Koh Lanta Bridge
Thailand

Environmental Impact Assessment
Critical Habitat Assessment

Long-tailed Macaque

Draft Consultant Report submitted for review and finalization to:

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Acronyms used in the Text

Acronym	Description
AoA	Critical Habitat Area of Analysis
AZE	Alliance for Zero Extinction
BOW	Cornell Lab of Ornithology Birds of the World online literature
CHA	Critical Habitat Assessment
CR	Critically Endangered with extinction
DD	Data Deficient
DMCR	Department of Marine and Coastal Resources
DRR	Department of Rural Roads
EN	Endangered with extinction
ESF	World Bank Environment and Social Framework
ESS6	World Bank Environmental and Social Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
FAO	Food and Agriculture Organization of the United Nations
HNS	Habitat Not Suitable
IBAT	Integrated Biodiversity Assessment Tool
IUCN	International Union for the Conservation of Nature
LC	Least Concern (not threatened)
LoO	Likelihood of Occurrence.
LR/NT	Lower Risk/near threatened (former threatened status classification that has been discontinued)
NT	Near Threatened
OoR	Out of Range
SLIP	Supplementary Lenders Information Package
VU	Vulnerable with extinction
WPE	Wetlands International Waterbirds Population Estimate online database

1 EXECUTIVE SUMMARY

This report presents an assessment of the occurrence of critical habitats with relevance to the Koh Lanta Bridge Project as required by ESS6, a component of the World Bank Environment and Social Framework (ESF).

This assessment of critical habitat follows an approach developed by the World Bank in 2022 for interpretation of ESS6 critical habitat criteria to determine if the habitat has significant importance for species or the ecosystem. The area of analysis for this assessment is defined as the Koh Lanta Noi Subdistrict plus an approximately 5 km marine buffer. The assessment is conducted in four steps:

- Step 1 involves compiling lists of Critically Endangered (CR), Endangered (EN) and Restricted Range (RR) species based on global and national red list data.
- Step 2 involves screening these species based on their likelihood of occurrence, which reduced the list of 313 species down to 55 species present or with possible occurrence.
- Step 3 determines if the reduced list of species qualify as critical habitat features with occurrence of unique ecosystems and ecological functions also assessed. Marine species that qualify as critical habitat features include Irrawaddy Dolphin, Dugong and sea turtles (Green, Hawksbill, Leatherback and Olive Ridley sea turtles). Long-tailed Macaque monkeys are the only terrestrial species recognized as a critical habitat feature.
- Step 4 investigates requirements for net gain[1], if such outcomes are feasible and proposes a way forward, which leads to the following discussion:

The Irrawaddy Dolphin, Dugong and sea turtles do occur in the greater vicinity, but the EIA and consultations with conservation authorities do not predict significant impacts to these species although mitigation and monitoring measures are provided in the EIA. Net gain outcomes are therefore not required for these species.

Long-tailed Macaque monkeys may have a limited impact as a construction camp will be established and their scavenging behavior could bring the monkeys into conflict with the camp management. Also the Koh Lanta Bridge will attract tourists during the implementation phase resulting in some Macaque-tourist conflict. However mitigation can be applied to avoid significant impacts and alleviate the requirement for net gain outcomes.

[1] Where critical habitats are adversely impacted by a project ESS6 requires net gain to be demonstrated for the biodiversity features for which the critical habitat is designated.

This CHA therefore concludes there are no critical habitat features that require mitigation to demonstrate net gain outcomes as compensation for impacts caused by the project.

The Project passes through a short stretch of mangrove habitat within a national forest reserve. The mangrove habitat is recognized as a natural habitat but does not qualify as a critical habitat. An area of 1.2 rai (0.192 ha) of mangrove habitat will be impacted based on calculations within the EIA. Funds have been allocated within the ESMP budget for the Department of Marine and Coastal Resources (DMCR) to identify a suitable site 20 times larger than the impact site for planting appropriate mangrove plant species. Mangrove restoration is an established science for which the DMCR have the expertise, and this mitigation will therefore exceed the scope of the impact and yield a net gain outcome for mangroves as a result of the project. No additional offset measures are therefore proposed within this document.

The marine environment supports some degraded corals around the Koh Pling Island. These corals do not qualify as a critical habitat although the marine environment is considered a natural habitat. The project route bypasses these coral habitats although construction of the bridge will result in some temporary impacts which are minimized. During the operational phase of the bridge, there will be considerably less boat activity and many of the pressures on the corals will be alleviated. No offset approach is therefore proposed.

2 INTRODUCTION

2.1 Purpose of this Report

This report provides a Critical Habitat Assessment (CHA) to supplement the Environmental Impact Assessment (EIA, PDC, 2022) for the Koh Lanta Bridge in Thailand through identifying important biodiversity sensitivities that require mitigation to safeguard their protection. This CHA is developed in accordance with ESS6, together with an assessment of the species that are likely to trigger Net Gain[2] requirements. This CHA is a component of the Supplementary Lenders Information Package (SLIP) which is developed to address gaps within the EIA to meet requirements of the World Bank Environment and Social Framework (ESF).

Scope of this Assignment

Box 1 presents an extract from the list of requirements of the SLIP relative to this assignment.

Box 1 Requirements for Critical Habitat Assessment as part of the Supplementary Lenders Information Package

Critical Habitat Assessment – Given that the project will transect at least 3 protected areas (Non-hunting area, National Forest Area and Mangrove Forest Area), and potentially impact several species of conservation importance (e.g. several plant species including one listed as Endangered, Indo-pacific humpback dolphin, sea turtles etc.) the SLIP will need to include a CHA that will inform construction and operation management plans. The results of the CHA will also determine whether the proposed offset approach for the impacted mangroves (as well as the Mangrove Action Plan and Reforestation Action Plan) are sufficient and/or whether additional mitigation or management measures will be required as they relate to both flora and fauna conservation. These assessments (and related plans) are required by Appraisal.

2.2 Project Description

The Koh Lanta Bridge forms part of the Thailand Resilient Transport Connectivity and Irrawaddy Dolphin Conservation Project (P509460) implemented by the Department of Rural Roads (DRR) of the Ministry of Transport, and the Department of Marine and Coastal, Resources, Ministry of Natural Resources and Environment, with financial support from the World Bank.

The Koh Lanta Bridge is located in Koh Lanta District, Krabi Province and crosses the Khlong Chong Laad sea channel of the Andaman Sea in southern Thailand. The bridge will connect the

[2] Net Gains are defined within the World Bank ESF as additional conservation outcomes that can be achieved for the biodiversity values for which the natural or critical habitat was designated. Net gains may be achieved through full application of the mitigation hierarchy that may include the development of a biodiversity offset and/or implementation of additional programs in situ to enhance habitat and protect and conserve biodiversity.

subdistricts of Koh Klang and Koh Lanta Noi. The length of the project route is 2.527 km with a total bridge span of 1405 meters.

The Koh Lanta Bridge will support two traffic lanes (one in each direction) and includes three bends to pass around the small Koh Pling Island. The profile of the bridge considers the average high tide level of +1.08 meters and will accommodate a tsunami wave similar to that which struck the Koh Lanta coast in 2004 (approx. 4 meters). The bridge will be supported by 40 piers each based on a single column with a 2.5-meter depth and 6.2-meter width. The bridge will be constructed using a concrete mix able to withstand the corrosive effects of chloride and sulfate components of sea water. Permanent steel casings will additionally act as a prevention from seawater corrosion.

The Koh Lanta Bridge will be constructed over a 3-year period with a labor force of 170 workers. Construction machinery will include backhoes, compactors, graders, trucks, cranes, barges and other equipment. A construction workers camp, site office, concrete mixing plant, maintenance facility and casting yard will be established on the left side of Highway 4206 close to the beginning point of construction.

Large and extremely heavy precast piles and steel reinforcement materials required for construction will be transported by land to Krabi Port and then transported by barge via the Khlong Chong Laad to the construction site. Other construction materials will be transported to site by trucks through Highway No. 4206. Cables and associated equipment for construction of the bridge will be imported and brought to site in containers. Sediments and debris from the drilling of bored piles foundations in the sea will be transported to land using barges and lifted into trucks using large cranes. These sediments will be disposed in disturbed land of the Koh Klang Sub-district Administrative Organization (AO) and Koh Lanta Noi Sub-District AO.

3 METHOD FOR CRITICAL HABITAT ASSESSMENT

This assessment of critical habitat follows an approach developed by the World Bank in 2022 for interpretation of ESS6 critical habitat criteria to determine if the habitat has significant importance for species or the ecosystem. This method has been developed as a guidance note and presented at the IAIA23 conference in Kuching.

ESS6 provides the following criteria for recognizing critical habitat:

(a) Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of Threatened Species or equivalent national approaches;
(b) Habitat of significant importance to endemic or restricted-range species;

(c) Habitat supporting globally or nationally significant concentrations of migratory or congregatory species;
(d) Highly threatened or unique ecosystems;
(e) Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).

Data is required for criteria (a), (b) and (c) to guide the decision whether a habitat has significant importance for a species, while criteria (d) and (e) need to be assessed on a case-by-case basis. A critical habitat is determined for an area, and a critical habitat Area of Analysis (AoA) therefore needs to be defined for the application of the ESS6 critical habitat criteria. The AoA should extend beyond the project footprint and be roughly equivalent in scale to practical site-based conservation management activities. The CHA approach is presented as the following four steps:

Step 1 – Generate a List of Threatened and Range-restricted Species

Criteria (a) and (c) require the use of global IUCN Red List and national red list data, and at least two key data sources are required for generating lists of species within the AoA and supplemented from other sources as appropriate, such as local knowledge, stakeholder engagement, reviews of previous surveys and habitat mapping.

Step 2 Screening based on Likelihood of Occurrence

The list of species is screened for Likelihood of Occurrence (LoO) based on the ecological state of habitats within the AoA. For this CHA, species have been classified into four LoO categories, namely Present, Possible, Unlikely and Not Present. Species known to be Present or with a Possible LoO are taken forward to Step 3.

Step 3 Determination of Critical Habitat Status

Reliable data on a species' population size, extent of occurrence, other relevant information and expert opinion are required to assesses each species retained after Step 2. The following six guidelines are provided as a structured approach to facilitate the interpretation and analysis of critical habitat:

(i) Recognized areas of high biodiversity value (such as legally protected areas, Key Biodiversity Areas, Important Bird Areas, Alliance for Zero Extinction (AZE) sites, Ramsar Wetlands of International Importance and World Heritage Natural Sites) and importantly the reasons for which they are designated can provide useful indicators of potential critical habitat. A review of protected areas data should therefore be included into an assessment of critical habitat.

(ii) ESS6 Criterion (a) requires an assessment against both global (IUCN) and national red list ratings. ESS6 footnote 13 states that where the threatened status of a species is listed

differently on the (global) IUCN Red List and national/regional lists, assessment of the impact of net reduction should be based on the national/regional population. This is interpreted as a requirement to follow a precautionary approach and to prioritize assessment of species reduction (project impact) to the lesser population of a species (i.e. the national assessment) over the global assessment.

(iii) By definition, Critically Endangered (CR) species face an extremely high risk of extinction and their continued survival in the wild is in a critical state. Therefore, if a surviving population of a CR species is present in the critical habitat AoA, the habitat should be considered to have significant importance for the species under ESS6 Criterion (a).

(iv) Where a significant proportion of the national, regional or global population of a species is present or has a likely presence within the AoA, the habitat is considered to have significant importance for the species under ESS6 Criterion (a), (b) or (c). Each project is encouraged to develop its own measurement of significance. For this CHA, presence (or likely presence) of ±1% of the global or national population within the AoA is considered significant.

(v) ESS6 Criterion (b) can additionally be achieved for range-restricted species where the full extent of the critical habitat AoA overlaps a significant proportion of a species' distribution range (±1% is considered significant for this CHA).

(vi) ESS6 Criteria (d) and (e) are to be assessed on a case-by-case basis using specialist input and reliable data sources with consideration given to the presence of conservation initiatives, legally protected areas and internationally or regionally recognized areas of high biodiversity value and the reasons for which they are designated.

Step 4 Identify Critical Habitat Features of Relevance to the Project

ESS6 paragraph 24 presents a list of requirements for projects impacting critical habitats, and the CHA needs to demonstrate how each of those requirements can be met. These requirements state the project's mitigation strategy will be designed to achieve net gains of those biodiversity values for which the critical habitat is designated. Critical habitat features therefore need to be assessed for relevance to the project, as those features that are not impacted by a project do not present a risk that the project will fail to meet ESS6 requirements. The feasibility and way forward to achieving net gain for such critical habitat features needs to be discussed. ESS6 paragraph 24 also requires an appropriately designed, long-term biodiversity monitoring and evaluation program aimed at assessing the status of the critical habitat, and the CHA needs to demonstrate how this will be addressed.

4 OCCURRENCE OF PROTECTED AREAS

A review of legally protected and internationally recognized areas of biodiversity value is included to address components of Step 3. The project route passes through the Thung Thale Non-hunting Area (TTNHA). The TTNHA covers 25.72 km² in extent (Figure 1 and Appendix C) and is declared under the Wildlife Conservation and Protection Act and recognized as a legally protected area (IUCN Management Category IV). The reserve supports a diversity of wildlife species and protects Thailand's only large expanse of *Melaleuca* Forest and connects to adjacent mangrove forest.

