Environmental Impact Assessment

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Philippines: Bataan-Cavite Interlink Bridge Project

Volume 2 Annexes (Part 1)

Prepared by the Department of Public Works and Highways for the Asian Development Bank.

NOTES

THIS ANNEX INCLUDES THE TECHNICAL REPORTS AND DOCUMENTATION IN THE FOLLOWING ORDER:

1. **Critical Habitat Assessment Report**
2. **Underwater Acoustic Noise Analysis**
3. **Preliminary Biodiversity Action Plan**
4. **Visual Impact Assessment Report**
5. **Bridge Deck Drainage Management Approach (Letter)**
6. **Stakeholder Engagement Documentation**
7. **Climate Change Report**

Design/ Provision of Reference

Section 7: TERMS OF REFERENCE, Subsection E. Environment Safeguard Plan, Task 11
TASK 11 – Preparing Environmental Impact Assessment (EIA)/ Environmental Management Plan (EMP) Deliverable: (i) Updated EIA and (ii) Updated Comprehensive EMP

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Abbreviations

ADB	Asian Development Bank
AoA	Area of Analysis
AoI	Area of Influence
AOO	Area of Occupancy
BAP	Biodiversity Action Plan
BCIB	Bataan–Cavite Interlink Bridge Project
BFAR	Bureau of Fisheries and Aquatic Resources
CIMP	Corregidor Islands Marine Park
CPA	Conservation Priority Area
CR	Critically Endangered
DD	Data Deficient
DENR	Department of Environment and Natural Resources
DENR-BMB	Biodiversity Management Bureau
DPWH	Department of Public Works and Highways
EAAA	Ecologically Appropriate Area of Analysis
ECC	Environmental Compliance Certificate
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EN	Endangered
EOO	Extent of Occurrence
GN6	Guidance Note 6
IBAT	Integrated Biodiversity Assessment Tool
ICM	Integrated Coastal Management
IFC	International Finance Corporation
IUCN	World Conservation Union
KBA	Key Biodiversity Area
LGU	Local Government Unit
LMMPA	Locally-Managed Marine Protected Area
MBCS	Manila Bay Coastal Strategy
MBEMP	Manila Bay Environmental Management Project
MBSDMP	Manila Bay Sustainable Development Master Plan
MPA	Marine Protected Area
NEDA	National Economic and Development Authority
NT	Near Threatened
PEMSEA	Program on Building Partnerships in Environmental Management for the Seas of East Asia
PS6	Performance Standard 6
RR	Restricted Range
VU	Vulnerable

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1 INTRODUCTION

This critical habitat assessment report has been prepared at the direction of the Asian Development Bank (ADB), as one component of the updated environmental impact assessment (EIA) for the Bataan–Cavite Interlink Bridge Project (BCIB) in Manila Bay, Philippines. The critical habitat assessment has been carried out in accordance with the guidance developed by the International Finance Corporation (IFC), as specified in its Performance Standard 6 (2012) and related documents.

1.1 Project Background

The proposed Bataan–Cavite Interlink Bridge (BCIB) project will entail construction and operation of a 32-km, four-lane road link across the mouth of Manila Bay, joining the provinces of Bataan and Cavite. The project aims to establish an alternative road transport corridor between Region III (Central Luzon) and Region IV-A (Calabarzon), to help ease traffic congestion in Metro Manila; achieve greater regional economic integration; ease disparities in public service access and economic opportunity that exist between Metro Manila and other parts of Luzon; enable development of ports in Mariveles to take some of the pressure off the overburdened Port of Manila; and boost nature-based tourism on Bataan's west coast. The project has been proposed by the Department of Public Works and Highways (DPWH), and is being pursued under the umbrella of the 'Build, Build, Build' economic development program of the Government of the Philippines. The BCIB project is under consideration for financing by the Asian Development Bank, through its Infrastructure Preparation and Implementation Facility (IPIF) for the Philippines.

The BCIB will connect to the Roman Highway in the Municipality of Mariveles, on the southern tip of the Bataan peninsula, and to the Antero Soriano Highway in the Municipality of Naic, in Cavite. The over-water alignment will be 26 km long, and will encompass two high cable-stayed bridges over navigation channels that transit the mouth of Manila Bay, as well as a smaller nearshore navigation bridge near the Cavite shore. The longest over-water component of the BCIB, at approximately 23 km, will be a series of marine viaducts, with road decks about 20 m above the water. The viaduct will pass nearby the east coast of Corregidor Island, which sits in the mouth of the bay, and an offshore turnaround structure will be integrated with the main alignment there. Besides facilitating safety and emergency traffic management, the turnaround structure will be designed to serve as a tie-in point for a possible spur link to Corregidor Island, should that be considered at some point in the future (a link will not be part of the BCIB project). The BCIB project's location is shown in Exhibit 1.

An environmental impact assessment (EIA) was carried out by Ove Arup & Partners Hong Kong, Ltd. during 2019 and 2020, concurrent with preparation of the Preliminary Engineering Design, and an EIA report was finalized in February 2021, following review by DENR-EMB. An Environmental Compliance Certificate (ECC) was issued by DENR-EMB for the BCIB project in April of 2021. The 2021 EIA report did not include a comprehensive critical habitat assessment.

The Detailed Engineering Design work for the BCIB project is being undertaken by a joint venture of T.Y. Lin International and Pyunghwa Engineering Consultants, Ltd., and an updated EIA is under preparation in parallel with the design process. This critical habitat assessment has been produced as a supporting element of the updated EIA for the BCIB project.

