Site ☒ Flyway Network Site ☐ others ()		
IBA/KBA name (and number) and other designations	Inner Gulf of Thailand		
Management Stakeholders	Department of Marine and Coastal Resources (DMCR), Office of Natural Resources and Environmental Planning (ONEP), Ban Laem sub-district government		
With management plan?	(for validation)		
Project concept themes	Sustainable production, nature-based tourism		
Length of project	5-10 years		
Sector/s:	Agriculture, tourism		
No. of potential beneficiaries	(for validation)		
Indigenous Peoples	☒ No ☐ Yes		
Anticipated Implementation Risks	Short-term disturbance to wildlife through infrastructure construction		
Estimated Project Budget (US\$)	31,900,000		
Potential Source/s of Financing:	☒ Loan (to be identified)	☐ Private Sector	
	☒ Grant (to be identified)	☐ Public- Private Partnership	

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Abbreviations

ADB	Asian Development Bank
AWC	Asian Waterbird Census
BCST	Bird Conservation Society of Thailand
CREL	Climate Resilient Ecosystems and Livelihoods
CSR	Conservation Status Review
DMC	Developing Member Country
DMCR	Department of Marine and Coastal Resources
EAAFP	East Asian-Australasian Flyway Partnership
ECA	Ecologically Critical Area
IBA	Important Bird and Biodiversity Area
IUCN	International Union for the Conservation of Nature
NGO	Non-governmental Organisation
ONEP	Office of Natural Resources and Environmental Policy
RFI	Regional Flyway Initiative
TAO	<i>Tambon</i> Administrative Organisation
TESSA	Toolkit for Ecosystem Services Assessment
USAID	United States Agency for International Development
USD	United States Dollars

Executive Summary

Pak Thale-Laem Phak Bia (8,666 ha) in Phetchaburi is a mosaic coastal landscape located along the western Inner Gulf of Thailand consisting of some of the most extensive salt pans in Thailand, aquaculture (both coastal and inland ponds), intertidal mudflats, mangrove forest and coastal wetlands. Approximately 50 ha of salt pans, ponds and mangrove remnants forms the Pak Thale Nature Reserve, a protected area directly managed by the Bird Conservation Society of Thailand. Pak Thale-Laem Phak Bia is one of the largest sea salt producing areas in Thailand alongside similar salt farming landscapes in Samut Sakhon and Chonburi, with thousands of (seasonal) workers employed in salt production in at least seven privately owned salt farms. Fisheries provide the next largest source of livelihoods.

The Pak Thale-Laem Phak Bia coast is also *the* most important (RFI) site for migratory shorebirds in Thailand, and regularly supports more than 20,000 resident and migratory waterbirds, including globally significant populations of the Spoon-billed Sandpiper *Calidris pygmaeus* (CR), and the largest known congregations of the Endangered Nordmann's Greenshank *Tringa guttifer* in the wintering distribution. Pak Thale is a part of an Important Bird and Biodiversity Area by BirdLife International in 2004 and a Flyway Network Site (FNS) by the East Asian-Australasian Flyway Partnership in 2010. Pak Thale-Laem Phak Bia is under the jurisdiction of Phetchaburi Province and is managed by the sub-district government units in Pak Thale, Bang Kaew and Laem Pak Bia. National and provincial government agencies are responsible for the natural resource and environmental management of this site, including the Provincial Office for Natural Resources and Environment, the Office of Natural Resources and Environmental Policy and Planning (ONEP).

The Pak Thale-Laem Pak Bia landscape is generally low-lying and is extremely vulnerable to sea level rise (and coastal erosion) as well as many other pressures on water use. RFI interventions at this site should aim to strengthen site management of a heavily used salt production landscape, with specific activities to address water pollution, water management, while strengthening wetland restoration and livelihood opportunities for local communities. A key priority for Pak Thale is to ensure that land uses that is beneficial to biodiversity (e.g. migratory shorebirds) such as salt farming is maintained through incentives for local communities. Salt farming exerts limited ecological footprint on wildlife and the salt production process inadvertently creates stable (wetland) habitat for migratory species in the forms of salt pans and ponds. Maintaining this landscape and existing management regimes will require incentives for the local communities to continue with wildlife-friendly approaches to salt production, including capacity building and market development programmes which can be driven by conservation organisations, local conservation groups and the *tambon* government of the three subdistricts. Tourism is another area of with a strong potential for expansion, given that Pak Thale is well known on many ecotourism (and birdwatching) circuits, and there are substantial opportunities to expand local infrastructure to cater to increased tourist access to the sites, alongside local capacities to provide nature-based tourism experiences.

1. Background of the Regional Flyway Initiative

In July 2021, the Asian Development Bank made a commitment to develop a long-term Regional Flyway Initiative (RFI) in the East-Asian Australasian Flyway (EAAF) (Sovereign Project 55056-001) to protect and restore priority wetland ecosystems and the associated ecosystem services they provide in the EAAF, the most threatened migratory bird flyway globally. The Initiative is slated for implementation in nine ADB developing member countries (DMCs) in East, South and Southeast Asia: Mongolia, People's Republic of China (PRC), Bangladesh, Viet Nam, Cambodia, Philippines, Thailand, Malaysia and Indonesia. In 2023, the geographic scope of the RFI was further extended to two DMCs in Southeast Asia and the Pacific respectively, Lao PDR and Papua New Guinea.

The primary aim of the RFI is to enhance and expand the existing efforts in conserving and managing wetlands of the highest priority for migratory birds within the EAAF through innovative loan and grant financing, and at scale. Consultations and analyses over the development period help identify key interventions to strengthen the management of wetlands, enabling the implementation of nature-based solutions while strengthening biodiversity protection. Over time, the RFI seeks to leverage collaborative opportunities by developing partnerships among important stakeholders including national governments, civil society organizations, communities, regional organizations like the East Asian-Australasian Flyway Partnership (EAAFP), development agencies, the private sector, and other relevant entities.

Through the RFI Technical Assistance (TA) implemented over the RFI's development phase from 2021 to 2024, BirdLife International takes the lead in providing and coordinating technical support for development of the RFI. This is carried out in collaboration with the EAAFP and a consortium of international non-governmental organizations including Wetlands International and the Paulson Institute, as well as two universities, namely the University of Southampton, UK and the National University of Singapore. Over the development phase, the TA team undertook a site selection analysis to identify priority wetland sites in all 10 countries based on recent bird data benchmarked against internationally accepted criteria under the Convention on Wetlands of International Importance (or Ramsar Convention), EAAFP Flyway Network Sites and Important Bird and Biodiversity Areas (IBAs). The team further developed ecosystem services profiles for prioritised wetlands using a multi-pronged approach used the TESSA ecosystem services assessment tool, and data-driven modelling of water based ecosystem services and stored carbon.