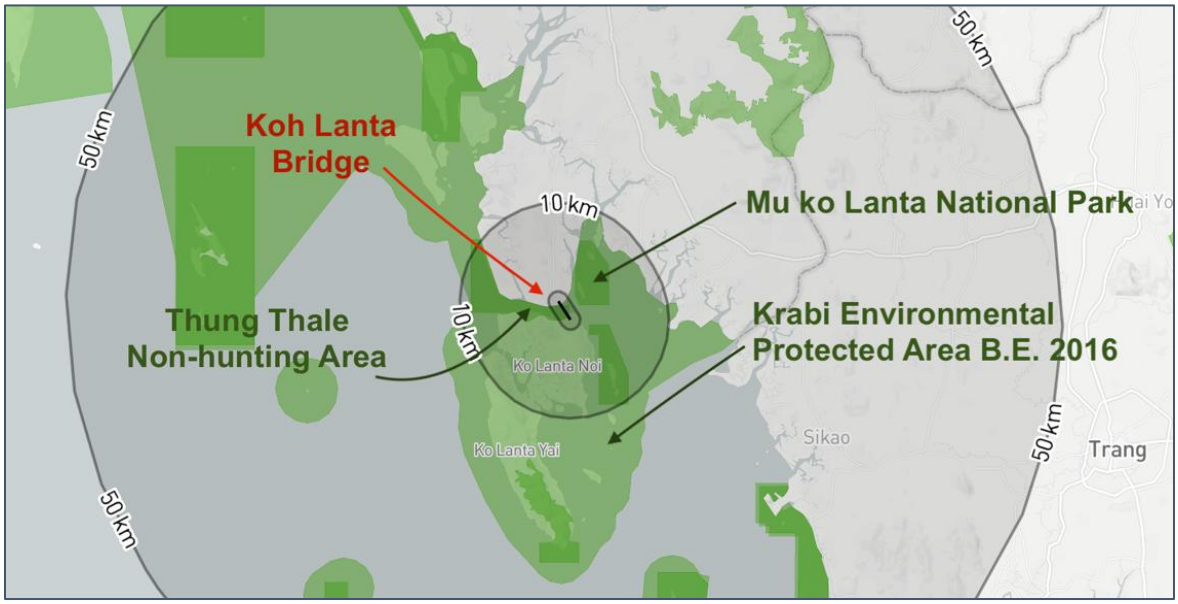

Figure 1 Annotated map of legally protected areas in the vicinity of the Koh Lanta Bridge provided by IBAT

The project route passes adjacent to the Middle Island National Forest and through the Pa Lang Sot National Forest/Kuan Ba Kan Koh National Forest for a distance of 569 meters and impacting an area of 4 rai (0.64 ha). These forest reserves support designated mangrove forest habitat according to Cabinet resolutions on August 22, 2000 and October 14, 2000 as described within the EIA (Figure 2 and Figure 3). Permission to develop the project within the Pa Lang Sot National Forest/Kuan Ba Kan Koh National Forest has been granted by the Royal Forestry Department, as presented in the EIA.

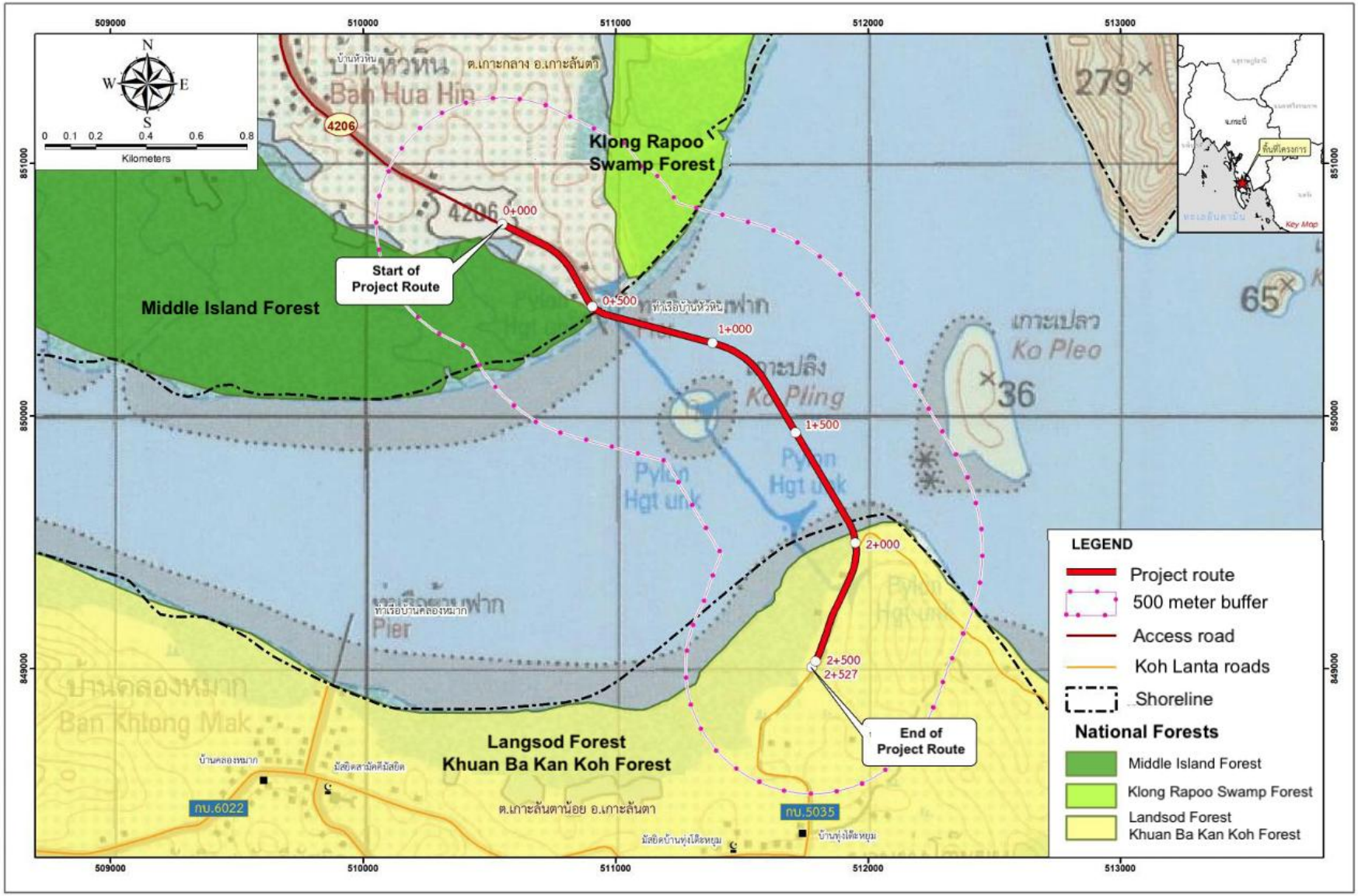

Figure 2 ***Layout of national forest reserves in the project area*** *(translated from the EIA baseline report)*

Figure 3 Layout of Mangrove forest according to the Cabinet resolution in the project study area *(translated from the EIA report)*

The TTNHA forms part of the larger Krabi Environmental Protected Area B.E. 2016 (Figure 1) which covers 1925 km² along the Krabi coast and is recognized as an IUCN Management Category VI legally protected area. The Mu ko Lanta National Park (IUCN Management Category II) is a fragmented marine park that protects coral reefs and sea grass meadows with a rich diversity of marine life and important for supporting dolphins, dugong (manatees) and marine turtles. The Mu ko Lanta National Park is not directly impacted by the project. Maps are provided in Appendix C showing the protected areas in greater detail.

Two Ramsar Wetlands exist in the greater vicinity of the project, namely the Krabi Estuary and the Had Chao Mai Marine National Park, Ta Libong Island Non-Hunting Area and Trang River Estuaries (Appendix C). These sites protect large areas of mangrove forest, sea grass meadows, marine and terrestrial habitat. These area are not expected to be adversely impacted by the project.

There are no other internationally recognized areas of biodiversity value (such as key biodiversity areas, World Heritage or AZE sites) in the vicinity of the project.

5 CRITICAL HABITAT DETERMINATION

5.1 Critical Habitat Area of Analysis (AoA)

Critical habitat is defined for an AoA and the Koh Lanta Noi Subdistrict plus an approximately 5 km marine buffer serves as a suitable AoA for this assessment (Figure 4).

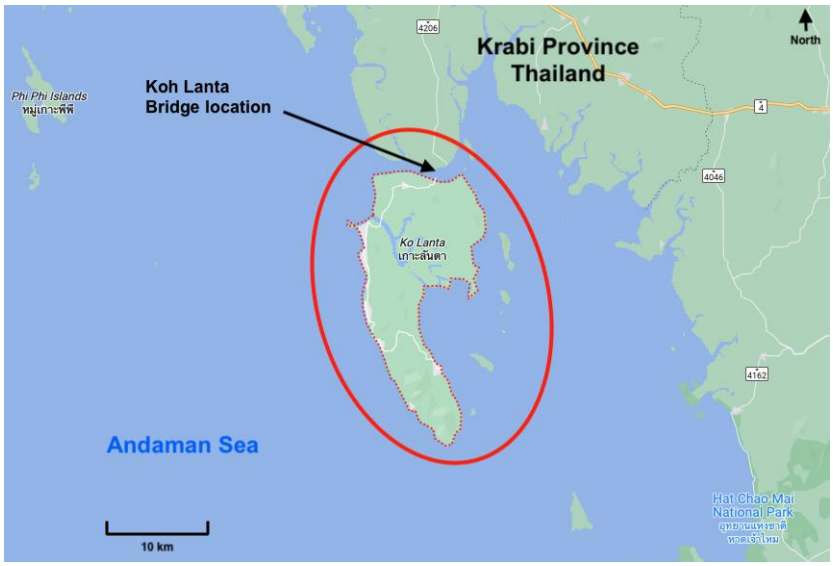

Figure 4 Critical Habitat Area of Analysis (AoA) shown with a red line comprising the Koh Lanta Noi subdistrict and an approx. 5 km marine buffer

5.2 Species with Potential Occurrence within the AoA

A list of locally threatened species was acquired using the Integrated Biodiversity Assessment Tool (IBAT). This online system generates an area with a default 50 km radius around the project site (Figure 1) and lists species from the IUCN Red List of Threatened Species with distributions that overlap that zone. IBAT has identified 102 CR or EN plant and animal species potentially occurring within a 50 km radius of the Project. These include 49, 11 and 36 species associated primarily with marine, aquatic and terrestrial habitats respectively (Table 3). IBAT has also identified 17 range restricted species (Table 4).

Nationally threatened species were sourced from the Thailand Red Data: Vertebrates (2005), which provides the latest national assessment of mammals, birds, reptiles, amphibians and fish. This document classifies species using the same assessment criteria as the IUCN Red List of Threatened Species and therefore integrates with the global data. A total of 236 species are listed comprising 47, 75 and 114 species associated primarily with marine, aquatic and terrestrial habitats respectively (considerable overlap occurs with the IBAT data). This national assessment is 18 years old, but the general trend is for species to increase their threatened status. Listed species are therefore considered valid but the risk of using old red list assessments is that more species may qualify as endangered than are listed. Appendix A Table 3 presents a combined list of 278 CR and EN species sourced from IBAT and the Thailand Red List (2005).

Additional data on bird distribution and global and regional population size was sourced from the Waterbird Population Estimates (WPE) online database, the online Cornell Lab of Ornithology Birds of the World (BOW) literature and eBird data. Additional data on fish was sourced from the FishBase online database.

5.3 Ecological State of Habitats within the AoA

An understanding of the ecological state of habitats is necessary to assess the LoO of a variety of species as part of a CHA. This understanding is guided by the classification of habitats as either modified or natural based on levels of human-induced disturbance to species composition and ecological functions, as per the definitions provided by ESS6 (Table 1).

Table 1 ESS6 definitions of modified and natural habitats

Modified Habitat	Natural Habitat
ESS6 paragraph 19: Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition.	ESS6 paragraph 21: Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.

The substrate of the sea floor along the project route is not conducive for corals but weakly formed coral habitats do occur around the Koh Pling Island. These corals do not present a coral reef as exists in the south of Koh Lanta Noi. These corals are present within 6 meters of the bridge route between the Koh Klang side and the island. These corals in the project vicinity occur at a ratio of 2 live corals per every dead coral with the deterioration attributed to human activities such as mooring boats, anchoring boats, finding oysters on the rocks and trampling. Minor sea grass patches occur close to the Koh Lanta Noi bank but are considered insignificant. Despite the deterioration of the coral, the marine habitats within the AoA retain much of the species composition and therefore qualify as natural habitats. The EIA includes mitigation to avoid impacts to corals and sea grass.

The EIA describes the terrestrial habitats within the project footprint dominated by plants cultivated by local households and are classified as modified habitat. This terrestrial habitat transitions to coastal mangrove habitat in which 37 mangrove species have been identified. The mangrove habitat on the northern bank of the construction footprint is disturbed and relatively open and is considered a modified habitat and is not recognized as a Mangrove area based on Cabinet resolutions (Section 4, Figure 3). On Koh Lanta Noi the project route passes through 129 meters of Cabinet recognized Mangrove habitat. The impacted Mangrove area is calculated within the EIA to cover 1.2 rai (0.192 ha).

5.4 Results of Critical Habitat Occurrence

Results of this CHA are presented based on the ESS6 critical habitat criteria.

(a) Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches

Table 5 presents the analysis of the validity of critical habitat for a wide spectrum of threatened species. Marine species that qualify as critical habitat features include Irrawaddy Dolphin, Dugong and four sea turtles, namely the Green, Hawksbill, Leatherback and Olive Ridley sea turtles.

- Irrawaddy Dolphin are present but there is no data available on their abundance. This species has a CR status and is therefore included as a critical habitat feature based on guideline item (iii) of Step 3.
- The EIA similarly mentions the occurrence of Dugongs. The IUCN Red List states that Thailand supports a genetically distinct subpopulation but there is no estimate of their population size. This species is present, has a CR status and is similarly included as a critical habitat feature based on guideline item (iii) of Step 3.

- The EIA mentions the occurrence of Green, Leatherback and Olive Ridley sea turtles which includes the species listed here. Green and Leatherback Turtles nest on Koh Lanta Island, with an average of 5 nests recorded per year. These turtles are collectively described as a critical habitat feature for the project based on their CR status based on guideline item (iii) of Step 3.

Table 5 explains that Long-tailed Macaque is included as a critical habitat feature based on its presence and recently designated EN status on the IUCN Red List (2022). This monkey is abundant at both start and end points of the Koh Lanta Bridge where troops are considered problematic for the wellbeing of residents and visitors and remains abundant in Thailand and surrounding states. There is no data available on global or national population numbers, but review of the justification for IUCN uplisting reveals there is concern for the survival of this species based on the widespread and uncontrolled capture and export of the species for medical research purposes and the pet trade (further explained in Appendix B). An EN threatened status will resonate through the medical research industry and will likely be effective for curbing the uncontrolled capture of this species from the wild.