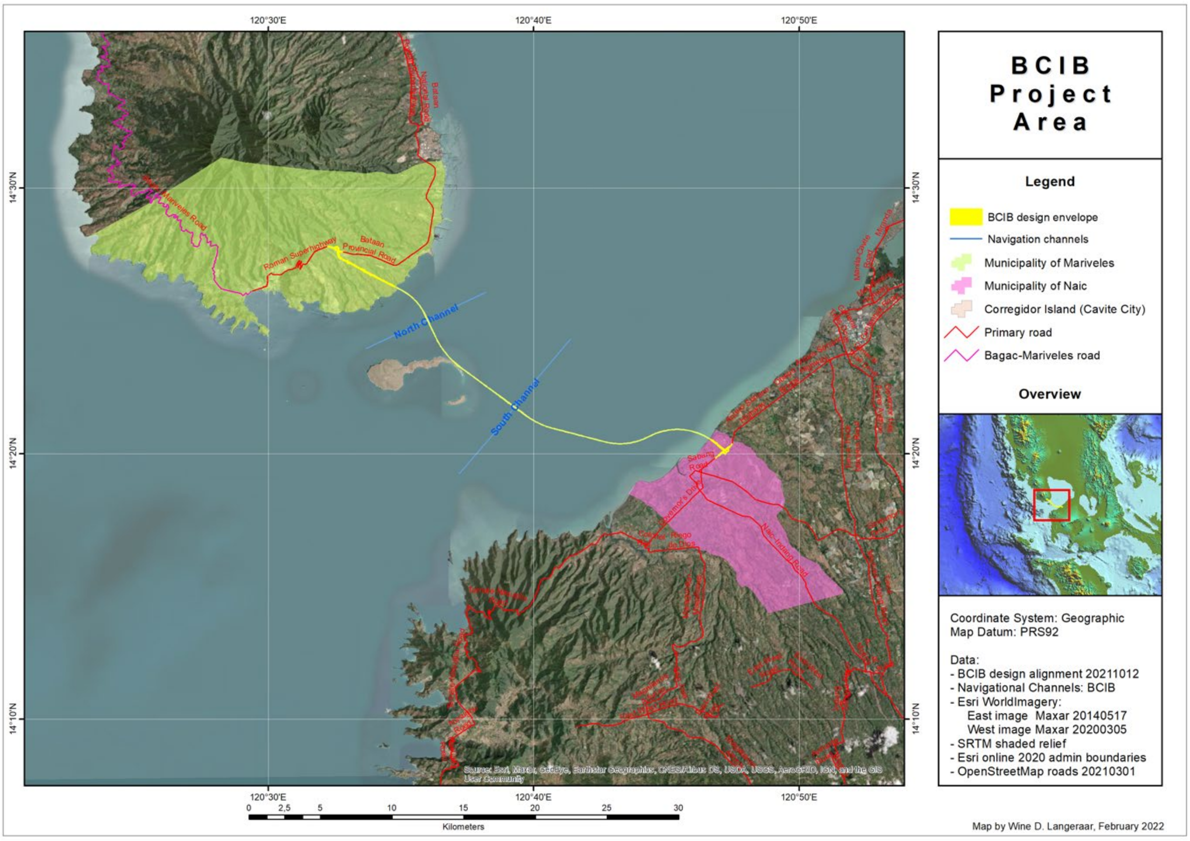


Exhibit 1: Location of BCIB Project

1.2 Habitat Classification Framework

This critical habitat assessment report follows the concepts and methodology developed by the International Finance Corporation (IFC), as specified in its Performance Standard 6 (2012) and the supporting Guidance Note 6 (2019).[1] Key definitions elaborated within the habitat classification framework are those for habitat, modified habitat, natural habitat and critical habitat.

1.2.1 Habitat

Performance Standard 6 (PS6) defines habitat as:

> '…a terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment. For the purposes of implementation of this Performance Standard, habitats are divided into modified, natural, and critical. Critical habitats are a subset of modified or natural habitats.' (PS6, Para. 9)

[1] International Finance Corporation. 2012. Performance Standard 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources. January 1, 2012.; (2) International Finance Corporation. 2019. International Finance Corporation's Guidance Note 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources. June 27, 2019 update.

1.2.2 Modified Habitat

Modified habitats are defined in PS6 as:

> '…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. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands.' (PS6, Para. 11)

Further direction regarding identification of modified habitat is given in Guidance Note 6 (GN6), which states:

> 'Human activity may modify the structure and composition of natural habitats to the degree that nonnative species become dominant and/or the natural ecological functions of the habitat fundamentally change. At the extreme, this takes the form of urbanized areas. However, there is a wide spectrum of modified habitats that includes agricultural areas, plantation forestry, and lands partially degraded by a range of other human interventions. The landscape context (for example, fragmentation of surrounding natural habitat, if any) will also influence the degree to which a project site is considered modified.' (GN6, Para. 35)

1.2.3 Natural Habitat

Natural habitats are defined in PS6 as:

> '…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 function and species composition.' (PS6, Para. 13)

Supporting interpretation with respect to what makes for a natural habitat is provided in GN6:

> 'Natural habitats are not to be interpreted as untouched or pristine habitats. It is likely that the majority of habitats designated as natural will have undergone some degree of historical or recent anthropogenic impact. The question is the degree of impact. If, in the judgement of a competent professional, the habitat still largely contains the principal characteristics and functions of a native ecosystem(s), it should be considered a natural habitat regardless of some degree of degradation and/or the presence of some invasive alien species, secondary forest, human habitation, or other human-induced alteration.' (GN6, Para. 39)

1.2.4 Critical Habitat

Critical habitat is understood as a sub-category to be assigned to a land or sea area following categorization of that area as either modified habitat or natural habitat. Critical habitat is defined in the PS6 as:

> '…areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or

congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes.' (PS6, Para. 16)

A critical habitat determination is an essential factor shaping requirements for consultation, mitigation and management plans, and monitoring in the context of environmental impact assessment and project development. IFC specifies five criteria for use in critical habitat determinations, as follows:

1.2.4.1 Criterion 1 – Critically Endangered and Endangered Species

Thresholds:

(a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species).

(b) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in (a).

(c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species

Applicability as per GN6:

Species threatened with global extinction and listed as CR and EN on the IUCN *Red List of Threatened Species* shall be considered as part of Criterion 1. (GN6, Para. 70)

...the inclusion in Criterion 1 of species that are listed nationally/regionally as CR or EN in countries that adhere to IUCN guidance shall be determined on a project-by-project basis in consultation with competent professionals. (GN6, Para. 71)

1.2.4.2 Criterion 2 – Endemic and Restricted-Range Species

Threshold:

(a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.

Definitions as per GN6:

For purposes of this Guidance Note, the term endemic is defined as restricted-range. Restricted range refers to a limited extent of occurrence (EOO).

- For terrestrial vertebrates and plants, restricted-range species are defined as those species that have an EOO less than 50,000 square kilometers (km^2).
- For marine systems, restricted-range species are provisionally being considered those with an EOO of less than 100,000 km^2.
- For coastal, riverine, and other aquatic species in habitats that do not exceed 200 km width at any point (for example, rivers), restricted range is defined as having a global range of less than or equal to 500 km linear geographic span (i.e., the distance between occupied locations furthest apart). (GN6, Para. 74)

1.2.4.3 Criterion 3 – Migratory and Congregatory Species

Thresholds:

(a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥1% of the global population of a migratory or congregatory species at any point of the species' lifecycle.

(b) Areas that predictably support ≥10% of the global population of a species during periods of environmental stress.

Definitions as per GN6:

Migratory species are defined as any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem). (GN6, Para. 76)

Congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis. Examples include:

- Species that form colonies.
- Species that form colonies for breeding purposes and/or where large numbers of individuals of a species gather at the same time for non-breeding purposes (for example, foraging and roosting).
- Species that utilize a bottleneck site where significant numbers of individuals of a species occur in a concentrated period of time (for example, for migration).
- Species with large but clumped distributions where a large number of individuals may be concentrated in a single or a few sites while the rest of the species is largely dispersed (for example, wildebeest distributions).
- Source populations where certain sites hold populations of species that make an inordinate contribution to recruitment of the species elsewhere (especially important for marine species). (GN6, Para. 77)

1.2.4.4 Criterion 4 – Highly Threatened and/or Unique Ecosystems

Thresholds:

(a) Areas representing ≥5% of the global extent of an ecosystem meeting the criteria for IUCN status of CR or EN under the IUCN's Red List of Ecosystems.

(b) Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning.

Applicability as per GN6:

The IUCN is developing a Red List of Ecosystems, following an approach similar to the Red List for Threatened Species. The client should use the Red List of Ecosystems where formal IUCN assessments have been performed. Where formal IUCN assessments have not been performed, the client may use assessments using systematic methods at the national/regional level, carried out by governmental bodies, recognized academic institutions and/or other relevant qualified organizations (including internationally recognized NGOs). (GN6, Para. 79)

1.2.4.5 Criterion 5 – Areas Associated With Key Evolutionary Processes

No quantitative thresholds apply to this criterion. Rather, a qualitative judgement is made as to the presence or absence of idiosyncratic landscape features that catalyze and support evolutionary processes, e.g., speciation, and can be considered to have given rise to genetically unique populations or subpopulations of plant and animal species.