In Thailand, a total of 36 wetland sites, including several Asian Waterbird Census (AWC) count sites, were initially assessed through data analysis and expert consultation, of which 18 were short-listed for assessment. Of these pool of sites, twelve (12) were defined and identified to be RFI priority sites on the basis that they support more than 1% the flyway population of at least one EAAF migratory waterbird species. Nine (9) of the RFI sites identified are coastal wetlands, a consequence of the country's long coastline along the Gulf of Thailand and Peninsular Thailand, with the largest cluster of priority sites concentrated in the Inner Gulf of Thailand (four: Pak Thale-Laem Pak Bia, Khok Kham, Bang Pu, Khlong Tamru). 15 EAAF species exceeded the 1% threshold at the site level in Thailand, with species such as Spotted Greenshank exceeding 10% of the estimated population in just one site (Laem Pak Bia) on a regular basis. Other species with

important non-breeding populations in Thailand includes Spoon-billed Sandpiper, Great Knot, and Sarus Crane.

2. Site profile of Pak Thale-Laem Phak Bia coast

Location: Pak Thale-Laem Pak Bia is located on the west coast of the Inner Gulf of Thailand, about 100 km southwest of Bangkok. It includes parts of three sub-districts, named Pak Thale, Bang Kaew and Laem Phak Bia, in Ban Laem District, Phetchaburi Province, central Thailand.

Area: The Pak Thale-Laem Pak Bia coast site covers a total area of 8,666 ha, of which approximately 40 ha of salt pan forms the Pak Thale Nature Reserve. 50% of the site is above the high tide line, while about 25% of Pak Thale-Laem Pak Bia lies on the intertidal zone.

Altitude: 1-2 m asl.

Geographical coordinates: 13.07° N, 100.07° E

Description of site: Pak Thale-Laem Phak Bia is on a coastal floodplain that runs from north to south along the coast of the Inner Gulf of Thailand. It has a range of wetland habitats, including saltpans, aquaculture (both coastal and inland ponds), intertidal mudflats, mangrove forest and open water. It encompasses a three-kilometre-long cape or sand spit (the *laem* from which Laem Phak Bia takes its name), a section of the sandy coastline that extends southwards along the east coast of the Thai-Malay peninsula, and networks of canals that facilitate drainage of fresh water into the Gulf of Thailand in the rainy season. Other habitats and land-uses in the site include paddy fields, other forms of agriculture and urban developments.

Site administration, management and land tenure: The coast of the Inner Gulf of Thailand, including Pak Thale-Laem Phak Bia, is considered a nationally important wetland by the Government of Thailand under a resolution passed in August 2000. The site was designated as an Important Bird and Biodiversity Area by BirdLife International in 2004 and a Flyway Network Site by the East Asian-Australasian Flyway Partnership in 2010. Pak Thale-Laem Phak Bia is under the jurisdiction of Phetchaburi Province and is managed by the sub-district or *tambon* administrative organisations (TAO) in Pak Thale, Bang Kaew and Laem Pak Bia. National and provincial government agencies are responsible for the natural resource and environmental management of this site, including the Provincial Office for Natural Resources and Environment, the Office of Natural Resources and Environmental Policy and Planning (ONEP), the Office of the Permanent Secretary for Natural Resource and Environment and the Department of Marine and Coastal Resources (DMCR). Civil society organisations involved in the environmental management of the site are Bird Conservation Society of Thailand, the Thai Wetlands Foundation and the Laem Phak Bia Environmental Study and Development Project (LEED). Within the site, coastal land below the high-water mark is publicly owned or is under the control of the Ministry of Interior. Most of the land above the high-water mark is legally owned either by people in the communities, or by outside investors or land speculators. In the surrounding area, most of mangroves are reserved forests and are protected by the Royal Forest Department and Department of Marine and Coastal Resources. The canals in the area are the responsibility of the

Marine Department, and mudflats and the adjacent coastal waters are the responsibility of the Department of Marine and Coastal Resources and the Department of Fisheries.

Social and economic values: Pak Thale-Laem Phak Bia is notable for retaining traditional salt farming practices, among the most extensive in Thailand. Sea salt production is a major source of livelihoods for communities in the Inner Gulf of Thailand, and recent reports (2022-2023) from the Thai Sea Salt Development Committee showed that 946 households are involved in salt production across 1,595 plots of land (totalling 47,210.3 rai) (Plaiphum & Tansuchat 2023). The majority of sea salt production occurs in the western Inner Gulf in the coastal provinces of Phetchaburi, Samut Sakhon, and Samut Songkhram. However, a recent slump in salt prices is encouraging land use change to other uses that are less favourable for coastal wetland and biodiversity conservation. The local fishermen also continue to use traditional fishing equipment, and there have been projects at the site to create high economic values for commercial fisheries by promoting fresh seafood consumption and seafood processing for domestic consumption and export. Other major livelihood activities in the area include aquaculture and shellfish collection on the coastal mudflats. Bird Conservation Society of Thailand has been working with other stakeholders for the conservation of Spoon-billed Sandpiper and other waterbirds at Pak Thale-Laem Phak Bia for over 10 years, including by monitoring the shorebirds, promoted community engagement through bird tourism, and conservation education and awareness-raising. In 2020, BCST acquired 8 ha of salt pans identified to be of high conservation value for shorebirds, and established it as a nature reserve. Since 2021, BirdLife has supported BCST to expand shorebird monitoring and public awareness projects, and increase local infrastructure for ecotourism, as well as a project to build capacity for local livelihoods.