(b) Habitat of significant importance to endemic or restricted-range species

One endemic fish species has a possible likelihood of occurrence (Table 4) but there is no evidence of its presence in the AoA and is therefore not included as a critical habitat feature.

(c) Habitat supporting globally or nationally significant concentrations of migratory or congregatory species

The environment associated with the AoA is not expected to host significant concentrations of migratory species. eBird data presents counts of bird species in local bird hotspots, and there is a record for 600 Asian Openbill Storks passing over Koh Lanta Island on 5 December 2019. The WPE online database estimates the regional population of Asian Openbill Storks to comprise 300,000 birds and recognizes a 1% threshold of 3,000 birds which is not achieved. Also a migratory flock of birds passing overhead is not dependent on the site and there is no reason to consider the local habitat as having significant importance for the species and no critical habitat is recognized. No other significant concentrations of species are known.

(d) Highly threatened or unique ecosystems

The marine environment is well protected with the presence of multiple overlapping marine protected areas and there is no evidence to recognize it as a unique ecosystem.

Another consideration is the significance of mangrove forest. A DMCR website estimates the Krabi Province supports an area of 34,909 ha (218,186 rai) of mangrove forest, which represents 33% of the mangrove habitat within the Upper Andaman Sea region of Thailand. Two Ramsar sites are recognized within Krabi Province for conserving large areas of mangrove habitat (Section 4 and Appendix C). Extensive mangrove loss has occurred in the region and in many coastal areas of Thailand due to charcoal production and clearing for shrimp farming. Concerns were raised in 1996 which resulted in the issuing of forest concessions within mangrove habitats being cancelled by Cabinet. The last mangrove forest concession expired in 2003. Pressure from tourism development and road construction continue to exert pressure resulting in loss of mangrove habitat, however FAO data from monitoring Landsat images reveals mangrove habitats have shown some recovery and subsequent stabilization since the cancellation of forestry concessions (Figure 5). Two Endangered mangrove tree species are listed in Table 4 of Appendix A but there is no justification to consider the habitat to be highly threatened due to the extensive protection, habitats are also widespread and are therefore not unique.

No critical habitat is therefore recognized under criterion (d).

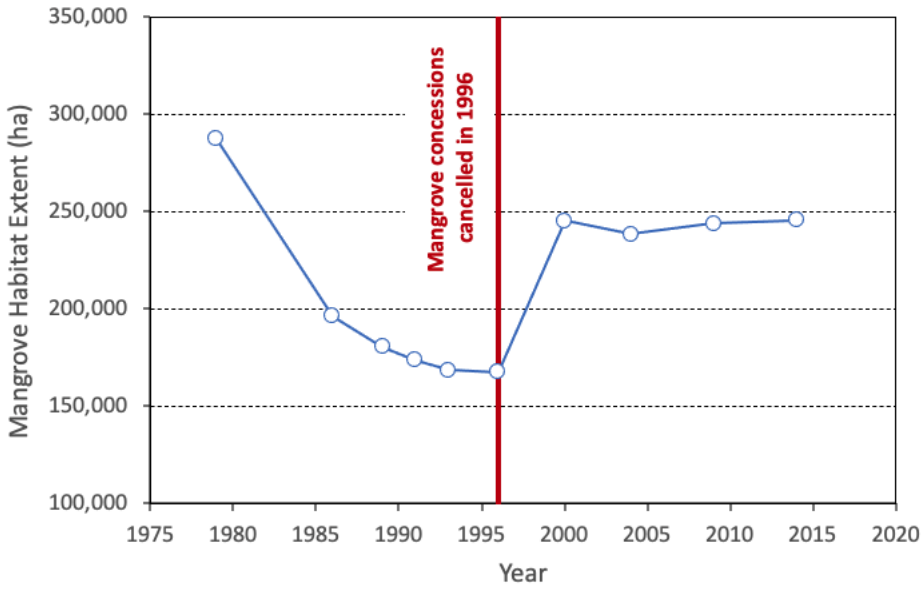

Figure 5 National trend of mangrove coverage in Thailand (based on FAO data, 2020) showing the date when mangrove forestry concessions were cancelled.

(e) Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d)

No ecological functions necessary to support biodiversity values described under criteria (a) to (d) have been identified.

5.5 Exposure to Impacts and Feasibility of Net Gain Requirements

Step 4 of the CHA method requires a high-level assessment of the potential for critical habitat features to be impacted by the project. This step is necessary to determine whether Net Gain measures need to be demonstrated and if this is feasible. Based on the above analysis, features that qualify as critical habitat include Irrawaddy Dolphin, Dugong, Green, Hawksbill, Leatherback and Olive Ridley sea turtles and Long-tailed Macaque.

Marine Mammals and Turtles

These marine species are known to occur in the greater vicinity, but the EIA and consultations with conservation authorities do not predict significant impacts to these species. The marine environment allows abundant opportunity for mobile species to escape the area if a disturbance happens and significant impacts are not expected to occur. Indo-Pacific humpbacked dolphin (*Sousa chinensis*), which are not endangered, do occur near the project site and mitigation measures are provided to avoid and minimize impacts to this species and provide monitoring thereof. These measures will be equally effective to avoid significant impacts to the marine critical habitat features in this report. Net Gain measures therefore do not need to be demonstrated for Irrawaddy Dolphin, Dugong and sea turtles.

Long-tailed Macaque

Long-tailed Macaque are recognized as a critical habitat feature based on a recently uplisted global Endangered (EN) status due to the increased demand for medical research as described above and substantiated in Appendix B. Yet Long-tailed Macaque are considered a problem as they steal food and injure tourists and the TTNHA authorities have requested funds to manage the population to minimize the human-macaque conflict. This species will likely be impacted by the project as a construction camp will be established to accommodate 170 workers at the project site. Long-tailed Macaque will be unable to resist the temptations to steal food from the canteen and scavenge from the kitchen waste, which will foul the facilities, spread garbage, lead to aggressive encounters with workers and bring them into conflict with the camp management. Also the Koh Lanta Bridge is designed to attract tourists during the implementation phase which could exacerbate the Macaque-tourist conflict. This impact must be seen in perspective as the construction camp will accommodate 170 workers which is a not a significant increase compared against the 30,000 people that live nearby. Also the tourism strategy aims at attracting quality tourism rather than mass tourism (Bangkok Post, 2022). Significant impacts can be avoided if mitigation is applied to monkey-proof the construction camp with strong screens on the doors and windows, apply effective kitchen hygiene and waste management to remove food scraps. Tourists must be warned and discouraged from feeding monkeys for their own health and safety and the monkeys. A scientific and ethical approach is also required to manage the monkey

population onsite. Effective mitigation can avoid a significant residual impact which alleviates the requirement for measures to demonstrate Net Gain outcomes.

Mangrove Habitats

Mangrove habitats are not described as critical habitats however the scope of this study requires an assessment of the adequacy of the offset approach for mangrove habitats provided by the Mangrove Action Plan and Reforestation Action Plan.

The project route will cut through 129 meters of mangrove habitat on Koh Lanta Island covering an area of 1.2 rai (0.192 ha). The EIA states that 40 trees will need to be cut, of which 47 are mangrove tree species. The DMCR regulation on mangrove forest restoration (B.E. 2556) specifies that "Article 6: Any government agency utilizing and benefiting from mangrove forests shall allocate a budget for the DMCR for the planting of mangrove forests not less than 20 times of the area that was utilized". Mitigation is provided within the EIA to meet this regulation with budget allocated for the DMCR to select degraded sites and appropriate mangrove species for replanting and habitat restoration. Establishment of mangroves is an established science and the DMCR have the required expertise and experience to successfully implement the task. An expansion of mangrove habitat is therefore expected, which equates to a net gain outcome on a like-for-like basis.

Coral Habitats

The marine environment is not suitable for the establishment of coral reef although some corals exist in a degraded state around the Koh Pling Island. The marine environment qualifies as a natural habitat but is not a critical habitat. Degradation of the corals is the result of boat moorings and anthropogenic pressures. The project route bypasses coral habitats although construction of the bridge but will result in some sediment dispersal that will impact the corals. Sediment plumes will be minimized and temporary and mitigation is included in the EIA to avoid unnecessary impacts to corals. During the operational phase of the bridge, there will be considerably less boat activity and many of the pressures on the corals will be alleviated. No offset approach is therefore proposed.

6 PROPOSED WAY FORWARD

ESS6 paragraph 24 presents the following set of requirements for projects operating in critical habitats. The text states "the Borrower will not implement any project activities that have potential adverse impacts unless all of the following conditions are met" (as listed in Table 2):

Table 2 Requirements of ESS6 paragraph 24 for projects with activities in critical habitat

ESS6 Requirement	Assessment and Proposed Action
(a) No other viable alternatives within the region exist for development of the project in habitats of lesser biodiversity value;	The EIA has conducted an analysis of alternatives and the selected route minimizes the loss of mangrove habitat. Critical habitat features identified in this report would not be avoided through selection of any of the alternative routes.
(b) All due process required under international obligations or national law that is a prerequisite to a country granting approval for project activities in or adjacent to a critical habitat has been complied with;	The project is developed in accordance with the national legislative framework and is developed to align with ESF requirements.
(c) The potential adverse impacts, or likelihood of such, on the habitat will not lead to measurable net reduction or negative change in those biodiversity values for which the critical habitat was designated;	Based on the assessment in Section 5.5, project activities are not expected to result in a net reduction or negative change to critical habitat features.
(d) The project is not anticipated to lead to a net reduction in the population of any Critically Endangered, Endangered, or restricted-range species, over a reasonable time period;	The presence of Critically Endangered, Endangered, or restricted-range species has been assessed and no reduction is their populations are expected as a result of project activities during the construction and implementation phases.
(e) The project will not involve significant conversion or significant degradation of critical habitats. In circumstances where the project involves new or renewed forestry or agricultural plantations, it will not convert or degrade any critical habitat;	No significant change of habitat status is anticipated.
(f) The project's mitigation strategy will be designed to achieve net gains of those biodiversity values for which the critical habitat was designated; and	Section 5.5 provides an assessment of the potential impacts to critical habitat features, which reveals that mitigation shall be adequate to address potential impacts with no significant residual impact expected. The conclusion is that additional measures are not required to demonstrate net gain outcomes for these biodiversity values.

ESS6 Requirement	Assessment and Proposed Action
(g) A robust and appropriately designed, long-term biodiversity monitoring and evaluation program aimed at assessing the status of the critical habitat is integrated into the Borrower's management program.	The Lanta Bridge ESMP is in preparation and presents activities for long-term monitoring and evaluation of biodiversity values. The ESMP will be used for the development of a contractor's terms of reference and implementation plan. The ESMP also specifies DRR responsibility in carrying out the monitoring of aquatic ecology, plants and rare species during not only the construction phase but also in many years in the operation phase of the project

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8 APPENDIX A - SPECIES DATA

8.1 Steps 1 and 2: Species Lists and Likelihood of Occurrence

Table 3 Critically Endangered and Endangered Species from IBAT and the Thailand Red List with analysis of their Likelihood of Occurrence (LoO)

Species present or with a possible LoO are shaded in orange (52 species). An explanation of acronyms is provided at the end of this table.

Species	Thai Name (English Name)	Red List Status		Habitat	Likelihood of Occurrence (LoO)	Reason for low LoO	Source
		National	IUCN				
Mammals (Carnivores)							
Felis chaus	เสือกระต่าย (Jungle cat)	CR	LC	Terrestrial	Not present	HNS	Nat.
Ictailurus planiceps	แมวป่าหัวแบน (Flat-headed cat)	CR	EN	Terrestrial	Not present	HNS	Nat.
Panthera pardus	เสือดาว, เสือดำ (Indochinese Leopard)	-	CR	Terrestrial	Not present	HNS (terrestrial)	IBAT
Panthera tigris	เสือโคร่ง (Tiger)	EN	EN	Terrestrial	Not present	HNS (terrestrial)	Both
Pardofelis marmorata	แมวลายหินอ่อน (Marbled cat)	EN	NT	Terrestrial	Not present	HNS (forest)	Nat.
Lutra lutra	นากใหญ่ภูเขา (Eurasian otter)	EN	NT	Aquatic	Not present	OoR	Nat.
Lutra sumatrana	นากใหญ่หัวปลาดุก, (Hairy-nosed otter)	CR	EN	Aquatic	Unlikely	Distribution marginal	Nat.
Mustela strigidorsa	เพียงพอนเส้นหลังขาว (Back-striped weasel)	EN	LC	Terrestrial	Not present	HNS	Nat.
Prionodon pardicolor	ชะมดแปลงลายจุด (Spotted linsang)	EN	LC	Terrestrial	Not present	OoR	Nat.
Cynogale bennettii	อีเห็นน้ำ (Otter Civet)	CR	EN	Terrestrial	Not present	HNS (forest, wetlands)	Both
Hemigalus derbyanus	อีเห็นลายพาด (Banded palm civet)	EN	NT	Terrestrial	Not present	HNS	Nat.
Viverra megaspila	ชะมดแผงสันหางดำ (Large-spotted Civet)	EN	EN	Terrestrial	Not present	HNS (terrestrial)	Both
Mammals (Marine Mammals)							
Balaenoptera edeni	วาฬแกลบ, วาฬบรูด้า, (Bryde's whale)	EN	LC	Marine	Not present	HNS (offshore sp.)	Nat.
Balaenoptera musculus	(Blue Whale)	-	EN	Marine	Not present	HNS (offshore sp.)	IBAT
Balaenoptera physalus	วาฬฟิน, วาฬแกลบ (Fin whale)	EN	VU	Marine	Not present	HNS (offshore sp.)	Nat.
Delphinus capensis	โลมาปากยาว (Common dolphin)	EN	LC	Marine	Possible	Global distribution	Nat.
Feresa attenuata	วาฬเพชฌฆาตเล็ก (Pygmy killer whale)	EN	LC	Marine	Not present	HNS (offshore sp.)	Nat.
Globicephala macrorhynchus	วาฬนำร่องครีบสั้น (Short-finned pilot whale)	EN	LC	Marine	Not present	HNS (offshore sp.)	Nat.
Orcaella brevirostris	โลมาอิรวดี (Irrawaddy Dolphin)	CR	EN	Marine	Present		Both
Orcinus orca	วาฬเพชฌฆาต (Killer whale)	EN	DD	Marine	Possible	Global distribution	Nat.