Several examples of landscape attributes understood to promote speciation interaction between landscape features and key evolutionary processes, that may be considered in relation to a possible trigger of Criterion 5 are listed in GN6 (Para. 82):

- Landscapes with high spatial *heterogeneity* are a driving force in speciation, as species are naturally selected based on their ability to adapt and diversify.
- *Environmental gradients*, also known as *ecotones*, produce transitional habitat, which has been associated with the process of speciation and high species and genetic diversity.
- *Edaphic interfaces* are specific juxtapositions of soil types (for example, serpentine outcrops, limestone, and gypsum deposits), which have led to the formation of unique plant communities characterized by both rarity and endemism.
- *Connectivity* between habitats (for example, biological corridors) ensures species migration and gene flow, which is especially important in fragmented habitats and for the conservation of metapopulations. This also includes biological corridors across altitudinal and climatic gradients and from “crest to coast.”
- Sites of demonstrated importance to *climate change adaptation* for either species or ecosystems are also included within this criterion.

Applicability as per GN6:

> The significance of structural attributes in a landscape that may influence evolutionary processes will be determined on a case-by-case basis, and the determination of critical habitat will be heavily reliant on scientific knowledge. In the majority of cases, this criterion will apply in areas that have been previously investigated and that are already known or suspected to be associated with unique evolutionary processes. While systematic methods to measure and prioritize evolutionary processes in a landscape do exist, they are typically beyond a reasonable expectation of assessments conducted by the private sector." (GN6, Para. 83)

1.3 Antecedents

1.3.1 Critical Habitat Screening Report

A critical habitat screening assessment was conducted in relation to the BCIB project in 2020, during the feasibility stage, by a consultant engaged by ADB.[2] The screening process required defined areas within which critical habitat could be assessed. Two areas of analysis (AoA) were subsequently created. The first included all of Manila Bay and a modest strip

[2] SC Environment, Ltd (SCE). 2020. Critical Habitat Screening, Nelex–Manila Bay Bridge. Report prepared for the Asian Development Bank. 7 May 2020.

of land around the two ends of the BCIB project (the 'Bridge and Surrounding Area' AoA), while the second encompassed a solely terrestrial area covering the southern half of the Bataan peninsula, centered on Mt. Mariveles (the 'Bataan Province' AoA). A long list of 293 critically endangered (CR), endangered (EN) and vulnerable (VU) marine and terrestrial species was generated by a spatial search using the Integrated Biodiversity Assessment Tool (IBAT).[3] The long list included 13 CR species, 39 EN species, and 241 VU species. Two thirds (161) of the VU species listed were corals. The Bridge and Surrounding Area AoA was assessed for marine species only and the Bataan Province AoA was assessed for terrestrial species only.

The Bridge and Surrounding Area AoA was screened in relation to a list of 9 CR and 28 EN marine species drawn from the long list. The screening report concluded, based on an initial species-by-species evaluation, that 29 of the 37 marine species could be considered 'Potentially present, but unlikely to meet thresholds of Criteria 1–3'. In the case of the remaining eight species (all EN corals), it was concluded that there was insufficient information at hand to assess the probability of presence within the AoA, and that additional research should be carried out in relation to coral reef areas in support of any further critical habitat assessment.

The Bataan Province AoA was screened in relation to 4 CR and 10 EN terrestrial species extracted from the long list. It was concluded that none of the terrestrial species presented sufficient reason to suggest that a critical habitat determination would be triggered in relation to Criterion 1 or Criterion 2. The report suggested it was possible but not likely that two avian species could trigger a determination under Criterion 3, in the event that presence or suitable habitat were confirmed through field investigation. The conclusion of the report stated (p. 36) that "The data and information reviewed suggests that the Bataan Province AoA is not qualified as Critical Habitats as defined by ADB."

In addition to the IBAT-generated species lists, the screening report reviewed and discussed information and bird census data regarding the use of habitat areas within the Bridge and Surrounding Area AoA by migratory waterbirds. Manila Bay is recognized as a significant wintering and stopover site on the East Asian-Australasian Flyway, and the screening report drew on a 2018 report prepared for Wetlands International and IUCN, which indicated that numbers of 16 species typically present in the bay during winter may account for quite large proportions of their respective flyway populations.[4] The critical habitat screening indicated that the census numbers reported in the Wetlands International/IUCN report should be compared to global population data for the 16 species to determine if any exceed the 1% threshold of Criterion 3, as part of any subsequent critical habitat assessment. It was noted that although the greatest concentrations of migratory waterbirds are typically found using the foreshore, mud flats, mangroves and brackish waters at the head of the bay (40-50 km away from the BCIB project location), those habitats are within the AoA. It was also argued that extensive habitat loss and degradation (which are well documented) in those somewhat distant reaches of the bay might be expected to lead at least some species to use marginal or less extensive habitat patches in other parts of the bay, including areas closer to the mouth.

[3] The spatial parameters for the search, e.g., reference points and radii, were not indicated in the critical habitat screening report.
[4] Jensen, A.E. 2018. Internationally Important Waterbird Sites in Manila Bay, Philippines, October 2018. Technical Report. Wetlands International and IUCN National Committee of the Netherlands.

With regards to Criterion 4, the screening report noted that Manila Bay has not yet been evaluated under the IUCN Red List of Ecosystems framework, and thus cannot be assessed in relation to Threshold (a) of Criterion 4. However, it was suggested that the Bridge and Surrounding Area AoA was likely, under more thoroughgoing consideration, to trigger Criterion 4 (b): *Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning*. The ongoing Manila Bay Sustainable Development Master Plan process was cited as possible evidence that the AoA, which is defined mostly by the boundaries of Manila Bay, had been identified as a high priority conservation target through systematic national or regional planning, and may appropriately qualify as critical habitat on that basis. Further investigation of conservation priorities developed in relation to Manila Bay by relevant governmental and NGO sector entities was therefore recommended.

The screening report concluded that Criterion 5 was not applicable to either of the two areas screened, as neither is recognized as a significant center of speciation or thought to represent any particular propensity for supporting heightened evolutionary activity.

1.3.2 Updated IBAT Screening Reports

In September of 2021, a new IBAT screening was carried out by ADB, for terrestrial and marine environments separately, based on the most recent alignment information for the BCIB project.[5] The terrestrial screening identified a list of 29 EN and CR terrestrial species, as well as 22 restricted range (RR) terrestrial species, within a 50-km radius of the project's centerline. The marine screening identified a list of 47 EN and CR marine species (and two RR marine species) within the same search radius. Fourteen terrestrial protected areas and six key biodiversity areas (KBAs) were identified within 50 km; two protected areas and one KBA were noted within 10 km of the project alignment. The updated IBAT screening reports, which are included in Appendix 1, are adopted as the basis for species evaluations in the present critical habitat assessment.

1.4 Purposes and Objectives

The overarching aim of this critical habitat assessment is to build upon the earlier critical habitat screening report to solidify a reasoned determination as to whether any known characteristics of the BCIB project's ecological setting should be considered to trigger critical habitat thresholds. If they do, they will set the stage for mitigation planning that adequately and appropriately meets the particular biodiversity conservation challenges posed by the project's development.

The key objectives supporting this aim are to (1) confirm and update the initial species-by-species evaluations carried out by SCE, Ltd. in relation to Criteria 1–3, including for the additional waterbird species discussed; (2) further develop the initial evaluation of conservation priorities, as articulated through national and regional systematic planning efforts, in relation to Criterion 4, Threshold (b); (3) scope the implications of any resulting critical habitat determinations for mitigation planning in relation to the BCIB project; and (4) identify future updates to the critical habitat assessment that may become possible

[5] (1) IBAT PS6 & ESS6 Report. Generated under licence 4846-21884 from the Integrated Biodiversity Assessment Tool on 13 September 2021 (GMT). www.ibat-alliance.org (Marine screening report); (2) IBAT PS6 & ESS6 Report. Generated under licence 4846-21885 from the Integrated Biodiversity Assessment Tool on 13 September 2021 (GMT). www.ibat-alliance.org (Terrestrial screening report)

following anticipated strengthening of baseline data on local presence, abundance and habitat use of individual species.