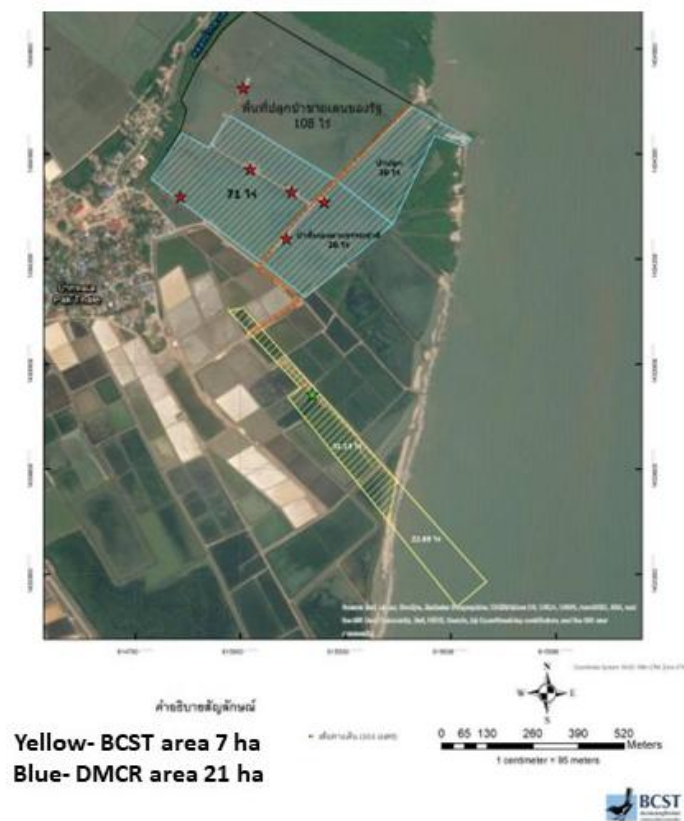
Birdwatching-based tourism also contributes revenue to local communities in Pak Thale, through tourist visits to local restaurants, hotels and shops, and through engagement with local nature guides. An estimated 1,000-2,000 birdwatching visitors access the Pak Thale and Laem Pak Bia area each year (Data: BCST), especially from the periods of January to March, and October to December. However, income for birdwatching tourism is seasonal, with far less visitors to the site in the middle of the year.

Figure 1. Map of Pak Thale-Laem Phak Bia coast, showing its boundary (in blue) and location within Thailand (in pink) (data from EAAFP Site Information Sheet).



Figure 2. Map of the Pak Thale Nature Reserve (in yellow and blue boundaries, and intervening area) (Source: Bird Conservation Society of Thailand).

BCST and DMCR collaboration at Pak Thale nature reserve



3. Biodiversity value of Pak Thale-Laem Phak Bia coast

3.1. Importance to migratory species

Table 1. List of migratory species (based on the EAAFP list of species) with globally significant congregations in Pak Thale and Laem Pak Bia AWC count sites.

Scientific name	IUCN	Average count	CSR1	CSR1 score
Nordmann's Greenshank <i>Tringa guttifer</i>	EN	105	10	10.5
Lesser Sandplover <i>Charadrius mongolus</i>	LC	1,604	300	5.3
Broad-billed Sandpiper <i>Calidris falcinellus</i>	VU	904	300	3.0
Ruff <i>Calidris pugnax</i>	LC	17	7	2.4
Black-tailed Godwit <i>Limosa limosa</i>	NT	2,795	1,600	1.7
Great Knot <i>Calidris tenuirostris</i>	EN	4,816	4,300	1.1
Caspian Tern <i>Hydroprogne caspia</i>	LC	264	250	1.1
Curlew Sandpiper <i>Calidris ferruginea</i>	VU	818	900	0.9

Pak Thale-Laem Phak Bia coast is *the* most important wetland site for migratory shorebirds in Thailand and regularly supports more than 20,000 resident and migratory waterbirds. A total of six datasets from four separate years were available for the RFI analysis at this site, including count data from the 2017 and 2018 Asian Waterbird Census (AWC), the Thailand Shorebird Surveys (2021-2022), an Oriental Bird Club Pak Thale project report, and the AWC Laem Pak Bia (2022) report, supplemented by data on Nordmann's Greenshank from Zöckler et al. (2018). The counts for the four years were averaged in the RFI analysis for this site, and then compared to the Conservation Status Review (CSR1) 1% population estimates to calculate a score for each species. Eight species were found to regularly exceed the 1% population estimate during these four years, and the CSR1 score for these species were summed to provide the overall site score (Table 1).

The Pak Thale-Laem Phak Bia coast is also known to support significant numbers of nine globally threatened and near-threatened waterbird species, Chinese Egret *Egretta eulophotes* (VU), Spot-billed Pelican *Pelecanus philippensis* (NT), Eurasian Curlew *Numenius arquata* (NT), Bar-tailed Godwit *Limosa lapponica* (NT), Red Knot *Calidris canutus* (NT), Spoon-billed Sandpiper *Calidris pygmaea* (CR), Red-necked Stint *Calidris ruficollis* (NT) and Asian Dowitcher *Limnodromus semipalmatus* (NT). The population of Spoon-billed Sandpiper at this site is notable, with up to 16

individuals counted in the past, but it has declined in numbers in recent years and does not currently meet the RFI site prioritisation criteria. Additionally, a further nine threatened or near threatened species of waterbird have been recorded at the site in smaller numbers (Grey-tailed Tattler NT, Far Eastern Curlew EN, Long-billed Dowitcher NT, Sharp-tailed Sandpiper VU, Dunlin NT, Black-legged Kittiwake VU, Milky Stork EN and Black-faced Spoonbill EN).

3.2 Other notable biodiversity

Several globally threatened mammal species are recorded from Pak Thale-Laem Phak Bia coast, including Long-tailed Macaque *Macaca fascicularis* (EN), Smooth-coated Otter *Lutrogale perspicillata* (VU), Fishing Cat *Prionailurus viverrinus* (VU), Lyle's Flying Fox *Pteropus lylei* (VU) and Pacific Finless Porpoise *Neophocaena phocaenoides* (VU).

4. Ecosystem services

4.1. Ecosystem services provided by Pak Thale-Laem Phak Bia coast

Pak Thale-Laem Phak Bia overlaps with diverse coastal habitats, providing valuable provisioning and cultural ecosystem services (Fig. 2). The results from the RFI workshop highlights the top ecosystem services provided by the site, emphasising their essential and non-substitutable nature (Table 3). Provisioning services, particularly food provision, benefit communities within the site but have experienced a decrease in the past and are expected to continue declining in the future. Genetic resources, benefiting communities at all distances, have remained stable in the past but are projected to decrease moving forward. Cultural services, including cultural identity and heritage, recreation ecotourism, and knowledge systems and education, significantly benefit communities within, adjacent to, and distant from the site. Cultural identity, recreation ecotourism, and genetic resources have shown no change in the past but are expected to decrease in the future, indicating potential challenges in preserving cultural and ecological values. However, knowledge systems and education have remained unchanged and are projected to continue without change, reinforcing the site's importance for education and cultural continuity.