Species	Thai Name (English Name)	Red List Status		Habitat	Likelihood of Occurrence (LoO)	Reason for low LoO	Source
		National	IUCN				
Peponocephala electra	โลมาหัวแตงโม (Melon-headed whale)	EN	LC	Marine	Not present	HNS (offshore sp.)	Nat.
Stenella attenuata	โลมาลายจุด (Pantropical spotted dolphin)	EN	LC	Marine	Possible	Global distribution	Nat.
Stenella coeruleoalba	โลมาแถบ (Striped dolphin)	EN	LC	Marine	Possible	Global distribution	Nat.
Steno bredanensis	โลมาฟันห่าง (Rough-toothed dolphin)	EN	LC	Marine	Possible	Global distribution	Nat.
Kogia breviceps	วาฬหัวทุยเล็ก (Pygmy sperm whale)	EN	LC	Marine	Not present	HNS (offshore sp.)	Nat.
Kogia simus	วาฬหัวทุยแคระ (Dwarf sperm whale)	EN	LC	Marine	Possible	Global distribution	Nat.
Neophocaena phocaenoides	โลมาหัวบาตรหลังเรียบ (Finless porpoise)	EN	VU	Marine	Possible	Wide near-coastal distrib.	Nat.
Physeter macrocephalus	วาฬหัวทุย (Sperm whale)	EN	VU	Marine	Not present	HNS (offshore sp.)	Nat.
Tragulus napu	กระจงควาย (Greater mouse deer)	EN	LC	Terrestrial	Not present	HNS	Nat.
Mesoplodon ginkgodens	วาฬฟันเขี้ยว (Ginkgo-toothed whale)	CR	DD	Marine	Not present	HNS (offshore sp.)	Nat.
Dugong dugon	พะยูน (Dugong)	CR	VU	Marine	Present		Nat.
Mammals (Large Herbivores)							
Elephas maximus	ช้างป่า (Asian Elephant)	EN	EN	Terrestrial	Not present	HNS (terrestrial)	Both
Dicerorhinus sumatrensis	กระซู่ (Sumatran rhinoceros)	EW	CR	Terrestrial	Not present	HNS	Nat.
Rhinoceros sondaicus	แรด (Javan rhinoceros)	EW	CR	Terrestrial	Not present	HNS	Nat.
Tapirus indicus	สมเสร็จ (Malay Tapir)	EN	EN	Aquatic	Not present	HNS (terrestrial)	Both
Bos javanicus	วัวแดง (Banteng)	CR	EN	Terrestrial	Not present	HNS	Nat.
Bos sauveli	กูปรี (Kouprey)	EW	CR	Terrestrial	Not present	HNS	Nat.
Bubalus bubalis	ควายป่า (Water buffalo)	EN	Domesticated	Terrestrial	Not present	HNS	Nat.
Naemorhedus caudatus	กวางผา (Long-tailed goral)	CR	VU	Terrestrial	Not present	HNS	Nat.
Axis porcinus	เนื้อทราย (Hog deer)	EN	EN	Terrestrial	Not present	HNS	Nat.
Cervus eldii	ละอง, ละมั่ง (Eld's deer)	EW	EN	Terrestrial	Not present	HNS	Nat.
Muntiacus feae	เก้งหม้อ (Fea's muntjac)	EN	DD	Terrestrial	Not present	HNS	Nat.
Mammals (Bats)							
Craseonycteris thonglongyai	ค้างคาวคุณกิตติ (Bumblebee bat)	CR	NT	Terrestrial	Not present	HNS	Nat.
Hipposideros halophyllus	ค้างคาวหน้ายักษ์จมูกปุ่ม (Limestone bat)	EN	VU	Terrestrial	Not present	HNS	Nat.
Pteropus vampyrus	ค้างคาวแม่ไก่ป่าฝน (Large Flying-fox)	VU	EN	Terrestrial	Present		IBAT
Rhinolophus marshalli	ค้างคาวมงกุฎหูโต (Marshall horseshoe bat)	EN	LC	Terrestrial	Not present	HNS	Nat.
Eptesicus demissus	ค้างคาวท้องสีน้ำตาล (Surat helmeted bat)	EN	-	Terrestrial	Not present	HNS	Nat.
Mammals (Primates)							
Macaca assamensis	ลิงอ้ายเงี้ยะ (Assamese macaque)	EN	NT	Terrestrial	Not present	HNS	Nat.

Species	Thai Name (English Name)	Red List Status		Habitat	Likelihood of Occurrence (LoO)	Reason for low LoO	Source
		National	IUCN				
Macaca fascicularis	(Long-tailed Macaque)	-	EN	Terrestrial	Present		IBAT
Macaca nemestrina	ลิงกังใต้ (Southern Pig-tailed Macaque)	NT	EN	Terrestrial	Unlikely	HNS (forest)	IBAT
Trachypithecus obscurus	(Dusky Langur)	-	EN	Terrestrial	Not present	HNS (forest)	IBAT
Hylobates agilis	ชะนีมือดำ (Agile gibbon)	CR	EN	Terrestrial	Not present	HNS	Nat.
Hylobates lar	ชะนีมือขาว (Lar Gibbon)	VU	EN	Terrestrial	Not present	HNS (terrestrial)	IBAT
Hylobates lar ssp. lar	(Malaysian Lar)	-	EN	Terrestrial	Not present	HNS	IBAT
Hylobates pileatus	ชะนีมงกุฎ (Capped gibbon)	EN	EN	Terrestrial	Not present	HNS	Nat.
Nycticebus bengalensis	(Bengal Slow Loris)	-	EN	Terrestrial	Not present	OoR	IBAT
Mammals (Rodents and Pangolins)							
Niviventer hinpoon	หนูขนเสี้ยนเขาหินปูน (Limestone Niviventer)	EN	EN	Terrestrial	Not present	OoR	Nat.
Callosciurus prevostii	กระรอกสามสี (Prevost's squirrel)	CR	LC	Terrestrial	Not present	HNS	Nat.
Sundasciurus hippurus	กระรอกหางม้าใหญ่ (Horse-tailed squirrel)	EN	NT	Terrestrial	Not present	HNS	Nat.
Manis javanica	ลิ่นชวา (Sunda Pangolin)	NT	CR	Terrestrial	Not present	HNS (terrestrial)	IBAT
Manis pentadactyla	ลิ่นจีน (Chinese pangolin)	EN	CR	Terrestrial	Not present	HNS	Nat.
Birds (Raptors)							
Aquila clanga	นกอินทรีปีกลาย (Greater spotted eagle)	EN	VU	Terrestrial	Not present	HNS	Nat.
Aquila heliacal	นกอินทรีหัวไหล่ขาว (Indian spotted eagle)	EN	LC	Terrestrial	Not present	OoR	Nat.
Aquila nipalensis	นกอินทรีทุ่งหญ้าสเต็ปป์ (Steppe Eagle)	NT	EN	Terrestrial	Unlikely	HNS (montane species)	IBAT
Gyps bengalensis	อีแร้งเทาหลังขาว (White-rumped Vulture)	CR	CR	Terrestrial	Not present	HNS (terrestrial)	Both
Gyps tenuirostris	อีแร้งสีน้ำตาล (Slender-billed Vulture)	CR	CR	Terrestrial	Not present	HNS (terrestrial)	Both
Ichthyophaga ichthyaetus	เหยี่ยวปลาใหญ่หัวเทา (Gray-head fish eagle)	CR	NT	Terrestrial	Not present	HNS (forest)	Nat.
Macheiramphus alcinus	เหยี่ยวค้างคาว (Bat hawk)	CR	LC	Terrestrial	Not present	HNS	Nat.
Milvus migrans	เหยี่ยวดำ (Black kite)	EN	LC	Terrestrial	Not present	HNS	Nat.
Sarcogyps calvus	พญาแร้ง (Red-headed Vulture)	CR	CR	Terrestrial	Not present	HNS (terrestrial)	Both
Spizaetus nanus	เหยี่ยวหงอนสีน้ำตาล (Wallace's hawk-eagle)	EN	NT	Terrestrial	Not present	HNS	Nat.
Birds (Waterbirds and Ground Birds)							
Asarcornis scutulata	เป็ดก่า (White-winged Duck)	-	EN	Aquatic	Unlikely	HNS (forest)	IBAT
Aythya baeri	เป็ดดำหัวดำ (Baer's pochard)	EN	NT	Aquatic	Not present	OoR	Nat.
Cairina scutulata	เป็ดก่า (White-winged duck)	CR	NT	Aquatic	Unlikely	HNS (forest)	Nat.
Sarkidiornis melanotos	เป็ดหงษ์ (Knob-billed duck)	CR	VU	Aquatic	Unlikely	OoR	Nat.
Esacus recurvirostris	นกกระแตผีใหญ่ (Great thick-knee)	CR	VU	Aquatic	Not present	OoR	Nat.

Species	Thai Name (English Name)	Red List Status		Habitat	Likelihood of Occurrence (LoO)	Reason for low LoO	Source
		National	IUCN				
Esacus neglectus	นกกระแตผีชายหาด (Beach Thick-knee)	CR	NT	Aquatic	Unlikely	OoR	Nat.
Charadrius peronii	นกหัวโตมลายู (Malaysian plover)	EN	NT	Coastal	Possible	Sandy beaches	Nat.
Anous stolidus	นกน็อดดี (Brown noddy)	CR	LC	Marine	Unlikely	Vagrant to Thailand	Nat.
Sterna acuticauda	นกนางนวลแกลบท้องดำ (Black-bellied tern)	CR	VU	Terrestrial	Not present	OoR	Nat.
Sterna aurantia	นกนางนวลแกลบแม่น้ำ (River tern)	CR	VU	Terrestrial	Not present	OoR	Nat.
Sterna bernsteini	นกนางนวลแกลบจีน (Chinese crested tern)	CR	LC	Coastal	Unlikely	Vagrant & little known	Nat.
Sterna dougallii	นกนางนวลแกลบ (Roseate tern)	EN	LC	Marine	Possible	Breeds on rocky islands	Nat.
Calidris pygmaea	นกชายเลนปากช้อน (Spoon-bill Sandpiper)	EN	CR	Marine	Not present	OoR	Both
Calidris tenuirostris	(Great Knot)	-	EN	Marine	Unlikely	Non-breeding migrant to intertidal mudflats	IBAT
Tringa guttifer	นกทะเลขาเขียวลายจุด (Spotted Greenshank)	EN	EN	Aquatic	Unlikely	Avoids marine habitats when overwintering	Both
Ciconia episcopus	นกกระสาคอขาว (Asian Woolly-necked stork)	CR	NT	Terrestrial	Unlikely	"Nearly of fully extirpated in Thailand"	Nat.
Ciconia stormi	นกกระสาคอขาวปากแดง (Storm's stork)	CR	EN	Aquatic	Unlikely	HNS (undisturbed habitat)	Nat.
Ephippiorhynchus asiaticus	นกกระสาคอดำ (Black-necked stork)	CR	NT	Aquatic	Not present	OoR	Nat.
Leptoptilos dubius	นกตะกราม (Greater adjutant)	CR	VU	Aquatic	Not present	OoR	Nat.
Leptoptilos javanicus	นกตะกรุม (Lesser adjutant)	CR	VU	Aquatic	Possible	Likes mangrove habitats	Nat.
Mycteria cinerea	นกกระสาปากเหลือง (Mikly Stork)	CR	EN	Aquatic	Not present	OoR	Nat.
Arborophila cambodiana	นกกระทาดงจันทบูรณ์ (Cambodia hill partridge)	EN	CR	Terrestrial	Not present	HNS	Nat.
Arborophila charltonii	นกกระทาดงปักษ์ใต้ (Chestnut-necklaced partridge)	CR	LC	Terrestrial	Not present	HNS	Nat.
Caloperdix oculea	นกกระทาสองเดือย (Malay partridge)	EN	VU	Terrestrial	Not present	HNS	Nat.
Lophura ignita	ไก่ฟ้าหน้าเขียว (Bornean fireback)	CR	LC	Terrestrial	Not present	HNS (forest)	Nat.
Pavo muticus	นกยูงไทย (Green Peafowl)	EN	EN	Terrestrial	Not present	HNS (terrestrial)	Both
Polyplectron inopinatum	นกแว่นภูเขา (Malayan peacock-pheasant)	EN	VU	Terrestrial	Not present	HNS	Nat.
Polyplectron malacense	นกแว่นสีน้ำตาล (Malayan pheasant)	CR	EN	Terrestrial	Not present	HNS	Nat.
Rhizothera longirostris	ไก่นวล (Long-billed partridge)	CR	NT	Terrestrial	Not present	HNS	Nat.
Rollulus rouloul	ไก่จุก (Crested partridge)	EN	VU	Terrestrial	Not present	HNS	Nat.
Syrmaticus humiae	ไก่ฟ้าหางลายขวาง (Hume's pheasant)	CR	VU	Terrestrial	Not present	HNS	Nat.