2 METHODOLOGY

2.1 Scope of Assessment

2.1.1 BCIB Area of Analysis

For the purposes of this assessment, the BCIB project area is defined as an envelope consisting of all land and sea areas within two kilometers of any part of the designed infrastructure footprint (see Exhibit 2). This is the Area of Influence (AoI). Thus, the marine portion of the AoI comprises a four-kilometer-wide strip across Manila Bay. Overall, the AoI comprises 150 km^2, of which 69% is sea area and 31% is land areas. The critical habitat assessment is not referenced in any direct or influential way to the location and character of the project infrastructure, expected project development activities, or anticipated impacts.

Exhibit 2: BCIB Project Area

2.1.2 Spatial Scope of Assessment

Typically for a critical habitat assessment a candidate long list of species is initially generated based on species that could potentially be present within a wider area of analysis (AoA). The area of analysis (AoA) should be defined based on an understanding of the predominant biodiversity attributes in a project's broader setting and the ecological patterns and processes required to maintain them. As per GN6,

> The project should identify an ecologically appropriate area of analysis to determine the presence of critical habitat for each species with regular occurrence in the project's area of influence, or ecosystem, covered by Criteria 1–4. The client should define the boundaries of this area taking into account the distribution of species or ecosystems (within and sometimes extending beyond the project's area of influence) and the ecological patterns, processes, features, and functions that are necessary for maintaining them. These boundaries may include catchments, large rivers, or geological features. (GN6, Para. 59)

IFC PS6 then requires that for each biodiversity feature or species that regularly occurs in the Project AoI, and could potentially meet IFC PS6 criteria, an ecologically appropriate area of analysis (EAAA) is defined. The boundaries of the EAAAs should be defined based on the ecological patterns and processes that are necessary to maintain that species. The local population supported within the EAAA is what is used to determine if IFC PS6 critical habitat thresholds have been met.

At the time of writing, insufficient data was available to define species level EAAAs. As such an area of analysis (AoA) has been adopted and the spatial area for assessment. The original critical habitat screening report developed a case for the Bridge and Surrounding Area AoA as an appropriate spatial unit for the critical habitat screening. This AoA encompasses all of Manila Bay and a reasonable buffer of land area around the proposed BCIB project in Bataan and Cavite. This AoA, as shown in Exhibit 3 is subsequently evaluated against the five standard criteria of the IFC assessment framework. The AoA encompasses 2,000 km^2, of which approximately 93% is sea area, and 7% is land areas.

This approach is in line with the precautionary approach and as the project improves its biodiversity baseline over time the critical habitat assessment will be revisited and updated. In the interim a precautionary approach has been taken to the assessment.

In keeping with the conclusion of the screening report, the Bataan Province AoA, as introduced earlier, is considered to be of limited utility, and is not adopted for this assessment.

Source: SC Environment, Ltd (SCE). 2020. Critical Habitat Screening, Nelex–Manila Bay Bridge. Report prepared for the Asian Development Bank. 7 May 2020.

Exhibit 3 Area of Analysis for Critical Habitat Assessment

2.2 By-Species Evaluations

For each species listed in the terrestrial and marine IBAT output reports, desktop research was conducted to review habitat requirements, known range, estimated global population, reported local presence and other parameters, as the basis for determining whether the species could reasonably be considered to meet any of the thresholds under Criteria 1–3. Findings were corroborated as appropriate with preliminary results from field surveys conducted in the BCIB project area as part of baseline development for the ongoing EIA update.

As introduced earlier, the thresholds under Criteria 1–3 are numerical, and the core of each by-species evaluation is a comparison between the population of the species that can reasonably be anticipated within the AoA on the one hand, and the global population of the same species on the other. When there is no basis for estimation of either a local or global population—as is often the case—the relative sizes of the expected local area of occupancy (AOO) and the species' estimated global extent of occurrence (EOO) are called upon to reflect on the probability of the species being present in numbers sufficient to trigger one of the thresholds. The present critical habitat assessment adopted the assumption that the AoA (terrestrial or marine portion, depending on the species) was representative of the AOO, unless knowledge of habitat requirements and/or local presence provided a reason to define a smaller possible AOO (e.g., a marine species known to inhabit only very shallow inshore waters, or a terrestrial species never documented below a particular altitude).

The areas of the terrestrial and marine portions of the AoA were calculated using Google Earth, and smaller AOO estimates were derived from triangulation of these known areas with available baseline information regarding bathymetry, land cover and habitat types.

EOO was roughly gauged from range maps available online, gathered principally from species profiles presented on the IUCN Red List website (redlist.org); in some cases, numerical estimates of EOO were also available. Global population estimates were gathered from online sources, mainly redlist.org; population estimates were available only for the most studied species. Information on habitat preferences and constraints, as well as movement patterns and other behaviors, was gathered from species profiles available on redlist.org and other credible online sources.

It is acknowledged that by-species evaluation relative to the thresholds under Criteria 1–3 is an imprecise science requiring use of assumptions and preliminary, partial and tentative data. However, it is felt that by integrating multiple sources of information in a logical and consistent analytical process, the present critical habitat assessment has arrived at a reasoned, non-arbitrary probability assessment for each species in relation to the relevant thresholds.

2.3 Desktop Research in Relation to Criterion 4

A detailed review of policy initiatives, ecosystem assessment efforts, conservation planning processes and practical conservation actions pertaining to biodiversity in the Manila Bay area was conducted in order to assess the applicability of Criterion 4, Threshold (b) to the AoA. The analysis was oriented to illuminating the development of institutional interest and focus regarding threats facing ecosystem health and biodiversity in Manila Bay, and used an approach that is largely historical. The protected areas and key biodiversity areas (KBAs) identified in the IBAT screening report were among the conservation initiatives catalogued and discussed.

2.4 Consultations

As per PS6, consultation with knowledgeable stakeholders and experts in the broader project setting is considered a valuable and advisable component of a critical habitat assessment process. A list of consultation encounters undertaken in support of the critical habitat assessment— and scoping of related mitigation planning—for the BCIB project is presented in Appendix 2.

3 CRITICAL HABITAT DETERMINATION

3.1 Criterion 1: Critically Endangered and Endangered Species

3.1.1 Terrestrial Species

The terrestrial IBAT output report list included 23 CR and EN species.[6] Each species on the list was evaluated based on available information on habitat requirements, global EOO, global population numbers, and local conditions as appropriate to estimate the probability

[6] Two marine turtle species were also included, but these were considered with marine fauna.

that a population present within the AoA might meet Threshold (a) under Criterion 1.[7] The results of the by-species evaluation are summarized in Exhibit 4; range maps and sources consulted in relation to each species are collated in Appendix 3.