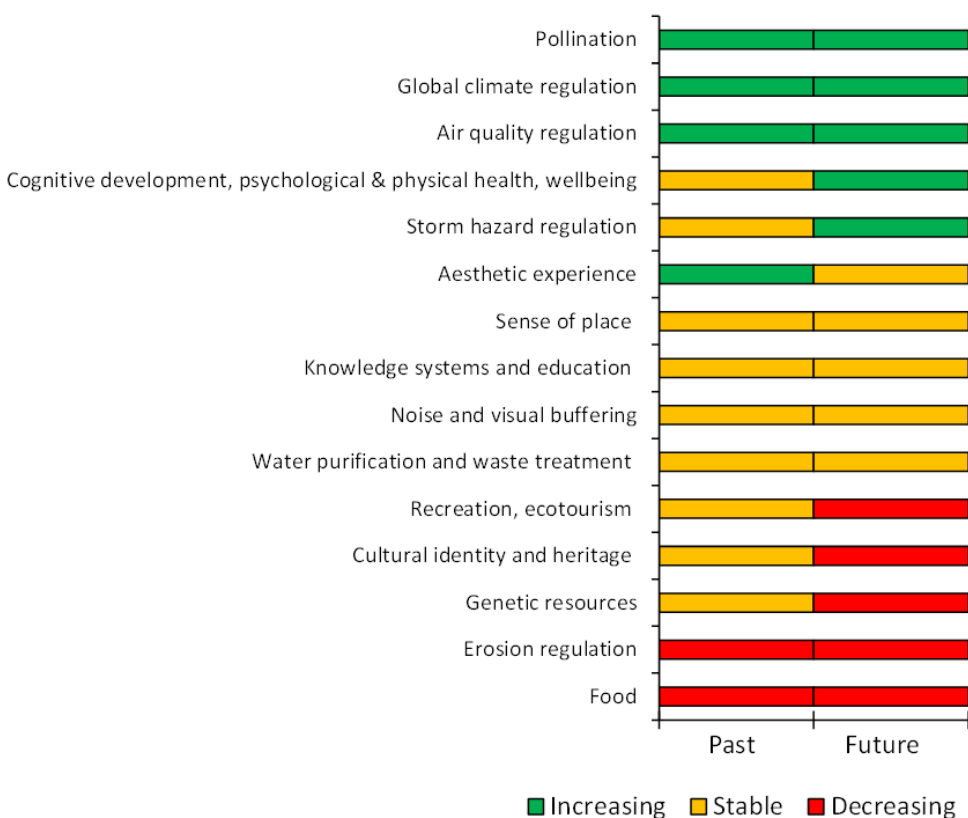


Figure 2. List of ecosystem services provided by Pak Thale-Laem Phak Bia coast, as identified through stakeholder consultation at the Regional Flyway Initiative workshop.

Table 3. List of top ecosystem services provided by Pak Thale-Laem Phak Bia coast.

Ecosystem services	Essential or non-substitutable	Benefits to communities			Change	
		Within the site	Adjacent to the site	Distant to the site	Past	Future
Provision services						
Food	Yes	✓			Decrease	Decrease
Genetic resources	Yes	✓	✓	✓	No change	Decrease
Cultural services						
Cultural identity and heritage	Yes	✓	✓	✓	No change	Decrease
Recreation, ecotourism	Yes	✓	✓	✓	No change	Decrease
Knowledge systems and education	Yes	✓	✓	✓	No change	No change

4.2. Global climate regulating services

Based on systematic reviews (Chen and Lee, 2022; Stankovic et al., 2023), the amount of carbon stored in Pak Thale-Laem Phak Bia coast is estimated to range from 311,000 to 805,000 tonnes, while the annual carbon sequestration rate is estimated to be between 4,710 and 14,800 tonnes per year.

4.3. Coastal protection services

The coastal protection services provided by Pak Thale-Laem Phak Bia coast were assessed using both biophysical indices and monetary values (see Tables A1 and A2, and Annex 1 for details). When compared to both the average of the nine RFI coastal sites and the average of all other coastal areas in Thailand (Table A3 in Annex 1), Pak Thale-Laem Phak Bia coast shows some partly mixed results in terms of risk level:

(1) for the potential exposure to coastal hazards, Pak Thale-Laem Phak Bia coast is consistently above average (index: 3.23 vs. 2.75 for RFI coastal sites and 2.70 for all other coastal areas);

(2) for the contribution to reducing coastal risk as a proportion of population density with 2.5 km of the coast, Pak Thale-Laem Phak Bia coast is however below average (28 vs. 63 people/ha for RFI coastal sites and 30 people/ha for all other coastal areas); and

(3) for the contribution to reducing coastal risk as a percentage of the maximum potential exposure, Pak Thale-Laem Phak Bia coast is again below average (3.36% vs. 5.44% for RFI coastal sites and 3.92% for all other coastal areas).

In monetary terms (Table A4 in Annex 1), Pak Thale-Laem Phak Bia coast ranks just below the national RFI average (1,967 vs. 1,987 USD/ha) in terms of total annual benefits per ha of mangroves. At the same time, if not above the average of all RFI sites in Thailand (807 vs. 1,804 thousand USD), these benefits for the total area of Pak Thale-Laem Phak Bia coast are above the average of all other coastal sites in the country (807 vs. 789 thousand USD).

5. Drivers of change and their potential impacts on Pak Thale-Laem Phak Bia coast

5.1. Current drivers of change and their level of impact

Stakeholders identified several drivers of change impacting Pak Thale. Table 6 highlights these key drivers of change and their corresponding levels of impact on the wetland site. High-impact drivers include dams on rivers draining into the Gulf of Thailand coast, which alter the hydrological and sedimentation regime and significantly affect water flow and habitat conditions. Droughts and

drought conditions pose substantial threats to water availability and the wetland's ecological balance. Erosion and siltation further degrade habitat quality, while fishing, garbage and solid waste, housing and settlement developments, and recreational activities disturb the ecosystem. Additional high-impact factors include research and educational activities, restoration for conservation efforts, sewage and wastewater from wetland facilities, temperature extremes, and tourism infrastructure.

Medium-impact drivers consist of agricultural and forestry effluents, which affect water quality, and air-borne pollutants. Other medium-impact factors include non-timber crop production, commercial and industrial areas, dams affecting water management, habitat clearing, habitat shifting, and household sewage. Hunting of terrestrial animals, increased fragmentation within the wetland, invasive plant species, isolation from other natural habitats, livestock farming, and loss of cultural links all contribute to the medium-level stress on the wetland. The list also includes loss of hydrological connectivity, marine and freshwater aquaculture, natural deterioration of cultural wetland values, roads, storms, utility lines, and water extraction.