Species	Thai Name (English Name)	Red List Status		Habitat	Likelihood of Occurrence (LoO)	Reason for low LoO	Source
		National	IUCN				
Grus antigone	นกกระเรียน (Sarus crane)	EW	VU	Terrestrial	Not present	OoR	Nat.
Heliopais personata	นกฟินฟุต (Masked finfoot)	CR	CR	Aquatic	Possible	Likes mangrove habitats	Nat.
Porzana bicolor	นกอัญชันหางดำ (Black-banded crake)	EN	NT	Terrestrial	Not present	OoR	Nat.
Ardea sumatrana	นกกระสาใหญ่ (Great-billed heron)	CR	LC	Aquatic	Not present	Likely extirpated in Gulf of Thailand	Nat.
Egretta eulophotes	นกยางจีน (Chinese egret)	EN	VU	Coastal	Not present	OoR	Nat.
Pelecanus philippensis	นกกระทุง (Spot-billed pelican)	EN	NT	Aquatic	Not present	OoR	Nat.
Platalea minor	นกปากช้อนหน้าดำ (Black-faced Spoonbill)	EN	EN	Marine	Not present	OoR	Both
Pseudibis davisoni	นกช้อนหอยดำ (White-shouldered ibis)	EW	CR	Aquatic	Not present	OoR	Nat.
Threskiornis melanocephalus	นกช้อนหอยขาว (Black-headed ibis)	EN	NT	Aquatic	Unlikely	Uncommon winter visitor to Thailand	Nat.
Anhinga melanogaster	นกอ้ายงั่ว (Oriental darter)	EN	NT	Aquatic	Not present	HNS	Nat.
Fregata andrewsi	นกโจรสลัดเกาะคริสต์มาส (Christmas Island frigatebird)	CR	VU	Marine	Possible	Non-breeding migrant	Nat.
Phalacrocorax carbo	นกกาน้ำใหญ่ (Great cormorant)	EN	LC	Aquatic	Not present	HNS	Nat.
Sula leucogaster	นกบูบีสีน้ำตาล (Brown booby)	CR	LC	Marine	Unlikely	Vagrant visitor	Nat.
Birds (Perching and Song birds)							
Aceros comatus	นกเงือกหัวหงอก (Rufous-necked hornbill)	EN	VU	Terrestrial	Not present	HNS (terrestrial)	Nat.
Aceros corrugatus	นกเงือกปากย่น (Wrinkled hornbill)	CR	NT	Terrestrial	Not present	HNS (terrestrial)	Nat.
Aceros nipalensis	นกเงือกคอแดง (Rusty-cheeked hornbill)	EN	VU	Terrestrial	Not present	HNS (terrestrial)	Nat.
Aceros subruficollis	นกเงือกกรามช้าง (Plain-pouched hornbill)	EN	VU	Terrestrial	Not present	HNS (terrestrial)	Nat.
Anthracoceros malayanus	นกเงือกดำ (Black hornbill)	CR	VU	Terrestrial	Not present	HNS (terrestrial)	Nat.
Berenicornis comatus	(White-crowned Hornbill)	-	EN	Terrestrial	Not present	HNS (terrestrial)	IBAT
Buceros rhinoceros	นกเงือกหัวแรด (Rhinoceros hornbill)	EN	VU	Terrestrial	Not present	HNS (terrestrial)	Nat.
Rhinoplax vigil	นกชนหิน (Helmeted Hornbill)	EN	CR	Terrestrial	Not present	HNS (terrestrial)	Both
Batrachostomus auritus	นกปากกบยักษ์ (Large frogmouth)	CR	LC	Terrestrial	Not present	HNS	Nat.
Batrachostomus stellatus	นกปากกบปักษ์ใต้ (Gould's frogmouth)	EN	NT	Terrestrial	Not present	OoR	Nat.
Ptilinopus jambu	นกเปล้าหน้าแดง (Jambu fruit dove)	EN	VU	Terrestrial	Not present	HNS	Nat.
Treron capellei	นกเปล้าใหญ่ (Large green pigeon)	EN	VU	Terrestrial	Not present	HNS	Nat.
Treron fulvicollis	นกเปล้าแดง (Cinnamon green pigeon)	CR	VU	Terrestrial	Not present	HNS	Nat.
Treron olax	นกเปล้าเล็กหัวเทา (Pink-necked pigeon)	EN	LC	Terrestrial	Not present	HNS	Nat.

Species	Thai Name (English Name)	Red List Status		Habitat	Likelihood of Occurrence (LoO)	Reason for low LoO	Source
		National	IUCN				
Alcedo hercules	นกกะเต็นเฮอคิวลิส (Blyth's kingfisher)	CR	NT	Aquatic	Not present	OoR	Nat.
Megaceryle lugubris	นกกะเต็นขาวดำใหญ่ (Crested kingfisher)	EN	LC	Aquatic	Not present	OoR	Nat.
Centropus rectunguis	นกกะปูดนิ้วสั้น (Crested cuckoo)	EN	NT	Terrestrial	Not present	HNS	Nat.
Acrocephalus tangorum	นกพงนาพันธุ์แมนจูเรีย (Man. reed warbler)	EN	LC	Terrestrial	Not present	OoR	Nat.
Alcippe rufogularis	นกมุ่นรกคอแดง (Rufous-throated fulvetta)	EN	NT	Terrestrial	Not present	OoR	Nat.
Chloropsis sonnerati	(Greater Green Leafbird)	-	EN	Terrestrial	Not present	HNS (terrestrial)	IBAT
Cinclus pallasii	นกมุดน้ำ (Brown dipper)	EN	LC	Aquatic	Not present	OoR	Nat.
Cissa hypoleuca	นกสาริกาเขียวหางสั้น (Green-Magpie)	EN	LC	Terrestrial	Not present	OoR	Nat.
Prionochilus thoracicus	นกกาฝากอกแดง (Chestnut-br. malkoha)	EN	NT	Terrestrial	Not present	HNS	Nat.
Pseudochelidon sirintarae	นกเจ้าฟ้าหญิงสิรินธร (River martin)	CR	CR	Aquatic	Not present	OoR	Nat.
Cutia nipalensis	นกขัตียา (Himalayan cutia)	EN	LC	Terrestrial	Not present	OoR	Nat.
Garrulax milnei	นกกะรางหางแดง (Chestnut laughingthrush)	EN	NT	Terrestrial	Not present	HNS	Nat.
Muscicapa muttui	นกจับแมลงอกสีน้ำตาล (Brown-br. flycatcher)	EN	LC	Terrestrial	Not present	HNS	Nat.
Saxicola jerdoni	นกยอดหญ้าหลังดำ (Jerdon's bushchat)	EN	EN	Terrestrial	Not present	HNS	Nat.
Trichixos pyrropyga	นกกางเขนดงหางแดง (Chestnut-cap. thrush)	EN	EN	Terrestrial	Not present	HNS	Nat.
Aethopyga temminckii	นกกินปลีแดง (Temminck's sunbird)	EN	LC	Terrestrial	Not present	HNS	Nat.
Kenopia striata	นกจู๋เต้นลาย (Burmese yuhina)	CR	EN	Terrestrial	Not present	OoR	Nat.
Malacocincla sepiarium	นกกินแมลงปากหนา (Brown fulvetta)	EN	NT	Terrestrial	Not present	HNS	Nat.
Malacopteron affine	นกกินแมลงหัวสีคล้ำ (Sooty-capped babbler)	EN	NT	Terrestrial	Not present	HNS (forest)	Nat.
Napothera crispifrons	นกจู๋เต้นเขาปูน (Bornean wren-babbler)	EN	VU	Terrestrial	Not present	HNS	Nat.
Napothera macrodactyla	นกจู๋เต้นตีนใหญ่ (Long-billed wren-babbler)	EN	NT	Terrestrial	Not present	HNS	Nat.
Hydrornis gurneyi	(Gurney's Pitta)	-	CR	Terrestrial	Not present	HNS	IBAT
Pitta caerulea	นกแต้วแล้วยักษ์ (Giant pitta)	EN	NT	Terrestrial	Not present	HNS	Nat.
Pitta ellioti	นกแต้วแล้วเขียวเขมร (Blue-rumped pitta)	CR	LC	Terrestrial	Not present	HNS	Nat.
Pitta granatina	นกแต้วแล้วแดงมลายู (Garnet pitta)	EN	NT	Terrestrial	Not present	HNS	Nat.
Pitta gurneyi	นกแต้วแล้วท้องดำ (Gurney's pitta)	CR	EN	Terrestrial	Not present	HNS	Nat.
Pitta soror	นกแต้วแล้วใหญ่ (Blue-naped pitta)	EN	EN	Terrestrial	Not present	HNS	Nat.
Pycnonotus melanoleucos	นกปรอดดำปีกขาว (Streak-eared bulbul)	CR	NT	Terrestrial	Not present	HNS	Nat.
Pycnonotus zeylanicus	นกปรอดแม่ทะ (Straw-headed bulbul)	CR	NT	Terrestrial	Not present	HNS	Nat.
Abroscopus albogularis	นกกระจ้อยคอดำ (Rufous-faced warbler)	EN	LC	Terrestrial	Not present	OoR	Nat.
Tesia cyaniventer	นกจุนจู๋ท้องเทา (Gray-bellied tesia)	EN	NT	Terrestrial	Not present	OoR	Nat.

Species	Thai Name (English Name)	Red List Status		Habitat	Likelihood of Occurrence (LoO)	Reason for low LoO	Source
		National	IUCN				
Sitta formosa	นกไต่ไม้สีสวย (Beautiful nuthatch)	CR	EN	Terrestrial	Not present	HNS	Nat.
Sitta magna	นกไต่ไม้ใหญ่ (Blue nuthatch)	EN	EN	Terrestrial	Not present	HNS	Nat.
Stachyris leucotis	นกกินแมลงหูขาว (Silver-eared mesia)	EN	NT	Terrestrial	Not present	HNS (forest)	Nat.
Cochoa purpurea	นกปีกแพรสีม่วง (Purple cochoa)	EN	LC	Terrestrial	Not present	OoR	Nat.
Zoothera interpres	นกเดินดงหัวน้ำตาลแดง (Chestnut-backed thrush)	EN	EN	Terrestrial	Not present	OoR	Nat.
Indicator archipelagicus	นกพรานผึ้ง (Sunda woodpecker)	EN	NT	Terrestrial	Not present	HNS	Nat.
Megalaima rafflesii	นกโพระดกหลากสี (Red-crowned barbet)	EN	LC	Terrestrial	Not present	HNS	Nat.
Dendrocopos mahrattensis	นกหัวขวานด่าง (Yellow-crowned woodpecker)	CR	NT	Terrestrial	Not present	HNS	Nat.
Dinopium rafflesii	นกหัวขวานสามนิ้ว (Olive-backed woodpecker)	EN	VU	Terrestrial	Not present	HNS	Nat.
Gecinulus grantia	นกหัวขวานหัวเหลือง (Pale-headed Woodpecker)	CR	CR	Terrestrial	Not present	OoR	Nat.
Picus xanthopygaeus	นกหัวขวานเขียวท้องลาย (Streak-throated woodpecker)	EN	LC	Terrestrial	Not present	HNS	Nat.
Psittacula eupatria	นกแก้วโม่ง (Alexandrine parakeet)	EN	NT	Terrestrial	Not present	HNS	Nat.
Psittinus cyanurus	นกหกใหญ่ (Blue-rumped parrot)	EN	NT	Terrestrial	Not present	HNS	Nat.
Bubo coromandus	นกเค้าใหญ่สีคล้ำ (Dusky eagle-owl)	CR	LC	Terrestrial	Not present	HNS	Nat.
Otus rufescens	นกเค้าแดง (Reddish scops owl)	EN	VU	Terrestrial	Not present	HNS	Nat.
Otus sagittatus	นกเค้าหน้าผากขาว (White-fronted scops owl)	EN	VU	Terrestrial	Not present	HNS	Nat.
Harpactes kasumba	นกขุนแผนท้ายทอยแดง (Red-headed trogon)	EN	NT	Terrestrial	Not present	HNS	Nat.
Harpactes orrhophaeus	นกขุนแผนตะโพก (Orange-breasted trogon)	EN	NT	Terrestrial	Not present	HNS	Nat.
Reptiles							
Crocodylus porosus	จระเข้น้ำเค็ม (Saltwater crocodile)	CR	LC	Aquatic	Not present	OoR	Nat.
Crocodylus siamensis	จระเข้น้ำจืด (Siamese crocodile)	CR	CR	Aquatic	Not present	OoR	Nat.
Tomistoma schlegelii	ตะโขง (False gharial)	EW	VU	Aquatic	Not present	OoR	Nat.
Physignathus cocincinus	ตะกอง, ลั้ง (Green water dragon)	EN	VU	Terrestrial	Not present	OoR	Nat.
Boiga saengsomi	(Banded Green Cat Snake)	-	EN	Terrestrial	Not present	HNS	IBAT