Exhibit 4: By-Species Evaluation in Relation to Criterion 1 (Terrestrial Species)

Species	Habitat and Range Notes[1]	Global population[2]	0.5% threshold	Probability of meeting Criterion 1 Threshold(a)
Acerodon jubatus Golden-Capped Fruit Bat (EN)	Endemic to the Philippines and widely distributed across most of the archipelago, this forest-dependent species' preferred feeding habitats are primary forest and high-quality secondary forest. This bat shares mixed-species roosts in locations inaccessible to humans, such as steep slopes, cliff edges and mangrove islands. The AoA has almost no sites that match these descriptors well, although there may be some minor mangrove islands near the head of the bay, and some suitable secondary forest within the AoA on the lower slopes of Mt. Mariveles. Terrestrial portions of the AoA, especially when narrowed by habitat type, comprise a tiny fraction of the global EOO for this species, making it very unlikely that any population present could comprise 0.5% of the Philippines-wide (i.e., global) population. This species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	10,000–20,000	50–100	Very low
Adelmeria dicranochila (EN)	A perennial herb new to science until 2019 and thought to be endemic to the Philippines, this species is known from only four sites, none of which are near the AoA and all of which are in primary and mossy forest between 1,000 and 2,100 masl. The species can be considered extremely unlikely to be found in the AoA. No specimens were recorded during vegetation surveys conducted in the BCIB project area in 2020 and 2021/2022.	Unknown	-	Zero
Cacatua haematuropygia Philippine Cockatoo (CR)	This species, endemic to the Philippines, is considered 'possibly extinct' over much of its former known range, including Luzon. The species favors primary lowland forest (of which there is none in the AoA), and was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022. It can be considered very unlikely that this species would be found within the AoA.	430–750	3–4	Very low
Calidris tenuirostris Great Knot (EN)	Preferred wintering habitat for this migratory species is sheltered coastal habitats such as bays, estuaries and lagoons with large intertidal mud and sand flats, oceanic sandy beaches with nearby mudflats, sandy spits and muddy shorelines. Preferred wintering food is molluscs and crustaceans plucked from intertidal muds and sands. The global EOO is 331,000 km^2, of which the terrestrial portion of the AoA comprises less than 0.1%. Data from bird counts in areas of Manila Bay with preferred habitat from 2003–2018 indicate that no more than 500 individuals were ever documented across all count sites in any year. It can be considered improbable that this species would meet the 0.5% threshold consistently. The species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	292,000–295,000	1,460–1,475	Low

[7] Threshold (b) refers to VU species that might change status to CR and EN in the event of loss of the AoA population; as the IBAT output list included only CR and EN species, this threshold was not applied. Threshold (c) refers to nationally listed EN and CR species, where the national classification system follows the IUCN methodology; as this is not really the case with Philippines classifications of EN and CR species (made under various legal instruments), this threshold was not applied.

Species	Habitat and Range Notes[1]	Global population[2]	0.5% threshold	Probability of meeting Criterion 1 Threshold(a)
Calostoma insigne (EN)	This fungal species is associated with *Dipterocarp* trees and is found in tropical and subtropical lowland forests. The absence of significant lowland forest in the AoA suggests a very low probability of presence. Range maps indicate possible wide distribution across land areas of the Indo-Pacific, so it can be considered extremely unlikely that any populations present in the very limited lowland forest habitat left in the AoA could support as much as 0.5% of the global population.	Unknown	-	Extremely low
Camptostemon philippinense (EN)	This mangrove species has a very patchy distribution across much of the Philippines and part of Indonesia, and reportedly occurs in very small numbers where it is present. Range maps indicate that Manila Bay is just outside the known range, which includes the north coast of Batangas, but not coastline within the bay itself. In view of this, it can be considered improbable that any individuals of the species would be found in the AoA, and very unlikely that any specimens present would constitute as much as 0.5% of the global population. The species was not recorded during baseline surveys of coastal vegetation conducted in 2020 and 2021.	1,200	6	Very low
Cerberus microlepis Lake Buhi Bockadam (EN)	This freshwater snake species is known from a single lake in southeast Luzon, and can be considered extremely unlikely to be present in the AoA. It was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	Unknown	-	Zero
Crocodylus mindorensis Philippine Crocodile (CR)	This species is considered extinct in central Luzon.	92–137	4–7	Zero
Cuora amboinensis Southeast Asian Box Turtle (EN)	This aquatic turtle species, of which there are four sub-species, is widely distributed from India to Indonesia. It is reportedly fairly common throughout the Philippines, though under threat from hunting for the pet trade, food and use in handicrafts. The species prefers warm, standing fresh water such as may be found in natural ponds and swamps, fish ponds and flooded rice paddies. This species is likely to be present in the AoA; however, since its distribution is very wide, it is highly unlikely that the population within the limited terrestrial portions of the AoA would approach 0.5% of the global population. The species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022, or in a river ecology survey conducted in 2021/2022.	Unknown	-	Extremely low
Dipterocarpus grandiflorus (EN)	This large forest tree species is usually found in primary lowland forest, often near the sea, and is known from one location within the AoA, in eastern Mariveles. The species was not recorded in the floral surveys carried out in the BCIB project area in 2020 and 2021/2022. *Dipterocarpus grandiflorus* has a scattered distribution across a very wide area (EOO over 6 million km^2) encompassing the northern Philippine Islands, Eastern Borneo, Sumatra, the Malay Peninsula, Vietnam, Laos, Myanmar and the Andaman Islands. Given this distribution, it is extremely unlikely that the population of a single known site in the AoA could account for anywhere close to 0.5% of the global population.	Unknown	-	Extremely low

Species	Habitat and Range Notes[1]	Global population[2]	0.5% threshold	Probability of meeting Criterion 1 Threshold(a)
Drepanosticta makilingia (CR)	This species of damselfly is known only from Mt. Makiling, on the south end of Laguna de Bay and some 45 km away from the AoA. It can be considered extremely unlikely to be present within the AoA.	Unknown	-	Extremely low
Drepanosticta trimaculata (CR)	This species is a forest-dependent damselfly documented from a single location south of Lake Taal, nearly 50 km away from the AoA. It can be considered extremely unlikely to be present within the AoA.	Unknown	-	Extremely low
Lonchura oryzivora Java Sparrow (EN)	There is a known population of this species, which is not native to the Philippines, within Metro Manila. The one available range map indicates that Metro Manila is the only place on Luzon where this bird lives, although this likely underestimates the local range quite significantly, since the species appears on extant species checklists for various forest areas both north and south of Manila Bay (e.g., Bataan Natural Park, Mariveles, Nasugbu, Taal) and was documented in the BCIB project area (Cavite portion) in 2021/2022 field surveys. Although the Java Sparrow is under severe threat from capture for the cagebird trade in its native central Java, it has been widely introduced elsewhere, and there are resident populations in Southeast Asia, East Asia and the Pacific, and as far away as Sri Lanka, Hawaii and Venezuela. Although the Java Sparrow can be considered likely in both land portions of the AoA, in view of the wide distribution of native and feral populations of the species, it is very unlikely that these limited land areas could account for as much as 0.5% of global population.	Unclear (1,500–3,750 estimated for native range)	-	Very low
Macromia negrito (EN)	This forest dragonfly species is known only from the area around Mt Makiling, 45 km away from the AoA. It is speculated that the species may be under-reported, perhaps drastically so, because of the difficulty in catching it. Regardless, there is no basis for concluding that this insect would have a significant presence in the AoA, particularly given the paucity of forest habitat in the Cavite portion.	Unknown	-	Extremely low
Nisaetus philippensis North Philippine Hawk-Eagle (EN)	A forest-dwelling lowland species, *Nisaetus philippensis* is mainly found on Luzon and Mindoro, and is suspected on Palawan. The Luzon population is thought to be concentrated primarily in the Sierra Madre Range, which runs up the east coast of the northern part of Luzon, to the west of the AoA. Although there is virtually no closed forest left in the AoA, the species is known to use somewhat modified forest as a marginal habitat, and to frequent open areas occasionally. Accordingly, presence within the AoA cannot be ruled out. However, it seems unlikely the modest land areas within the AoA, nonwell-endowed with forest land, could support more than 0.5% of the global population. Estimated EOO for this species is 233,000 km^2, while the terrestrial portion of the AoA is just 163 km^2. The species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	600–900	3–5	Low