Driver of change	Impact
Dams within or upstream of the wetland site, which alter the hydrological regime	High
Drought conditions	
Droughts	
Erosion and siltation/deposition	
Fishing, killing and harvesting of aquatic resources	
Garbage and solid waste	
Housing and settlement	
Recreational activities and tourism	
Research, education and other work-related activities	
Restoration for conservation	
Sewage and wastewater from wetland site facilities	
Temperature extremes	
Tourism and recreation infrastructure	
Agricultural and forestry effluents	Medium
Air-borne pollutants	
Annual and perennial non-timber crop production	
Commercial and industrial areas	
Dams, hydrological modification and water management/use	
Habitat clearing	
Habitat shifting and alteration	
Household sewage and urban wastewater from outside the wetland site	
Hunting, killing and collecting of terrestrial animals	
Increased fragmentation within the wetland site	
Invasive plant species	
Isolation from other natural habitats	
Livestock farming and grazing	
Loss of cultural links, traditional knowledge and/or management practices	
Loss of hydrological connectivity	
Marine and freshwater aquaculture	
Natural deterioration of important cultural wetland site values	
Roads and railroads	
Storm and flooding	
Utility and service lines	
Water extraction/diversion within the wetland site or catchment	Low
Excess ponding of water onsite	
Invasive animal species	
Logging and timber harvesting	
Other 'edge effects' that degrade the wetland site values	
Shipping lanes and canals	

Table 4. Drivers of change and their potential impact on the integrity of Pak Thale-Laem Phak Bia coast based on consultations with stakeholders.

5.2. Potential alternative state of Pak Thale-Laem Phak Bia coast under current drivers of change

Stakeholders defined the most plausible future alternative state (to 2035), and how this will translate to a net change in the cover of different types of wetland habitat types within this site (current habitat cover vs future alternative cover; Figure 3). The alternative state of the site assumes there will be no changes in the current drivers of change impacting the site, and the current management regime.

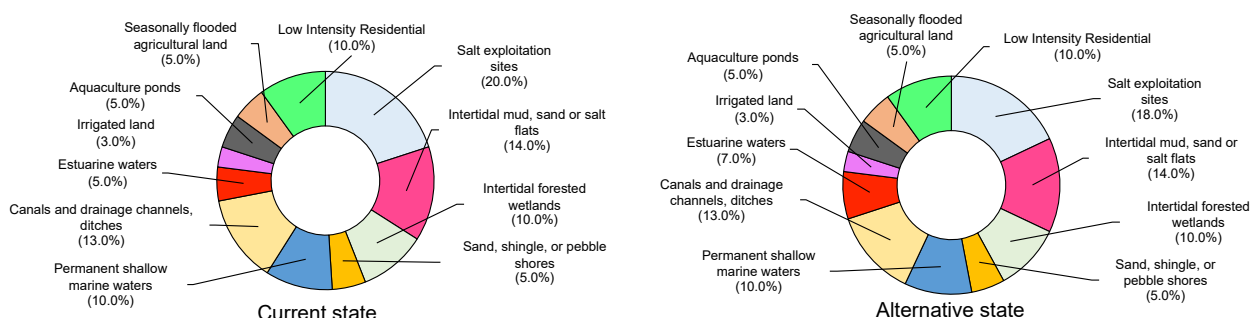


Figure 3. The proportional change in the extent of different habitat types between the current and alternative states of Pak Thale-Laem Phak Bia coast.

5.3. Expected changes in the ecosystem services Pak Thale-Laem Phak Bia coast

Stakeholders documented the future trends in the provision of ecosystem services in Pak Thale-Laem Phak Bia coast, indicating if the ecosystem services provided by this site (to 2035) will increase, decrease, or will remain stable if the current drivers of change impacting this site will continue in their present condition, with the intervention remains unchanged.

Figure 2 and Table 2 highlight that provisioning services, particularly food provision, are expected to increase in the long term. However, there is concern that regulating services, such as air quality and global climate regulation, as well as flood and storm hazard regulations may decrease in the long term, while cultural services, particularly recreation and tourism, remain stable.

Pak Thale-Laem Phak Bia coast overlaps with diverse coastal habitats, providing valuable provisioning and cultural ecosystem services (Figure 2). The results from the RFI workshop highlights the top ecosystem services provided by the site, emphasising their essential and non-substitutable nature (Table 3). Provisioning services, particularly food provision, benefit communities within the site but have experienced a decrease in the past and are expected to continue declining in the future. Genetic resources, benefiting communities at all distances, have remained stable in the past but are projected to decrease moving forward. Cultural services, including cultural identity and heritage, recreation ecotourism, and knowledge systems and

education, significantly benefit communities within, adjacent to, and distant from the site. Cultural identity, recreation ecotourism, and genetic resources have shown no change in the past but are expected to decrease in the future, indicating potential challenges in preserving cultural and ecological values. However, knowledge systems and education have remained unchanged and are projected to continue without change, reinforcing the site's importance for education and cultural continuity.

In the alternative state, the 6% loss of salt pans will result in a loss of stored carbon, estimated to be between 15,100 and 24,900 tonnes, and a decrease in carbon sequestration rate (carbon accumulation) approximately by 226 tonnes per year.

A loss of 0 ha of mangroves as presented in Table A5, is not expected to result in any reduction in coastal protection as estimated in 4.3.

Climate related predictions (Norris et al, 2024) indicate that sea-level at the site will increase by 0.3m up to 2050 and 0.7m by the late century under a high emissions pathway, this will likely have an impact in a low-lying site such as the Pak Thale-Laem Phak Bia coast, through increased flooding, saline intrusion, changes to the extent of mangroves and changes to the available area for sea-bird food foraging. Temperatures are also expected to increase, exacerbating heat stress, both on the site's biodiversity and also the communities living in the area. Rainfall is likely to be more variable, with larger dry periods and increased rainfall in shorter timeframes.

6. Capacity needs in Pak Thale-Laem Phak Bia coast

Table 5. List of stakeholders and their potential roles in relation to the management of the Pak Thale – Laem Pak Bia coast.