Species	Thai Name (English Name)	Red List Status		Habitat	Likelihood of Occurrence (LoO)	Reason for low LoO	Source
		National	IUCN				
Chelonia mydas	เต่าตนุ (Green sea turtle)	CR	EN	Marine	Present	Nesting on Koh Lanta Island	Nat.
Eretmochelys imbricata	เต่ากระ (Hawksbill Turtle)	CR	CR	Marine	Possible	Nests on the north-east Thailand coast	Both
Lepidochelys olivacea	เต่าหญ้า (Olive ridley sea turtle)	CR	VU	Marine	Possible	Nests on the west side of Thailand Peninsula	Nat.
Dermochelys coriacea	เต่ามะเฟือง (Leatherback sea turtle)	CR	VU	Marine	Present	Nesting on Koh Lanta Island	Nat.
Batagur baska	เต่ากะอาน (Northern river terrapin)	CR	CR	Aquatic	Not present	Regionally extinct	Nat.
Cuora amboinensis	เต่าหับ (Southeast Asian Box Turtle)	VU	EN	Aquatic	Not present	HNS	IBAT
Heosemys grandis	เต่าหวาย (Giant Asian Pond Turtle)	VU	CR	Aquatic	Not present	HNS (inland wetlands)	IBAT
Heosemys spinosa	เต่าจักร (Spiny Turtle)	VU	EN	Aquatic	Not present	HNS (inland wetlands)	IBAT
Siebenrockiella crassicollis	เต่าดำ (Black Marsh Turtle)	VU	EN	Aquatic	Not present	HNS (inland wetlands)	IBAT
Platysternon megacephalum	เต่าปูลู (Big-headed turtle)	EN	EN	Aquatic	Not present	OoR	Nat.
Indotestudo elongata	เต่าเหลือง (Elongated Tortoise)	EN	CR	Terrestrial	Not present	HNS (forest)	Both
Manouria emys	เต่าหกเหลือง (Asian Giant Tortoise)	EN	CR	Terrestrial	Not present	HNS (forest)	Both
Manouria impressa	เต่าเดือย (Impressed tortoise)	EN	VU	Terrestrial	Not present	OoR	Nat.
Chitra chitra	ตะพาบม่านลาย (Asian narrow-headed softshell turtle)	CR	CR	Aquatic	Not present	Freshwater rivers	Nat.
Chitra vandijki	ตะพาบม่านลายพม่า (Southern river terrapin)	CR	CR	Aquatic	Not present	OoR	Nat.
Pelochelys cantorii	ตะพาบหัวกบ (Asian Giant Softshell Turtle)	CR	CR	Aquatic	Not present	HNS	Both
Callagur borneoensis	เต่าลายดีนเปิด (Painted terrapin)	CR	CR	Aquatic	Not present	Forest	Nat.
Fish							
Datnioides undecimradiatus	เสือตอลายเล็ก (Gold tigerfish)	EN	VU	Aquatic	Not present	HNS (river fish)	Nat.
Betta simplex	กัดกระบี่ (Krabi Mouth Brooding Betta)	CR	CR	Aquatic	Not present	HNS (small pools)	Both
Calostoma insigne	-	-	EN	Terrestrial	Not present	HNS (forest)	IBAT
Carcharhinus amblyrhynchos	ฉลามครีบดำใหญ่ (Grey Reef Shark)	VU	EN	Marine	Unlikely	Patchy distribution inside continental shelf	IBAT
Carcharhinus longimanus	(Oceanic Whitetip Shark)	-	CR	Marine	Not present	HNS (offshore sp.)	IBAT
Carcharhinus plumbeus	ฉลามกระโดงสูง (Sandbar Shark)	VU	EN	Marine	Possible	Near global distribution	IBAT
Galeocerdo cuvier	ฉลามเสือ, ตะเพียนทอง (Tiger shark)	EN	NT	Marine	Possible	Wide near-coastal distrib.	Nat.
Lamiopsis temminckii	(Broadfin Shark)	-	EN	Marine	Unlikely	Project marginal to distrib.	IBAT

Species	Thai Name (English Name)	Red List Status		Habitat	Likelihood of Occurrence (LoO)	Reason for low LoO	Source
		National	IUCN				
Negaprion acutidens	ฉลามทราย (Sharptooth Lemon Shark)	VU	EN	Marine	Possible	Vicinity of mangroves	IBAT
Epalzeorhynchos bicolor	ทรงเครื่อง, ฉลามหางแดง (Red-tailed shark)	CR	CR	Marine	Not present	OoR	Nat.
Eusphyra blochii	(Winghead Shark)	-	EN	Marine	Possible	Wide near-coastal distrib.	IBAT
Eusphyrna blochi	ฉลามหัวค้อนยาว (Carolina hammerhead)	EN	-	Marine	Unknown	Distribution not available	Nat.
Sphyrna lewini	ฉลามหัวค้อน (Scalloped hammerhead)	EN	CR	Marine	Possible	Wide near-coastal distrib.	Both
Sphyrna mokarran	ฉลามหัวค้อนยักษ์ (Great hammerhead)	EN	CR	Marine	Not present	OoR	Nat.
Tenualosa macrura	ตะลุมพุก (Longtail shad)	EN	NT	Marine	Not present	OoR	Nat.
Tenualosa thibaudeaui	หมากผาง (Vietnamese herring)	EN	VU	Aquatic	Not present	OoR	Nat.
Tenualosa toil	ตะลุมพุก (Toil herring)	EN	-	Marine	Unknown	Distribution not available	Nat.
Botia rostrata	หมูฮ่องเต้ (Banded loach)	EN	VU	Aquatic	Not present	OoR	Nat.
Yasuhikotakia nigrolineata	หมูน่าน (Blacklined loach)	EN	VU	Aquatic	Not present	OoR	Nat.
Yasuhikotakia sidthimunki	หมูอารีย์ (Dwarf chain loach)	CR	EN	Aquatic	Not present	OoR	Nat.
Aaptosyax grypus	สะนากยักษ์ (Mekong Giant Salmon Carp)	CR	CR	Aquatic	Not present	OoR	Nat.
Albulichthys albuloides	ตะโกกหน้าสั้น (Longfin bonefish)	EN	LC	Marine	Not present	OoR	Nat.
Catlocarpio siamensis	กระโห้ (Giant carp)	EN	CR	Aquatic	Not present	OoR	Nat.
Osteochilus schlegeli	บัว (Siamese giant carp)	CR	DD	Aquatic	Unlikely	HNS (floodplains)	Nat.
Probarbus labeamajor	เอินคางมุม (Giant barb)	EN	EN	Aquatic	Not present	OoR	Nat.
Probarbus labeaminor	เอินฝ้าย (Siamese giant carp)	EN	NT	Aquatic	Not present	OoR	Nat.
Laubuca mouhoti	ท้องพลุ (Spotted barb)	CR	-	Aquatic	Not present	OoR	Nat.
Trigonostigma somphongsi	ชิวสมพงษ์ (Somphongsi rasbora)	CR	CR	Aquatic	Not present	OoR	Nat.
Nemacheilus trogocataractus	ค้อตาบอด, ค้อถ้ำ (Crocodile loach)	CR	-	Aquatic	Not present	OoR	Nat.
Schistura jaruthanini	ค้อจารุธาณินทร์ (Jaruthanin's loach)	CR	-	Aquatic	Not present	HNS (caves)	Nat.
Macrochirichthys macrochirus	ตาบลาว, ฝักพร้า (Giant mudskipper)	EN	LC	Aquatic	Not present	HNS (inland wetlands)	Nat.
Cheilinus undulatus	นกขุนทองหัวโหนก, (Humphead wrasse)	EN	EN	Marine	Unknown	Unknown distribution	Nat.
Bolbometopon muricatum	นกแก้วหัวค้อน (Humphead wrasse)	EN	VU	Marine	Possible	Wide near-coastal distrib.	Nat.
Rhinogobius chiangmaiensis	บู่น้ำตกเชียงใหม่ (Chiang Mai goby)	EN	-	Aquatic	Not present	HNS (hill streams)	Nat.
Alopias pelagicus	(Pelagic Thresher)	-	EN	Marine	Not present	HNS (offshore sp)	IBAT
Isurus oxyrinchus	(Shortfin Mako)	-	EN	Marine	Not present	HNS (offshore sp)	IBAT
Isurus paucus	(Longfin Mako)	-	EN	Marine	Not present	HNS (offshore sp)	IBAT

Species	Thai Name (English Name)	Red List Status		Habitat	Likelihood of Occurrence (LoO)	Reason for low LoO	Source
		National	IUCN				
Carcharias taurus	(Sand Tiger Shark)	-	CR	Marine	Not present	HNS (offshore sp)	IBAT
Fluvitrygon signifer	(White-edge Whipray)	-	EN	Aquatic	Not present	HNS	IBAT
Himantura chaophraya	กระเบนราหู, (Giant freshwater stingray)	EN	CR	Aquatic	Not present	OoR	Nat.
Himantura uarnak	กระเบนลายแมลงวัน (Coach Whipray)	VU	EN	Marine	Possible	Wide near-coastal distrib.	IBAT
Himantura undulata	(Honeycomb Whipray)	-	EN	Marine	Possible	Wide near-coastal distrib.	IBAT
Maculabatis gerrardi	(Whitespotted Whipray)	-	EN	Marine	Possible	Wide near-coastal distrib.	IBAT
Maculabatis pastinacoides	(Round Whipray)	-	EN	Marine	Possible	Wide near-coastal distrib.	IBAT
Pateobatis bleekeri	(Bleeker's Whipray)	-	EN	Marine	Possible	Wide near-coastal distrib.	IBAT
Pateobatis uarnacoides	(Whitenose Whipray)	-	EN	Marine	Possible	Wide near-coastal distrib.	IBAT
Gymnura zonura	(Zonetail Butterfly Ray)	-	EN	Marine	Possible	Wide near-coastal distrib.	IBAT
Mobula birostris	(Oceanic Manta Ray)	-	EN	Marine	Possible	Wide distribution	IBAT
Mobula kuhlii	(Shorthorned Pygmy Devil Ray)	-	EN	Marine	Possible	Wide near-coastal distrib.	IBAT
Mobula mobular	(Spinetail Devil Ray)	-	EN	Marine	Not present	HNS (offshore sp)	IBAT
Mobula tarapacana	(Sicklefin Devil Ray)	-	EN	Marine	Unlikely	Wide distribution but unlikely near AoA	IBAT
Mobula thurstoni	กระเบนราหู (Bentfin Devil Ray)	VU	EN	Marine	Unlikely	Wide distribution but unlikely near AoA	IBAT
Aetomylaeus maculatus	กระเบนนกจุดขาว (Mottled Eagle Ray)	DD	EN	Marine	Possible	Wide near-coastal distrib.	IBAT
Rhinoptera javanica	กระเบนจมูกวัว, ยี่สน (Java Cownose Ray)	DD	EN	Marine	Possible	Wide near-coastal distrib.	IBAT
Rhinoptera jayakari	(Oman Cownose Ray)	-	EN	Marine	Possible	Wide near-coastal distrib.	IBAT
Chiloscyllium hasselti	(Indonesian Bambooshark)	-	EN	Marine	Possible	Wide near-coastal distrib.	IBAT
Rhincodon typus	ฉลามวาฬ, ทงกานต์ (Whale Shark)	VU	EN	Marine	Unlikely	Widespread pelagic sp.	IBAT
Stegostoma tigrinum	(Zebra Shark)	-	EN	Marine	Possible	Wide near-coastal distrib.	IBAT
Chitala blanci	ตองลาย (Giant featherback)	EX	NT	Aquatic	Not present	EX	Nat.
Chitala lopis	สะตือ (Black sharkminnow)	EN	EX	Aquatic	Not present	Extinct	Nat.
Cromileptes altivelis	กะรังหน้างอน (Humpback grouper)	EN	EN	Marine	Unknown	Distribution not available	Nat.
Glaucostegus obtusus	(Widenose Guitarfish)	-	CR	Marine	Possible	Wide near-coastal distrib.	IBAT
Glaucostegus thouin	(Clubnose Guitarfish)	-	CR	Marine	Possible	Wide near-coastal distrib.	IBAT
Glaucostegus typus	(Giant Guitarfish)	-	CR	Marine	Possible	Wide near-coastal distrib.	IBAT
Rhinobatos granulatus	โรนัน,อีมุด (Sharpnose guitarfish)	EN	CR	Marine	Not present	OoR	Nat.
Rhinobatos schlegelii	โรนันหัวใส (Brown guitarfish)	EN	CR	Marine	Not present	OoR	Nat.
Rhinobatos thouini	อีมด, อีมุด, โรนัน (Longheaded guitarfish)	EN	-	Marine	Unknown	Distribution not available	Nat.

Species	Thai Name (English Name)	Red List Status		Habitat	Likelihood of Occurrence (LoO)	Reason for low LoO	Source
		National	IUCN				
Rhinobatos typus	โรนันยักษ์ (Bowmouth (Giant) guitarfish)	EN	CR	Marine	Possible	Wide near-coastal distrib.	Nat.
Anoxypristis cuspidata	ฉนากจะงอยแคบ (Narrow Sawfish)	CR	EN	Marine	Unlikely	Wide near-coastal distrib., uncertain near AoA	Both
Pristis microdon (pristis)	ฉนากยักษ์ (Largetooth sawfish)	CR	CR	Marine	Not present	Possibly extinct in AoA	Nat.
Pristis zijsron	ฉนากเขียว (Green Sawfish)	CR	CR	Marine	Not present	Possibly extinct in AoA	Both
Rhina ancylostoma	โรนิน, กระเบนท้องน้ำ (Bowmouth Guitarfish)	CR	CR	Marine	Possible	Wide near-coastal distrib.	Both
Rhynchobatus australiae	(Bottlenose Wedgefish)	-	CR	Marine	Possible	Wide near-coastal distrib.	IBAT
Rhynchobatus springeri	(Broadnose Wedgefish)	-	CR	Marine	Possible	Patchy localised distribution	IBAT
Acrochordonichthys gyrinus	ขยุยยักษ์พรหมพิราม (T-barb)	EN	DD	Aquatic	Not present	OoR	Nat.
Acrochordonichthys septemtrionalis	ขยุยยักษ์แม่กลอง (Snow-tiger catfish)	EN	-	Aquatic	Not present	HNS (hill streams)	Nat.
Hemiarias verrucosus	กดหัวผาน (Verrucose pipefish)	EN	-	Marine	Unknown	Distribution not available	Nat.
Rita sacerdotum	กดหมูยักษ์ (Redtail catfish)	EN	LC	Aquatic	Not present	OoR	Nat.
Pangasius sanitwongsei	เทพา (Chao Phraya giant catfish)	EN	CR	Aquatic	Not present	OoR	Nat.
Ceratoglanis pachynema	เกด (Rhino catfish)	CR	CR	Aquatic	Not present	OoR	Nat.
Kryptopterus dissitus	ปึกไก่หนวดยาว (False glass catfish)	EN	DD	Aquatic	Not present	OoR	Nat.
Kryptopterus heperius	ปึกไก่หนวดยาว (Humped glass catfish)	EN	-	Aquatic	Not present	OoR	Nat.
Kryptopterus limpok	ปึกไก่หนวดยาว (Malaysian glass catfish)	EN	LC	Aquatic	Not present	OoR	Nat.
Ompok eugeneiatus	หนวดแมว (Tawny redtail catfish)	EN	LC	Aquatic	Not present	OoR	Nat.
Ompok pinnatus	หนวดแมว (Paddyfield catfish)	EN	DD	Aquatic	Not present	OoR	Nat.
Exostoma labiatum	ติดหิน (Vietnamese brook lamprey)	EN	LC	Aquatic	Not present	HNS (fast-flowing water)	Nat.
Oreoglanis siamensis	ติดหิน, ค้างคาว (Hillstream catfish)	EN	EN	Aquatic	Not present	OoR	Nat.
Pseudoecheineus sulcatus	ติดหินแผ่นท้องหนา (Giant tiger perch)	EN	-	Aquatic	Not present	OoR	Nat.
Pterocryptis buccata	ชะโอนถ้ำ (Crested loach)	EN	DD	Aquatic	Not present	OoR	Nat.
Monotrete baileyi	ปักเป้าขน (Hairy puffer)	EN	LC	Aquatic	Not present	OoR	Nat.
Plants							
Pseuduvaria gardneri	-	-	CR	Terrestrial	Not present	HNS	IBAT
Terniopsis chanthaburiensis	-	-	EN	Aquatic	Not present	HNS (fast-flowing water)	IBAT
Terniopsis ubonensis	-	-	CR	Aquatic	Not present	HNS (fast-flowing water)	IBAT
Anisoptera costata	-	-	EN	Terrestrial	Not present	HNS (large forest tree)	IBAT
Dipterocarpus dyeri	-	-	EN	Terrestrial	Not present	HNS (large forest tree)	IBAT
Dipterocarpus grandiflorus	-	-	EN	Terrestrial	Not present	HNS (large forest tree)	IBAT