Species	Habitat and Range Notes[1]	Global population[2]	0.5% threshold	Probability of meeting Criterion 1 Threshold(a)
Numenius madagascariensis Far Eastern Curlew (EN)	Preferred wintering habitat for this migratory species is estuaries, mangrove swamps, saltmarshes and intertidal flats, particularly those with extensive seagrass meadows; this kind of habitat is found around the northern and some eastern fringe portions of Manila Bay. Data from bird counts in areas of Manila Bay with preferred habitat from 2003–2018 indicate that no more than 68 individuals were ever documented across all count sites in any year, which suggests relatively low probability that the wintering population within the AoA would exceed 0.5% of the global population. The Far Eastern Curlew was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	32,000	160	Low
Oriolus isabellae Isabela Oriole (CR)	This forest-dependent species is present in only a few localities in the northern Sierra Madre Mountains. It was formerly reported from southern Bataan, but is now considered likely to be extinct in this area, as it has not been seen there since 1947. The AoA contains very little preferred habitat (primary and secondary bamboo forest) for this species, and the very limited forest area within the Bataan portion (an estimated maximum area of 10 km^2 on the lower slopes of Mt. Mariveles) would constitute about 0.1% of the EOO for the species (8,900 km^2). The Isabella Oriole was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	250	25	Very low
Pericnemis bonita (EN)	This species of damselfly lives in forest and wetland habitat and is known only from three areas of central and southern Luzon, the closest of which is the Mt. Makiling area about 45 km south of the AoA. Accordingly, the AoA can be assumed to have very little chance of meeting the 0.5% threshold for this species.	Unknown	-	Zero
Pericnemis incallida (EN)	Very little is known about this damselfly species, which was described from specimens collected at just five sites in central and northern Luzon, but it is thought to be forest-dependent and a phytotelmata breeder and have an altitudinal range of 50–600 masl. One of the specimens was collected in Ternate, Cavite, and the only range map available indicates Naic as part of the range, which seems dubious and may be a matter of low precision. The estimated EOO for this species is indicated as 32,913–45,577 km^2, whereas the terrestrial portion of the AoA in Cavite is 82 km^2 (0.25% of lower EOO estimate); based on this comparison, it may be reasonable to consider the AoA unlikely to support a population sufficient to meet the 0.5% threshold. The very reduced and disturbed state of forests in the part of Cavite included in the AoA, as well as the fact that the AoA within Cavite is virtually all lower than 50 masl, would tend to support this conclusion.	Unknown	-	Very low
Pithecophaga jefferyi Philippine Eagle (CR)	Range maps indicate that the Philippine Eagle is not extant west of the central Sierra Madre Range, which suggests the species would be unlikely to occur in the AoA; the AoA also lacks the rugged mountain terrain and primary forest typically frequented. The species was not recorded in faunal surveys of the BCIB project area in 2020 and 2021/2022. This species can safely be considered not to be a qualifying species for a critical habitat determination.	250–750	2–4	Extremely low

Species	Habitat and Range Notes[1]	Global population[2]	0.5% threshold	Probability of meeting Criterion 1 Threshold(a)
Prioniturus luconensis Green Racquet-Tail (EN)	Although range maps indicate likely presence throughout central and northern Luzon, this species, which is thought to be dependent on lowland primary forest, is now considered to be largely confined to the Subic Bay Forest Reserve and Northern Sierra Madre Natural Park. The EOO for this species is estimated at 147,000 km², which suggests that any population occurring in the terrestrial portion of the AoA in Bataan (75 km²) would be quite unlikely to meet the 0.5% threshold. The Green Racquet-Tail was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	1,500–3,800	8–19	Very low
Pterocarpus indicus Burmese Rosewood (EN)	Wild-grown specimens of this species are known from a large number of widely scattered sites spread across the Indo-Pacific. None of the sites indicated on range maps indicate a recorded presence within the AoA, and the altitudinal range for the species is 600–1,300 masl, likely putting wild populations well out of range for the AoA (highest elevation approximately 300 masl). It can be considered extremely unlikely that wild-grown specimens of this species would be found in the AoA in sufficient numbers to meet the 0.5% threshold. *Pterocarpus indicus* is commonly planted for living fences, and numerous instances of this were observed in the Bataan portion of the BCIB project area during field surveys; however, even when taking account of such plantings, the probability of the threshold being met can still safely be considered to be very low, given the species' wide distribution.	Unknown	-	Very low
Pterospermum cumingii (EN)	This small tree species is reported from only five sites, all of which are on Luzon and none of which are within the AoA. The species is considered endemic to ultramafic soils, which are not known to be present within the AoA. The species was not recorded during vegetation surveys of the BCIB project area in 2020 and 2021/2022.	Unknown	-	Zero
[1] Information for habitat and range notes is sourced primarily from species profiles on redlist.org, supplemented as needed from other online sources. Sources and range maps for each species are presented in Appendix 3. [2] Global population estimates are sourced primarily from redlist.org, and other online sources where necessary.				

The by-species evaluations presented in Exhibit 4 do not indicate that any terrestrial species can be considered likely to meet Threshold (a) under Criterion 1. However, special note is to be made of the Philippine Duck (*Anas luzonica*), a VU species which was considered in the present critical habitat assessment because it was identified in the aforementioned Wetlands International/IUCN report on waterbird numbers in Manila Bay as one of the extant species whose estimated Manila Bay populations appear to account for a large proportion of the estimated flyway or global population.[8] Under Threshold (b) of Criterion 1, an AoA that supports globally important concentrations of a VU species, the loss of which would result in a change of Red List status from VU to EN or CR and meet the Criterion 1 Threshold (a), may be considered a critical habitat.

Comparison of 2017-2018 *Anas luzonica* numbers documented by the Wetlands International/IUCN study conducted in the northern and eastern parts of Manila Bay (625 individuals) against the estimated global population of this species (5,000–10,000 individuals) indicates that the Manila Bay population may represent somewhere on the order

[8] Jensen, A.E. 2018. Internationally Important Waterbird Sites in Manila Bay, Philippines, October 2018. Technical Report. Wetlands International and IUCN National Committee of the Netherlands.

of 6.3% to 12.5% of the global population. This can reasonably be considered to constitute a globally important concentration of the species, although it is unclear whether the hypothetical loss of the Manila Bay population of *Anas luzonica* could be expected to trigger a change in IUCN conservation status from VU to EN; re-assignment is appropriately determined only through a detailed whole-population technical assessment by IUCN-designated experts. That said, the most recent (2016) IUCN assessment indicates that the species is thought to be on a substantial downward trend:

> A steep population decline was evident by the mid-1970s, with high numbers recorded at only a few sites in the following decade. Subsequent local extinctions and near-disappearances have occurred in several significant sites, owing to exceptionally high levels of hunting and trapping, conversion of natural wetlands, mangrove destruction and the recent extensive use of pesticides on rice-fields. This species' population is suspected to be undergoing a rapid and continuing decline in line with these impacts.[9]

This rather grim assessment suggests that *Anas luzonica* may be headed for EN status before very long, at which point the significant concentration of this species in the AoA would be certain to far exceed the 0.5% needed to meet Threshold (a) of Criterion 1. Further, the species was recorded in Cavite, within the AoI, albeit in small numbers, during the 2021 avian surveys. In light of this, it is proposed that the weight of evidence favors assignment of qualifying species status to *Anas luzonica*, in accordance with Criterion 1, Threshold (b).

3.1.2 Marine Species

The marine IBAT screening output list comprised 44 aquatic species.[10] Of these, 12 were CR, and 32 were EN. In addition to the species flagged by IBAT, two EN and one CR marine species were identified as being possibly present in the BCIB project area by local informants interviewed in October 2021 as part of field surveys supporting EIA updating work. Each species identified by IBAT or the interview data was evaluated in the same manner as described above for the terrestrial species. The results of the by-species evaluation are summarized in Exhibit 5; sources consulted and range maps for all species are presented in Appendix 3.