Stakeholder group	Current role in wetland management (Positive or Negative)	Possible future role in wetland management	Capacity development needed to improve wetland management	Form of capacity development (e.g. training, organisational strengthening etc.)
Department of Marine and Coastal Resources (DMCR)	Oversee policy on coastal reclamation and maintenance of natural areas	Address coastal erosion issues		
Marine Department	Manage coastal erosion (potentially through the construction of seawalls)	Address coastal erosion, including the use of novel approaches to mitigate and manage loss of substrate		
Department of Local Administration	Oversee the construction of retaining wall to manage river and coastal erosion.	Maintain regulations and ensure local compliance to development and construction legislation	Promote better understanding of legislation and land use	Organisational training to strength capacity on knowledge and understanding of wetland importance,

				and law enforcement issues.
Salt farming communities	Manage existing areas of mangroves; create infrastructure (canals) to move sea water into salt pans.	Continue work to maintain salt pans	Better understand of public land use plans. Alternative livelihood activities to increase local incomes.	Training in Ramsar site classification and better understanding coastal wetland sustainable or wise use

7. Opportunities for RFI interventions

Pak Thale – Laem Pak Bia is envisioned by the government of Thailand as a globally recognised model of integrated wetland conservation and sustainable land use. Besides being a haven for migratory shorebirds, wetlands at the site also contributes to Thailand’s blue carbon contribution, and functions as an OECM (part of it is a private nature reserve, abutting leased land from the government) that enables species conservation and sustainable use of wetlands at the same time.

The dominant land use in the Pak Thale landscape, as with several other parts of the Gulf of Thailand, is sea salt production; the salt pans provide a stable habitat for waterbirds, and maintaining these safe landscapes for migratory birds requires the salt pans to be managed as they are currently, while expanding on restorative work for wetlands in this landscape.

To strengthen management and conservation of the wider Pak Thale – Laem Pak Bia landscape, there is a pressing need to:

- (1) Sustain and improve the existing management of coastal wetlands through
 - a. Maintain the traditional production of salt from salt pans, through incentives and community-driven initiative
 - b. Expansion of wetland restoration work with a focus on ‘mangrove zones’ and degraded areas of the coastline to strengthen shoreline stability at suitable areas, notwithstanding the coastal erosion challenges the site faces¹.
 - c. Establish and formalise co-management structures involving the local community and government agencies
- (2) Enable, and up-scale (economic) infrastructure for compatible forms of economic activity for local communities
 - a. Promoting and expanding nature-based tourism for local and overseas visitors, through capacity building and expansion of tourism infrastructure
 - b. Promoting sustainable approaches to aquaculture (for prawn and fish) that are biodiversity friendly.

¹ The Upper Gulf of Thailand has experienced severe erosion, exacerbated by sea level rise and extreme weather events. Estimated erosion rates is about -0.54 m/yr from the period 2018-2023 (Chavalit et al. 2025)

Table 6. List of proposed interventions for Pak Thale – Laem Pak Bia and possible indicators.

Intervention	Output	Cost (USD)	Timeframe	Indicators	Potential Stakeholders
<i>Component 1. Expand and strengthen wetland protection and management to cover all of Pak Thale-Laem Pak Bia</i>					
Scoping study of existing interventions implemented in Pak Thale and Laem Pak Bia area, including targeted work on long-term threats (from climate change and changing hydrology). Identify, successes failures, gaps and lessons for RFI interventions.	Assessment and scoping guidance to provide basis for proposed interventions.	50,000	1 year	Assessment report published and disseminated to key stakeholders.	ONEP DMCR BCST Phetchaburi provincial government Ban Laem district government/TAO Consultancy companies
Expand protection and management of salt pans for migratory birds	Salt pans and adjacent wetlands under sustainable management for migratory species scaled up.	200,000	10 years	At least 500 ha of salt pans secured under new management plan, with improved management efforts, to benefit migratory species, in consultation with local communities, Stakeholder consultation meetings organised. Meetings and workshops to engage local stakeholders for participatory processes.	DMCR ONEP Conservation organisations (including BCST) Local community groups Salt farming households and cooperatives
Expansion of Pak Thale Nature Reserve.	Acquisition of up to 20 ha of adjacent salt pans.	400,000	2 years		BCST Salt farming households and cooperatives

Expand coastal habitat restoration with a focus on degraded mangroves on the Pak Thale-Laem Pak Bia coastline.	Up to 200 ha of degraded coastline and disused fishponds replanted with mangroves at degraded fringes. Plots for mangrove restoration identified by biodiversity specialists and community leaders.	200,000	5 years	200 ha of degraded wetlands restored with native mangrove species at identified plots.	RFD DMCR Ban Laem district government, Pak Thale TAO Research institutions
Coastal defences to mitigate coastal erosion strengthened using nature-based solutions.	Nature-based solutions to mitigate coastal erosion strengthened.	200,000	10 years	Up to 10 km of coastal 'barriers' along the Pak Thale and Laem Pak Bia coast protected using natural material established.	DMCR ONEP Phetchaburi Provincial Government Ban Laem district government/ Pak Thale, Ban Kaew, Laem Pak Bia TAO
Development of a zoning and management plan (ICZ). Establishment of a Pak Thale-Laem Pak Bia site management framework (for the whole OECD landscape)	One new zonation and landscape management plan developed, with clear management goals identified over short and medium term	150,000	2 years	One new zonation plan agreed on with stakeholders and endorsed by relevant government agencies. Stakeholder consultation meetings organised. Meetings and workshops to engage local stakeholders for participatory processes.	Conservation organisations
Long-term biodiversity and threat monitoring framework developed and actively implemented,	One biodiversity monitoring programme established, with regular field-based counts and	50,000	5 years	Adaptive management framework for biodiversity monitoring established and actively	ONEP Conservation organisations (e.g. BCST, BirdLife)

with a focus on Spotted Greenshank and Spoon-billed Sandpiper.	assessments of threats Capacity of local communities of subdistricts to undertake biodiversity monitoring strengthened.			implemented (including bird ringing programmes and satellite tracking-based research)	Research institutions (Phetchaburi Rajabhat University, KMUTT)
Component 2. Improvement of waste and water management infrastructure to address environmental pollution					
Improve and renovate water management infrastructure such as canals and sluice gates	Sluice gates and canals improved between salt pans and the sea.	500,000	Up to 5 years	Draining canals and tidal sluice gates well maintained.	Ban Laem district government Pak Thale, Ban Kaew, Laem Pak Bia TAO DWR DMCR Local community groups
Improve the management of wastewater (industrial effluents and pollutants from industries and aquaculture) from canals and drains draining into the site.	Improved infrastructure for wastewater management, including canals and storage ponds. Improve regulations and guidance on wastewater and pollution management.	1,000,000	5 years	Measurable reduction in key chemical and biological contamination in water and harvested shellfish. Stakeholder consultation meetings organised. Meetings and workshops to engage local stakeholders for participatory processes.	DWR DMCR Businesses, including light industries and aquaculture Local community groups
Address plastic pollution from light industries, aquaculture and salt farms	Establishment of new waste management facilities to	500,000	10 years	Up to XX waste management centres established, with	