Species	Thai Name (English Name)	Red List Status		Habitat	Likelihood of Occurrence (LoO)	Reason for low LoO	Source
		National	IUCN				
Dipterocarpus kerrii	-	-	EN	Terrestrial	Not present	HNS (large forest tree)	IBAT
Hopea ferrea	-	-	EN	Terrestrial	Not present	HNS (large forest tree)	IBAT
Hopea helferi	-	-	EN	Terrestrial	Not present	HNS (large forest tree)	IBAT
Shorea farinosa	-	-	EN	Terrestrial	Not present	HNS	IBAT
Shorea gratissima	(White Meranti)	-	EN	Terrestrial	Unlikely	HNS (freshwater habitats)	IBAT
Shorea hypochra	(White Meranti)	-	EN	Terrestrial	Not present	HNS (large forest tree)	IBAT
Heritiera fomes	(Mangrove tree sp.)	-	EN	Marine	Possible	Wide coastal distribution	IBAT
Sonneratia griffithii	Cannon Ball Mangrove tree	-	EN	Marine	Present	Wide coastal distribution	IBAT

Explanation of acronyms:

- Data sources of threatened status: National - Thailand Red Data Book 2005 (national status); IUCN - International Union for the Conservation of Nature (global status)
- Threatened status categories: CR - Critically Endangered; EN - Endangered; VU - Vulnerable; NT - Near Threatened; LC - Least Concern; DD - Data Deficient.
- LoO - Likelihood of Occurrence. Reasons for low LoO categories: OoR - Out of Range of AoA; HNS - Habitat Not Suitable
- Data Sources: IBAT - Integrated Biodiversity Assessment Tool (IUCN global status); Nat. - Listed in Thailand Red Data Book (2005); Both - IBAT and Thailand Red Data Book

Table 4 Range Restricted Species from IBAT with analysis of their Likelihood of Occurrence

Species	Thai Name (English Name)	Red List Status		Habitat	Likelihood of Occurrence (LoO)	Reason for low LoO	Source
		National	IUCN				
Hydrornis gurneyi	(Gurney's Pitta – bird)	-	CR	Terrestrial	Not present	HNS (forest)	IBAT
Platalea minor	นกปากช้อนหน้าดำ (Black-faced Spoonbill)	EN	EN	Marine	Not present	OoR	IBAT
Fregata andrewsi	นกโจรสลัดเกาะคริสต์มาส (Christmas Island Frigatebird)	CR	VU	Marine	Unlikely	Non-breeding migrant	IBAT
Boiga saengsomi	(Banded Green Cat Snake)	-	EN	Terrestrial	Not present	HNS (forest)	IBAT
Lycodon butleri	(Butler's Wolf Snake)	DD	LC	Terrestrial	Not present	HNS (forest)	IBAT
Cnemaspis chanardi	(Chan-ard's Rock Gecko)	-	LC	Terrestrial	Not present	HNS (rocky forest)	IBAT
Ellopostoma mystax	ค้อหน้าหัก (Pla Kor Nah-hug – fish)	CR	EN	Aquatic	Unlikely	HNS (flowing conditions)	IBAT
Mugilogobius fasciatus	(Black-banded Goby - fish species)	-	DD	Marine	Possible	Inhabits mangrove creeks	IBAT
Badis siamensis	(fish sp.)	-	DD	Aquatic	Not present	HNS (inland wetlands)	IBAT
Betta simplex	กัดกระบี่ (Krabi Mouth Brooding Betta - fish)	CR	CR	Aquatic	Not present	HNS (small inland pools)	IBAT
Akysis pulvinatus	(fish sp.)	-	DD	Aquatic	Not present	HNS (inland wetlands)	IBAT
Phricotelphusa limula	(Crab sp.)	-	VU	Aquatic	Not present	HNS (inland wetlands)	IBAT
Salangathelphusa anophrys	(Crab sp.)	-	EN	Aquatic	Not present	HNS (inland wetlands)	IBAT
Terrapotamon palian	(Crab sp.)	-	LC	Aquatic	Not present	HNS (inland wetlands)	IBAT
Rhinocypha pelops	(Dragonfly sp.)	-	NT	Aquatic	Not present	HNS (forest, inland wetlands)	IBAT
Euphaea pahyapi	(Dragonfly sp.)	-	EN	Aquatic	Not present	HNS (inland wetlands)	IBAT
Drepanosticta khaochongensis	(Dragonfly sp.)	-	DD	Aquatic	Not present	HNS (forest, inland wetlands)	IBAT

Explanation of acronyms:

- Data sources of threatened status: National - Thailand Red Data Book 2005 (national status); IUCN - International Union for the Conservation of Nature (global status)
- Threatened status categories: CR - Critically Endangered; EN - Endangered; VU - Vulnerable; NT - Near Threatened; LC - Least Concern; DD - Data Deficient
- LoO - Likelihood of Occurrence. Reasons for low LoO categories: OoR - Out of Range of AoA; HNS - Habitat Not Suitable
- Data Sources: IBAT - Integrated Biodiversity Assessment Tool (IUCN global status); Nat. - Listed in Thailand Red Data Book (2005); Both - IBAT and Thailand Red Data Book

8.2 Steps 3: Assessment of Critical Habitat Status

Table 5 Critical Habitat Determination of Species present and/or possible Likelihood of Occurrence

Species **Threatened Status (National, IUCN)**	**Ecological Assessment and Critical Habitat Determination**
Marine Mammals (9 species)	
Irrawaddy Dolphin (*Orcaella brevirostris*) National status: CR IUCN status: EN	The EIA mentions the occurrence of Irrawaddy Dolphin but there is no data available on their abundance. The IUCN Red List states there is no estimate of population size for Irrawaddy Dolphins from regional surveys. **This species is present, has a CR status and is therefore included as a critical habitat feature** based on item (iii) of the CHA method.
Dugong (*Dugong dugon*) National status: CR IUCN status: VU	The EIA similarly mentions the occurrence of Dugongs. The IUCN Red List states that Thailand supports a genetically distinct subpopulation but there is no estimate of population size. **This species is present, has a CR status and is therefore included as a critical habitat feature** based on item (iii) of the CHA method.
Common Dolphin (*Delphinus capensis*) EN, LC Killer Whale (*Orcinus orca*) EN, DD Pantropical Spotted Dolphin (*Stenella attenuata*) EN, LC Striped Dolphin (*Stenella coeruleoalba*) EN, LC Rough-toothed Dolphin (*Steno bredanensis*) EN, LC Dwarf Sperm Whale (*Kogia simus*) EN, LC Finless Porpoise (*Neophocaena phocaenoides*) EN, VU	The EIA mentions the occurrence of Finless Porpoise and other marine mammals in Thailand waters, but there is no direct evidence of their occurrence in the Project vicinity. Seven species listed here occur in the near-coastal zone but are not included as critical habitat features, although the marine habitat must be considered sensitive and precautionary measures are included in the EIA to avoid impacts.
Terrestrial Mammals (2 species)	
Long-tailed Macaque (*Macaca fascicularis*) National status: None IUCN status: EN	Field surveys and discussions with TTNHA authorities for the EIA revealed the presence of two large groups of these monkeys (up to 300 individuals per group) on both ends of the project route (Appendix B). The Long-tailed Macaque was upgraded on the IUCN Red List to EN in March 2022 due to rapid decline in the global population. The global and national population size are unknown, but the presence of two large groups in the project area suggests **a critical habitat feature may be applicable under Criterion (a).**
Large Flying-fox (*Pteropus vampyrus*) National status: VU IUCN status: EN	This large bat was recorded during baseline surveys for the nearby Songkhla Bridge EIA but is widely distributed across Southeast Asia and the local population is unlikely to be of significant importance. This species is therefore not considered as a critical habitat feature, also the Koh Lanta Bridge is not expected to lead to significant impacts to bats.
Birds (5 species)	
Malaysian Plover (*Charadrius peronii*) EN, NT Roseate Tern (*Sterna dougallii*) EN, LC Lesser Adjutant (*Leptoptilos javanicus*) CR, VU Masked Finfoot (*Heliopais personata*) CR, CR Christmas Island frigatebird (*Fregata andrewsi*) CR, VU	Field surveys of birds were conducted for the ESIA but none of the five species presented here were observed. No birds are therefore included as critical habitat features.
Marine Reptiles (4 species)	
Green Sea Turtle (*Chelonia mydas*) CR, EN Hawksbill Sea Turtle (Eretmochelys imbricata) CR, CR Leatherback Sea Turtle (*Dermochelys coriacea*) CR, VU Olive Ridley Sea Turtle (*Lepidochelys olivacea*) CR, VU	The EIA mentions the occurrence of sea turtles which includes the species listed here. Green and Leatherback Turtles nest on Koh Lanta Island, with an average of 5 nests recorded per year. **These turtles are collectively described as a critical habitat feature for the project** based on their CR status.
Marine Fish (29 species)	
Sandbar Shark (*Carcharhinus plumbeus*) VU, EN Tiger Shark (*Galeocerdo cuvier*) EN, NT	A rich marine environment exists in the greater area and large areas of marine habitat are protected. A wide diversity of fish species has the

Sharptooth Lemon Shark (*Negaprion acutidens*) VU, EN Winghead Shark (*Eusphyra blochii*) None, EN Scalloped Hammerhead (*Sphyrna lewini*) EN, CR Humphead Wrasse (*Cheilinus undulatus*) EN, EN Humphead Wrasse (*Bolbometopon muricatum*) EN, VU Coach Whipray (*Himantura uarnak*) VU, EN Honeycomb Whipray (*Himantura undulata*) None, EN Whitespotted Whipray (*Maculabatis gerrardi*) None, EN Round Whipray (Maculabatis pastinacoides) None, EN Bleeker's Whipray (*Pateobatis bleekeri*) None, EN Whitenose Whipray (*Pateobatis uarnacoides*) None, EN Zonetail Butterfly Ray (*Gymnura zonura*) None, EN Oceanic Manta Ray (*Mobula birostris*) None, EN Shorthorned Pygmy Devil Ray (*Mobula kuhlii*) None, EN Mottled Eagle Ray (*Aetomylaeus maculatus*) DD, EN Javanese Cownose Ray (*Rhinoptera javanica*) DD, EN Oman Cownose Ray (*Rhinoptera jayakari*) None, EN Indonesian Bambooshark (*Chiloscyllium hasselti*) -, EN Zebra Shark (*Stegostoma tigrinum*) None, EN Widenose Guitarfish (*Glaucostegus obtusus*) None, CR Clubnose Guitarfish (*Glaucostegus thouin*) None, CR Giant Guitarfish (*Glaucostegus typus*) None, CR Bowmouth (Giant) Guitarfish (*Rhinobatos typus*) EN, CR Bowmouth Guitarfish (*Rhina ancylostoma*) CR, CR Bottlenose Wedgefish (*Rhynchobatus australiae*) -, CR Broadnose Wedgefish (*Rhynchobatus springeri*) -, CR	potential to occur, however fish studies conducted for the EIA did not record any of the species listed here. No fish are therefore recognized as critical habitat features for the project, but as with marine mammals, the marine habitat must be considered sensitive and measures taken to avoid and minimize significant impacts to the extent possible.
Range Restricted Fish Black-banded Goby (*Mugilogobius fasciatus*) None, DD	
Marine Invertebrates (3 species)	
Golden Sandfish/ Cucumber (*Holothuria lessoni*) -, EN Golden Sandfish/ Cucumber (*Holothuria scabra*) -, EN Pineapple Sea Cucumber (*Thelenota ananas*) None, EN	Similar to fish, a diversity of marine invertebrates is known to occur, but species listed here have not been recorded. These species are therefore not listed as critical habitat features.
Coral species (1 species)	
Coral sp. (*Acropora rudis*) National status: None IUCN status: EN	Coral surveys conducted for the EIA identified corals in the project vicinity of the *Acropora* genus but were not able to confirm the species. Small coral patches occur along the project route but these are not recognized as critical habitat features, although measures will be taken to minimize impacts and safely translocate corals at risk.
Mangrove Trees (2 species)	
Cannon Ball Mangrove tree (*Sonneratia griffithii*) National status: None IUCN status: EN *Heritiera fomes* National status: None IUCN status: EN	*Sonneratia griffithii* was recorded during botanical surveys of the mangrove habitats in the vicinity of the project route. Extensive mangrove habitats occur in the near vicinity and this species is likely to be widespread in the area. A different *Heritiera* species (*H. littoralis*) was identified. These plants have a broad distribution around the northern and eastern edge of the Indian Ocean including the entire West Coast of Thailand (Krabi Province included 34,909 ha of mangrove forest in 2009, DMCR website) and two Ramsar wetlands are recognized for protection of mangrove habitat. Local populations of these mangrove trees are therefore unlikely to be significant relative to the national or global populations, and these species are not considered as critical habitat features. It is noted that the project route has been selected to minimize the impact to mangrove habitats and replanting programs will be implemented to compensate for the limited impact that does occur.