Exhibit 5: By-Species Evaluation in Relation to Criterion 1 (Marine Species)

Species	Habitat and Range Notes[1]	Global population[2]	0.5% threshold	Probability of meeting Criterion 1 Threshold(a)
Aetomylaeus vespertilio Ornate Eagle Ray (EN)	This species is found in muddy bays, over muddy banks and coral reefs, from the surface down to 110 m depth. It was reported as a locally extant species by locals in interviews conducted in the BCIB project area in 2021. Although little is known of the species' global population, its range is thought to include several large, dispersed nodes around the Indo-Pacific and the Indian Ocean, and the very small part of the global range contained within Manila Bay can be considered extremely unlikely to harbor as much as 0.5% of the global population.	Unknown	-	Extremely low

[9] BirdLife International. 2016. *Anas luzonica*. *The IUCN Red List of Threatened Species* 2016: e.T22680214A92849560. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22680214A92849560.en. Accessed on 26 April 2022.

[10] Three waterbird species were also included, but these have been considered as part of the terrestrial fauna.

Species	Habitat and Range Notes[1]	Global population[2]	0.5% threshold	Probability of meeting Criterion 1 Threshold(a)
Alopias pelagicus Pelagic Thresher (EN)	Although the ecology of this species is not well understood, it is thought to be mainly an oceanic species that sometimes comes close to shore and enters lagoons around atolls. On this basis, the waters of Manila Bay seem unlikely to represent a significant habitat. The global population of this species is unknown, but distribution encompasses all of the Indian Ocean, Indo-Pacific region and most of the tropical and warm temperate Pacific, which suggests that the limited waters of Manila Bay would be extremely unlikely to support even a transient population representing as much as 0.5 of global population.	Unknown	-	Extremely low
Alveopora excelsa (EN)	This submassive coral species is typically found on exposed outer reef slopes as deep as 30 m, and may be considered relatively likely in the fringing reefs near the mouth of Manila Bay, where water quality conditions are known to favor more resilient massive, submassive and encrusting species. The species is distributed widely across the Coral Triangle and north to Taiwan and Japan, so it is highly unlikely that a population on the spatially limited, low-density reefs of Manila Bay would have any chance of meeting the 0.5% threshold.	Unknown	-	Extremely low
Alveopora minuta (EN)	A submassive coral species found on rocks exposed to currents, this species may be considered reasonably likely on some of the fringing reefs near the mouth of Manila Bay, particularly around Corregidor and Caballo Islands, where currents are strongest. If present on the limited area of low-density reefs within Manila Bay, it would certainly not meet the 0.5% threshold, as the species is widely distributed across the Coral Triangle.	Unknown	-	Extremely low
Anacropora spinosa (EN)	This branching coral species can be considered unlikely in Manila Bay, as the relatively high turbidity conditions that prevail there favor massive and encrusting coral species. If present on the limited area of low-density reefs within Manila Bay, it would certainly not meet the 0.5% threshold, as the species is widely distributed across the Coral Triangle.	Unknown	-	Zero
Balaenoptera borealis *Sei Whale* *(EN)*	Preferred habitat is in deeper waters far from the coastline, and there are no documented sightings of this species within Manila Bay. Even if the species were to be present as an occasional transient, there is no chance that individuals present would come anywhere close to meeting the 0.5% threshold.	50,000	250	Zero
Balaenoptera musculus *Blue Whale* *(EN)*	Blue whales are thought to be very uncommon in the Philippines, and there are no known sightings of this species within Manila Bay. All documented sightings in the Philippines since the late 19th century have come from the Bohol Sea. Even if the species were to be present as an occasional transient, there is no chance that individuals present would come anywhere close to meeting the 0.5% threshold.	5,000–15,000 mature individuals	25–75	Zero
Carcharhinus amblyrhynchos Grey Reef Shark (EN)	This shark is common around coral reefs, particularly near drop-offs and fringing reefs, and so may be considered a possible visitor to areas around the mouth of Manila Bay, and very unlikely to be found further in. It has a very wide, if patchy, distribution across the Indian and Pacific Ocean, with major concentration in the Indo-Pacific. It is extremely unlikely that any population around the mouth of Manila Bay would constitute anywhere close to 0.5% of the global population.	Unknown	-	Zero
Carcharhinus borneensis Borneo Shark CR	This species did not appear in the IBAT screening lists, but was identified by local informants in the BCIB project area in October 2021, with reference to a visual key. A small shark that frequents shallow inshore areas, the Borneo shark is	Unknown	-	Very low

Species	Habitat and Range Notes[1]	Global population[2]	0.5% threshold	Probability of meeting Criterion 1 Threshold(a)
	frequently taken in subsistence fisheries throughout its range, and is thought to have suffered steep population declines and shrinkage of its EOO. The species' range includes coastal areas mainly around the southern part of the South China Sea, but there are also records from as far north as the Taiwan Strait. Range maps indicate the present center of distribution is likely along the northwest coast of Borneo, southeast coast of Sumatra, and the southern Malay Peninsula. The species' presence in the Philippines is listed by most sources as 'uncertain' or 'questionable'. Based on the available information, there is no basis for concluding that a population in Manila Bay would be likely to exceed 0.5% of global population.			
Carcharhinus longimanus Oceanic whitetip shark (CR)	This very widespread pelagic shark species lives offshore in deep water, on the outer continental shelf, and around oceanic islands in deep water areas. Individuals may occasionally come near shore, but the waters of Manila Bay would not be expected to be preferred habitat for this species. There are no documented sightings of the species in Manila Bay.	Unknown	-	Zero
Carcharhinus plumbeus Sandbar Shark (EN)	This species did not appear in the IBAT screening lists but was identified by local informants in the BCIB project area in October 2021, with reference to a visual key. The species is typically found in shallow waters of bays, estuaries and harbors, and also on offshore oceanic banks to a depth of 280 m. The sandbar shark has a very wide distribution spanning the continental shelves and coastal areas of all tropical and warm temperate oceans. Accordingly, it is exceedingly unlikely that the Manila Bay population of the species could approach 0.5% of the global population.	Unknown	-	Extremely low
Cephaloscyllium fasciatum Reticulated Swellshark (CR)	The Reticulated Swellshark is a deep-water demersal species that lives on continental and insular shelf margins at depths between 200 and 400 m. Range maps indicate likely presence along the shelf edge off the west coast of Luzon, but this is well outside the relatively shallow waters of Manila Bay. This species would not be expected in the AoA.	Unknown	-	Zero
Chelonia mydas Green Turtle (EN)	This species has been reported to nest on beaches within Manila Bay, but available nesting data suggest that the Green Turtle is unlikely to be present in numbers sufficient to meet the 0.5% threshold; although annual nests on beaches within the bay may number in the hundreds on average, virtually all of these are reported to be the more common Olive Ridley Turtle.	85,000–95,000 nesting females	425–475 nesting females	Extremely low
Clupea manulensis - (CR)	*Clupea manulensis* is a small sardine species known only from the Manila Bay area but has not been recorded since its collection and classification in 1822. The species is considered possibly extinct. Very little is known of the biology of *Clupea manulensis*, but it is thought to be a wetland and riverine species, and the one available range map does not indicate presence in Manila Bay itself. The species did not turn up amongst sardine species documented in any of the several trawl surveys conducted in the bay over recent decades, which would tend not to support the probability of a significant marine stage in the life cycle. Based on the range map (which seems speculative at best), any population of this species that may be present in the limited inland aquatic habitat included in the AoA would seem unlikely to meet the 0.5% threshold, if indeed the species still exists.	Unknown	-	Low