	control plastic waste. Improve regulations and guidance on plastic waste management.			designated disposal of plastic. Stakeholder consultation meetings organised. Meetings and workshops to engage local stakeholders for participatory processes.	
Component 3. Upscaling of tourism infrastructure for nature-based tourism expansion					
Sustain work to build local (community) capacity for nature-based tourism	Local capacity for alternative livelihoods, especially nature-based tourism, strengthened. Training programme established for supporting businesses (cafes, shops)	100,000	3 years	Training programme established for nature guides, with regular training activities	Department of Tourism ONEP Pak Thale, Ban Kaew, Laem Pak Bia TAO Conservation organisations (e.g. BCST) Research institutions (e.g. Phetchaburi Rajabhat University)
Develop business plans to promote Pak Thale and Laem Pak Bia for biodiversity-friendly tourism, including tourist operators on adjacent beaches (e.g. Hat Chao Samran)	Up to two (2) business plans developed, in consultation with local stakeholders Input to Phetchaburi and Thailand tourism plans and maps.	50,000	2 years	Economic conditions for small-scale operators and businesses improved, in consulted with stakeholders	Local conservation groups (e.g. Pak Thale Bird Club)
Expand infrastructure for tourism, including signages, trails on boardwalks and wetland interpretation facilities, shelters and bird hides	Field infrastructure for tourists improved. Pak Thale and Laem Pak Bia well promoted for nature-based tourism	500,000	5 years	3-5 km of birdwatching trails (including boardwalks created) Up to 20 signages on biodiversity featured mounted. Three (3) new bird	Pak Thale <i>tambon</i> administration Conservation organisations (e.g. BCST)

				observation hides constructed. Visitor centre on wetland conservation established.	
<i>Component 4. Maintain land use of coast for salt farming and other sustainable livelihoods</i>					
Build capacity and develop (artisanal) businesses for salt-based products (such as wildlife-friendly salt); loans and grants to incentivise biodiversity-friendly salt production	Economic conditions for salt production businesses improved, in consulted with stakeholders. Use of coastal land (salt ponds) is maintained to benefit biodiversity.	200,000	5 years	Up to three (3) salt farming cooperatives established. At least 10 business and marketing plans developed to promote salt-based products, including obtaining certification	ONEP DMCR Ban Laem District Government Pak Thale, Ban Kaew, Laem Pak Bia TAO Conservation organisations Cooperatives and salt-farm operators
	Financing instrument to generate small-scale loans and grants targeting local salt-farming communities established.	500,000	3 years		
Strengthen sustainable and environmentally-friendly practices in aquaculture, with a focus on shellfish (e.g. mussels, crabs, sea grapes)	Incentives and capacity building programmes focused on sustainable production practices in shellfish aquaculture. Local credit mechanisms strengthened to improve practices and	1,000,000	5 years	One training and awareness programme focused on sustainable practices in aquaculture, including certification processes. Exchange visits with other aquaculture sites. Up to 50 aquaculture (incl. shellfish)	Phetchaburi Provincial Government (provincial office for fisheries) Fisheries and shellfishery cooperatives Pak Thale district government Pak Thale, Ban Kaew, Laem Pak Bia TAO

	reduce impacts of aquaculture.			operators engaged. Small loan scheme in place for shellfish-aquaculture operators.	Aquaculture operators
<i>Component 5. Assess the feasibility of nature-based credits to generate long-term financing for nature protection in Pak Thale and the wider Inner Gulf of Thailand wetlands.</i>					
Undertake feasibility studies to explore frameworks for nature-credits for biodiversity-friendly salt farming process.	Feasibility studies on nature credits completed, with outcomes promoted to potential investing institutions.	100,000	1.5 years	Sustained, long-term investment in livelihoods and biodiversity, generated by nature credits-based investments.	ONEP Consultancy companies

Prior to implementation interventions would be discussed with stakeholders from across the landscape. Scoping opinions would be sought from the national/local government agencies such as DMCR and Department of Water Resources (DWR) to determine what documentation/permissions are needed for the planned interventions. Within the project assessment of climate change impacts will mitigate against lost investment e.g. by planning mangrove planting in suitable areas it can avoid loss by flooding / inundation.

There are no indigenous peoples present in the landscape. However, there is considerable scope in the involvement of women in project development. Conservation groups established for ongoing projects in Pak Thale, led by the Bird Conservation Society of Thailand already demonstrate strong representation of women from the local communities. These groups may be expected to play a role in the implementation of the proposed project activities.

Existing projects (2023-2026) are currently being implemented by BCST, ONEP and BirdLife, and can provide co-funding leverage for a large project.

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Annex 1. Supplementary information on coastal protection services

To further validate the identification of the top ecosystem services by means of stakeholder consultation, an expectedly essential or non-substitutable regulating service across all RFI sites, namely coastal protection and flood mitigation (i.e., storm and flood hazard regulation), was assessed based on a combination of globally available datasets supplemented by web-based tool Co\$tingNature (Mulligan, 2022). Estimates for coastal protection by mangroves (after the effects of coral reefs) were spatially inferred in QGIS from a selection of metrics expressing different biophysical and monetary values modelled by Chaplin-Kramer et al. (2023) and Menéndez et al. (2020), respectively.

The key metrics selected for biophysical values (Table A1) were current maximum potential exposure to coastal hazards, which is a vulnerability risk index calculated in InVEST^[1] for several hazard variables (i.e., wind, waves, sea level rise, geomorphology, and bathymetry) in the hypothetical absence of current mangrove extent, and nature's (i.e., the mangroves') contribution to reducing this coastal risk, both as an absolute value multiplied by the local population affected and a percentage of the maximum potential exposure.

Table A1. Contribution of mangroves to coastal protection as a critical natural asset in Pak Thale-Laem Phak Bia coast based on site-level (biophysical) values inferred from Chaplin-Kramer et al. (2023) and expressed as ranges to represent the resulting uncertainty. Key metrics are in italics.