9 APPENDIX B – SPECIES BASELINE DATA

Long-tailed Macaque - *Macaca fascicularis* (Raffles, 1821)

Thai name: ลิง หางยาว, ลิง แสม ling sà-mɛ̌ɛ

Other English names: Crab-eating Macaque; Cynomolgus Monkey (laboratory name)

Taxonomy

KINGDOM:	Animalia
PHYLUM:	Chordata
CLASS:	Mammalia
ORDER:	Primates
FAMILY:	Cercopithecidae
GENUS:	Macaca

Threatened Status: IUCN Red List - Endangered

Thailand Red Book (Vertebrates) - Not assessed.

Threatened Status History (IUCN Red List):

2023 - Endangered (EN); 2022 - Endangered (EN)
2020 - Vulnerable (VU)
2008 - Least Concern (LC)
1996 - Lower Risk/near threatened (LR/NT)

Justification for Endangered Status (extracted from the IUCN Red List): "Reports throughout Southeast Asia indicate a continued and even increased persecution of Long-tailed Macaque throughout large expanses of its current range. Hunting and trapping are increasing, as persecution from human-macaque conflict, for subsistence food, and to fuel both the legitimate and illicit trade for research and other usages. Both price and demand for Long-tailed Macaque as a trade commodity has skyrocketed during the Covid-19 pandemic. The demand for non-human primates in research is threatening the species. As such, the research industry needs to become accountable for the effects of their actions on wild non-human primate populations. There is a general lack of protection of this species across their range and few habitat countries have authoritative population estimates, yet there is widespread removal of these monkeys with the assumption that they are impervious to decline. The species has experienced a decline of 40% from mid 1980s until 2006, and the long-tailed macaque population is suspected to have experienced further decline during the last three generations."

Description: Adult size varies among subspecies from 38 to 55 cm with relatively short arms and legs. Males are larger than females, weighing 5 to 9 kg compared to the 3 to 6 kg of females. The tail is longer than the body, typically 40 to 65 cm and is used for balance. They have backward-directed crown hairs which sometimes form short crests on the midline. The upper parts of the body are dark brown with light

golden-brown tips. The under parts are light grey with a dark grey/brown tail. The skin on their feet and ears is black, whereas the muzzle is a light grayish pink color. The eyelids often have prominent white markings with white spots on the ears. Males have a moustache and cheek whiskers, while females have only cheek whiskers.

Distribution: Long-tailed Macaque are widely distributed across most of mainland of Southeast Asia although not continuously distributed. The species used to occur in Bangladesh, but is now considered extinct there.

Introduced into several countries, including Hong Kong, Taiwan, West Papua, Papua New Guinea, New Britain, New Ireland, New Caledonia, Solomon Islands, Fiji, Tonga, Samoa, Nauru, Vanuatu, Pohnpei, Anggaur Island in Palau, and Mauritius.

Habitat and Ecology: This monkey lives in matrilineal social groups of up to eight individuals. Male members leave the group when they reach puberty. The species is a generalist and opportunistic omnivore that has been documented to use tools to obtain food. They are adapted to living in a wide range of habitats, including forests, coasts, hills, and mountains. They occur most commonly in mangroves and swamp forests, particularly in riverine habitats; however, they are also commonly found in human-altered habitats, which include temples, roadsides, agricultural areas, and rural/urban settlements. It is possible that a significant portion of their population is synanthropic. They have inhabited human environments for millennia and anthropogenic effects are important for their historical natural ecology.

Medical Research: Long-tailed Macaque can share infections with humans due to their close physiology and are used extensively in medical research, particularly for neuroscience and associated diseases. Nafovanny in Vietnam is the World's largest facility for the captive breeding of non-human primates, houses 30,000 macaques although the use of non-human primates in medical research is controversial. In 2014, 21,768 Long-tailed Macaque were imported in the United States to be used in experimentation (U.S. primate import statistics for 2014, cited by Wikipedia). See also Economist article below.

Occurrence in the Koh Lanta Bridge Project Area: Long-tailed Macaque is a protected wild animal according to the Wild Animal Conservation and Protection Act B.E. 2562 but is abundant in the Project area. The Head of the Thung Thale Non-hunting Area (Mr. Suwat Suksiri), estimated in July 2019, there were 250 to 300 Long-tailed Macaque on Koh Klang side and 200 to 300 individuals on the Koh Lanta Noi side. These monkeys are problematic as they cause disturbances to people by stealing food and valuables and injure tourists. The Thung Thale Non-hunting Area has requested a budget from the Krabi Province for ethical control of the population through sterilization to minimize the disturbance they cause. The monkey groups are territorial and there is a low likelihood of individuals moving between the sub-districts because of the Koh Lanta bridge construction.

Appendix B continued

America has a shortage of lab monkeys

That is bad for biomedical research and encourages smuggling

Article published by The Economist - July 6th 2023: Online Link

American authorities arrested Masphal Kry, an official in Cambodia's forestry administration, last November when he was heading to an international meeting about trade regulations for endangered species in Panama. Prosecutors accused him of conspiring with a smuggling ring. The contraband: monkeys, specifically long-tailed macaques. His gang allegedly grabbed wild macaques in Cambodia's national parks and bribed officials to label them as captive-bred. Fake papers allowed Vanny Bio Research, a Cambodian pharma company, to ship these unfortunate primates to America for use in research. Mr Kry is facing trial in Florida's Southern District Court.

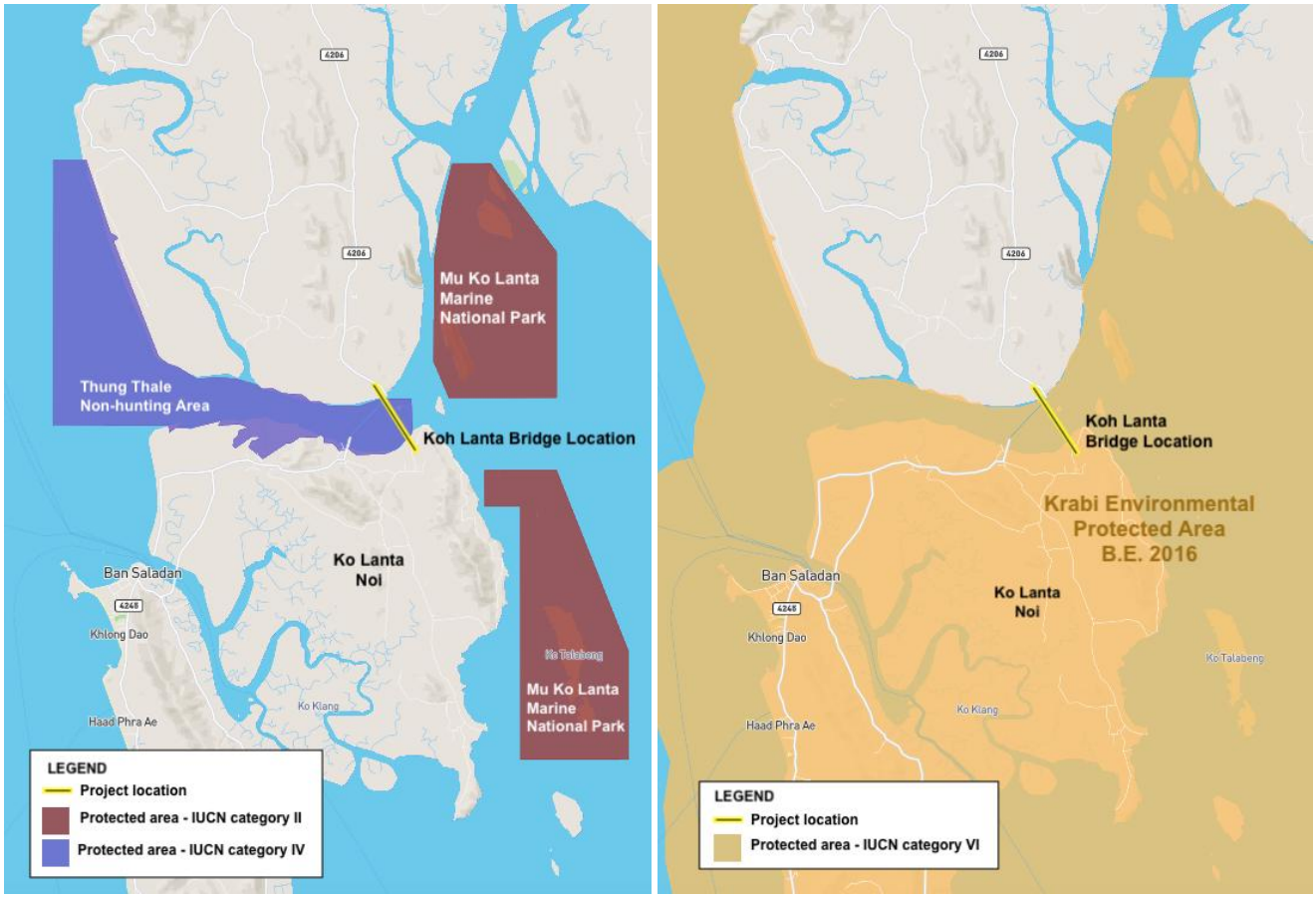
The federal government funds seven National Primate Research Centres (NPRCS), which house in total around 20,000 primates, macaques but also baboons and marmosets. These centres then award primates to labs across America. NPRCS have fulfilled only a third of requests for untested-on macaques in 2021 and prices have soared. Before the covid-19 pandemic a rhesus macaque cost $8,000; by 2022 they had hit $24,000. Another species, **long-tailed macaques, is probably per pound currently the most expensive traded wildlife**, says Lisa Jones-Engel, a science adviser at peta, an animal-rights group.

Getting lab monkeys from abroad became harder during the pandemic. Chinese authorities banned the export of all primates in early 2020. The Chinese government wanted to suppress the country's wildlife trade, which is thought to encourage the transmission of pathogens—like SARS-COV-2—from animals to humans. Chinese labs also need monkeys to achieve the Communist Party's goal of China becoming a world leader in neuroscience by 2025.

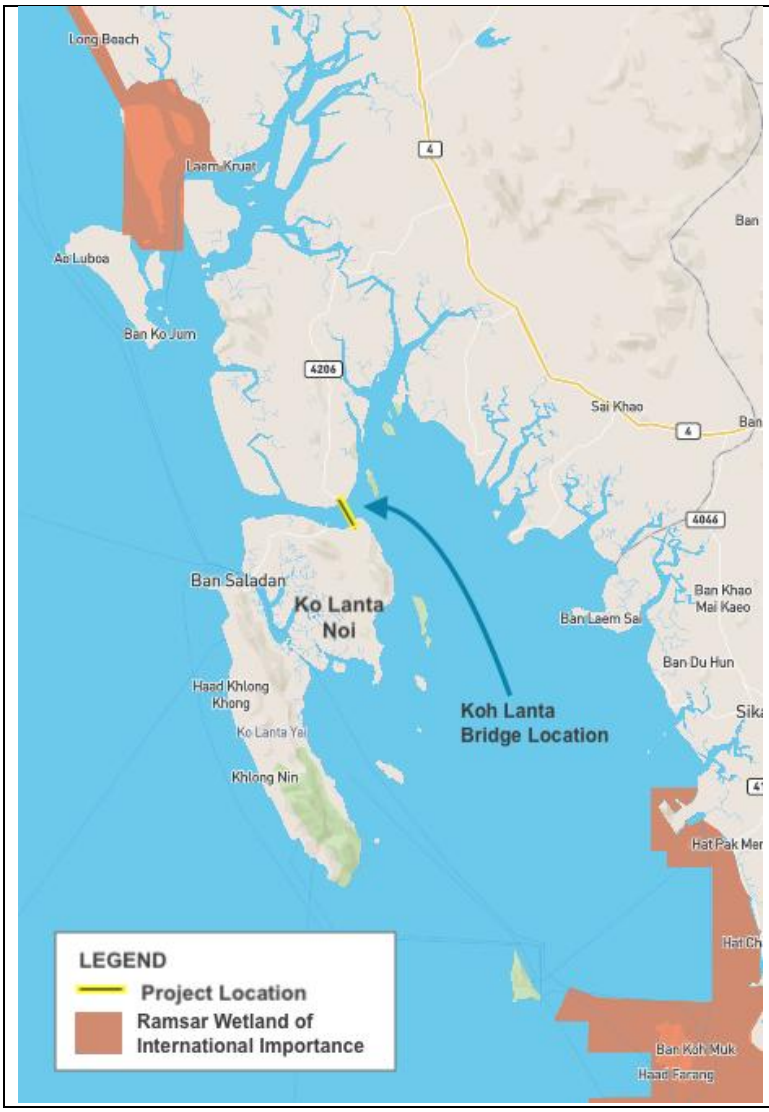
That forced American companies to rely on less scrupulous South-East Asian suppliers. Many scientists believe poaching is endemic across Cambodia. In February, the Department of Justice subpoenaed Charles River over 1,000 juvenile macaques the pharmaceutical company had bought from Cambodia; the DoJ suspected they were caught in the wild then exported. These primates are now in Texas and Maryland but also in limbo: they cannot be tested on, nor can they be flown back to Cambodia.

This article appeared in the United States section of the print edition under the headline "Monkeying around".

10 APPENDIX C – IBAT MAPS OF LEGALLY PROTECTED AREAS



Layout of the Thung Thale Non-hunting Area (TTNHA) and the Mu Ko Lanta Marine National Park (left) and the much larger Krabi Environmental Protected Area (right)



Locations of two Ramsar Wetlands in the greater vicinity of the Project. Neither is expected to be adversely impacted by the Project.

Ramsar Wetlands include:

- Krabi Estuary (northern site),
- Had Chao Mai Marine National Park - Ta Libong Island Non-Hunting Area - Trang River Estuaries (southern site).

The above maps in Appendix C are sourced from the IBAT Dashboard.