Critical contribution of mangroves to coastal protection (metrics)	Risk levels
Current population density within 2.5 km of the coast (number of people per hectare)	222 – 293
<i>Current maximum coastal risk to be mitigated, or potential exposure to coastal hazards (unitless index)</i>	3.15 - 3.30
Maximum coastal risk to be mitigated, or potential exposure to coastal hazards in 2050 according to IPCC's Shared Socioeconomic Pathway #1 'Sustainability' (unitless index)	3.15 - 3.30
Maximum coastal risk to be mitigated, or potential exposure to coastal hazards in 2050 according to IPCC's Shared Socioeconomic Pathway #3 'Regional Rivalry' (unitless index)	2.37- 3.54
Maximum coastal risk to be mitigated, or potential exposure to coastal hazards in 2050 according to IPCC's Shared Socioeconomic Pathway #5 'Fossil-fueled Development' (unitless index)	3.67- 3.85
Current proportional risk reduction, nature's contribution to reducing coastal risk as a proportion of maximum coastal risk (unitless index)	0.08- 0.14
<i>Nature's contribution to reducing coastal risk as a proportion of population density within 2.5 km of the coast (# of people per hectare)</i>	20 – 36

<i>Nature's contribution to reducing coastal risk as a percentage of the maximum potential exposure (%)</i>	2.50 - 4.21
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The key metrics selected for economic values (Table A2) were the annual expected flood protection benefits to total stock, which is the monetary value of the averted damages to the industrial and residential stocks (i.e., property) in 2015 US\$, the same total annual benefits expressed per hectare of mangroves, and the total benefits in the event of a 100-year return period storm, which are the rarest of cyclonic conditions but cause the most flood damages to property (i.e., maximum level of coastal protection by mangroves).

Table A2. Coastal protection benefits offered by mangroves in Pak Thale-Laem Phak Bia coast based on site-level (monetary) values inferred from Menéndez et al. (2020) and expressed as ranges to represent the resulting uncertainty. Key metrics are in italics.

Benefits of mangroves in terms of coastal protection (metrics)	Avoided costs (US\$)
Mangrove extent (hectares) ^[2]	212 – 641
Annual expected flood protection benefits to people (number of people)	(1,269) – 3,600
Annual expected flood protection benefits to Industrial Stock (US\$)	(164,342) - 466,113
Annual expected flood protection benefits to Residential Stock (US\$)	(387,003) - 1,097,633
<i>Annual expected flood protection benefits to Total Stock (US\$)</i>	<i>(878,545) - 2,491,763</i>
<i>Annual expected flood protection benefits to Industrial Stock per hectare of mangroves (US\$ per hectare)</i>	<i>(2,142) – 6,076</i>
1-in-100-year return period damage in terms of area flooded (number of hectares)	(14) – 172
<i>Total expected flood protection benefits of mangroves per 100-year return period storms (US\$)</i>	<i>(167,592) - 2,093,006</i>

Table A3. Biophysical benefits from RFI coastal wetland sites (expressed as ranges to represent the resulting uncertainty) and at the national level.

Site name	Max pot exp (index)	Risk reduction (index * pop)	Risk reduction (% max pot exp)
Bang Pu	No Data	No Data	No Data
Khlong Tamru (Bang Pakong)	3.22 (± 0.17)	147 (± 39)	4.9 (± 0.3)
Khlong Yai	2.15 (± 0.07)	59 (± 16)	7.3 (± 1.9)
Koh Kham	3.02 (± 0.09)	0 (± 0)	5.2 (± 0.2)
Ta Libong	2.63 (± 0.07)	21 (± 1)	6.2 (± 0.3)
Krabi Estuary	2.69 (± 0.07)	17 (± 1)	5.7 (± 0.3)
Pak Nam Prasae	2.63 (± 0.20)	53 (± 1)	5.9 (± 0.4)
Pak Thale	3.23 (± 0.08)	28 (± 8)	3.4 (± 0.9)
Ao Phang Nga	2.45 (± 0.10)	12 (± 1)	6.0 (± 0.4)
Thailand RFI average	2.75	63	5.4
Thailand national average	2,70	30	3.9

Table A4. Monetary benefits from RFI coastal wetland sites (expressed as ranges to represent the resulting uncertainty) and at the national level.

Site name	Total annual benefits (US\$)	Per mangrove area (US\$/ha)	For 100-yr return period storms (US\$)
Bang Pu	723,608 (±1,023,384)	985 (±1,393)	1,252,086 (±1,252,144)
Khlong Tamru (Bang Pakong)	4,064,792 (±101.810)	1,698 (±43)	1,028,638 (±46,938)
Khlong Yai	299,013 (±35,045)	37 (±4)	0 (±0)
Khok Kham	9,699,944 (±5,444,336)	12,815 (±7,193)	17,562,472 (±14,369,473)
Ko Libong	0 (±0)	0 (±0)	3,564,916 (±55,274)
Krabi Estuary	0 (±0)	0 (±0)	4,150,201 (±45,319)
Pak Nam Prasae	557,410 (±3,584,456)	300 (±1,929)	1,464,757 (±2,408,230)
Pak Thale – Laem Pak Bia	806,609 (±1,685,154)	1,967 (±4,109)	962,707 (±1,130,299)
Ao Phang Nga	81,744 (±96,861)	86 (±102)	5,723,399 (±12,351,015)
Thailand RFI average	1,803,680	1,987	3,967,686
Thailand RFI total	16,233,119	Not Applicable	18,146,703
Thailand national average	789,242	2,702	9,197,142
Thailand national total	85,257,773	Not Applicable	377,082,842

Table A5. Key habitat types in Pak Thale-Laem Phak Bia coast based on stakeholder-based assessment at the Regional Flyway Initiative workshop in November 2023.

Habitat type	Current state		Alternative state (2035)	
	Area (ha)	Cover (%)	Area (ha)	Cover (%)
Salt exploitation sites	1740.1	20.0	1566.1	18.0
Intertidal mud, sand or salt flats	1218.1	14.0	1218.1	14.0
Intertidal forested wetlands	870.1	10.0	870.1	10.0
Sand, shingle, or pebble shores	435.0	5.0	435.0	5.0
Permanent shallow marine waters	870.1	10.0	870.1	10.0
Canals and drainage channels, ditches	1131.1	13.0	1131.1	13.0
Estuarine waters	435.0	5.0	609.0	7.0
Irrigated land	261.0	3.0	261.0	3.0
Aquaculture ponds	435.0	5.0	435.0	5.0
Seasonally flooded agricultural land	435.0	5.0	435.0	5.0
Low Intensity Residential	870.1	10.0	870.1	10.0
Total	8700.6	100.0	8700.6	100.0