Species	Habitat and Range Notes[1]	Global population[2]	0.5% threshold	Probability of meeting Criterion 1 Threshold(a)
Eretmochelys imbricata Hawksbill Turtle (CR)	This species is reported by research literature and locals to nest on beaches within Manila Bay, but this is apparently a relatively rare occurrence, compared to the nesting activity of the Olive Ridley Turtle (which accounts for all nests recorded by a municipal hatchery program in Mariveles, and virtually all nests recorded by a similar effort in Naic). The preferred diet of hawksbills is sponges that grow on coral reefs, which suggests that Manila Bay (with quite limited coral reef area) is not likely to support significant numbers of resident hawksbills. The available evidence does not strongly suggest that the number of hawksbills frequenting Manila Bay in any given year would meet the 0.5% threshold.	20,000–23,000 nesting females	100–115 nesting females	Low
Eusphyra blochii Winghead Shark (EN)	Although there are no records of this species being present in Manila Bay, the bay's waters would be expected to constitute preferred habitat for this species, which favors shallow nearshore and estuarine areas over sandy and muddy bottoms. The species is widely distributed in coastal areas throughout the Indo-Pacific and north Australia, and as far west as the Red Sea, which makes it very unlikely that a population within Manila Bay could constitute 0.5% of the global population.	Unknown	-	Very low
Gymnura zonura Zonetail Butterfly Ray (EN)	This ray's preferred habitat is inshore waters over soft substrates, up to 40 m in depth; Manila Bay can be considered to offer ample habitat. Global population size is unknown, but the species is widely distributed across the Indo-Pacific and all around the margins of the Indian Ocean, so it is extremely unlikely that even a robust population within Manila Bay would constitute 0.5% of the global population.	Unknown	-	Extremely low
Hemitriakis leucoperiptera Whitefin Topeshark (CR)	Very little is known about this shark, but it is thought to prefer shallow coastal habitat with sandy and muddy bottom, coral reefs and seagrass. The species is endemic to the Philippines. Range maps indicate Manila Bay is within its expected range and may account for perhaps 1-2% of overall EOO. This shark is thought to have suffered steep population declines in heavily fished areas (where it is taken primarily as bycatch). Based on the long-term intense fishing pressure in Manila Bay, the local population is likely to be well below the average density found across its full range, which suggests that a local population of 1–2% of global population, which might be inferred from the range mapping, is very likely to be a significant overestimate. This species is therefore considered likely to be present, but not in numbers sufficient to meet the 0.5% threshold. The species was not reported as a locally known species in interviews with locals (using an identification key) in the BCIB project area in 2021.	Unknown	-	Low
Himantura uarnak Reticulate Whipray (EN)	This species, which is also known as the Coach Whipray and Honeycomb Stingray, did not appear in the IBAT screening lists, but was identified by local informants in the BCIB project area in October 2021, with reference to a visual key. It is typically found in inshore areas, preferring shallow waters including estuaries, intertidal lagoons, reef flats and reef faces, and sometimes into accessible freshwater bodies. This species has a wide distribution in coastal areas throughout the Indo-Pacific and all around the fringes of the Indian Ocean, including the Red Sea. It is extremely unlikely that a population within Manila Bay could approach 0.5% of the global population.	Unknown	-	Extremely low

Species	Habitat and Range Notes[1]	Global population[2]	0.5% threshold	Probability of meeting Criterion 1 Threshold(a)
Holothuria lessoni Golden Sandfish (EN)	This sea cucumber species is found in sandy and muddy flats in water depths typically less than 10 m, primarily within lagoons and in association with seagrass. The species can be considered a possible resident of selected areas within Manila Bay. The global range of this species extends to shallow areas around the Indian Ocean, throughout the Indo-Pacific, and across much of Polynesia, so a population in Manila Bay would have extremely low probability of meeting the 0.5% threshold.	Unknown	-	Extremely low
Holothuria scabra Golden Sandfish (EN)	This sea cucumber species prefers sandy-silty bottoms in low-energy shallow-water locations such as coral lagoons and near mangroves. It is strongly associated with seagrass beds, which are favored nurseries for juveniles. This species can be considered likely within some shallow areas of Manila Bay, but not in numbers sufficient to account for as much as 0.5% of the global population, as the global EOO is very large, spreading across all of the Indo-Pacific, much of Polynesia, and all around the margins of the Indian Ocean.	Unknown	-	Extremely low
Holothuria whitmaei Black Teatfish (EN)	This sea cucumber is found on slopes and passes within coral reef environments, in waters up to 30 m in depth. Manila Bay is on the far western extremity of the species' range, which extends across all of the eastern portion of the Indo-Pacific, across Northern Australia and over much of Polynesia. Based on its large global EOO, it is highly unlikely that a population present on the few reef areas within Manila Bay would constitute anywhere near 0.5% of the global population.	Unknown	-	Extremely low
Isurus oxyrinchus Shortfin Mako (EN)	A pelagic shark with very wide distribution through tropical and warm temperate oceans. Preferred habitat for this species is open ocean, and it is very unlikely that any individuals would be found within Manila Bay. Given the very large EOO, it is extremely unlikely that any population in the deeper waters outside the mouth (but inside the AoA) would approach 0.5% of the global population.	Unknown	-	Extremely low
Isurus paucas Longfin Mako (EN)	A pelagic shark with very wide distribution through tropical and warm temperate oceans. Preferred habitat for this species is open ocean, although it is thought that females may travel closer in towards shore to give birth. Given the shark's habitat preference and very large range, it is highly unlikely that the limited and shallow waters of Manila Bay would support, even temporarily, numbers sufficient to meet the 0.5% threshold.	Unknown	-	Extremely low
Lobophyllia serratus (EN)	This coral species is generally considered rare, although distributed widely across the Coral Triangle. It is a massive species found on reef slopes between 4 and 15 m depth, which may increase the probability of presence on the fringing reefs found around the mouth of Manila Bay, where generally turbid conditions tend to favor massive and encrusting corals. Given the small area of reefs within Manila Bay and a large EOO, it is extremely unlikely that local specimens of this species would approach 0.5% of the global population.	Unknown	-	Extremely low
Maculabatis macrura Sharpnose Whipray (EN)	Preferred habitat for this inshore species is soft bottom in depths less than 60 m, and range maps indicate likely presence in Manila Bay. The species' range covers most of Southeast Asia, and it is highly unlikely that Manila Bay could harbor more than 0.5% of the global population, given its limited area.	Unknown	-	Very low

Species	Habitat and Range Notes[1]	Global population[2]	0.5% threshold	Probability of meeting Criterion 1 Threshold(a)
Mobula birostris Giant Manta Ray (EN)	Giant manta rays are known to favor waters around seamounts and continental shelf edges with prominent upwelling, but also spend time in shallow inshore waters, including estuaries, so Manila Bay cannot be ruled out as habitat for this species (although none have been reported in the scientific literature, or by interviews conducted in 2021 fisherfolk and others in the BCIB project area). The species has a very wide distribution throughout coastal and seamount-proximate zones of tropical and temperate oceans, so any population in Manila Bay would be extremely unlikely to meet the 0.5% threshold.	Unknown	-	Extremely low
Mobula kuhlii Shortfin Devilray (EN)	This species is widespread in coastal and near-coastal areas around the Indian Ocean and Southeast Asia, and around the Solomon Islands; it is suspected that current documentation may under-estimate the global EOO. Preferred habitat is inshore areas to 50 m, including around coral reefs. This species can be considered a possible resident of Manila Bay, although its wide global distribution suggests that a local population in the bay would be extremely unlikely to approach 0.5% of global population.	Unknown	-	Extremely low
Mobula mobular Spinetail Devilray (EN)	Also known as the Giant Devilray, this species was reported in interviews with locals in the BCIB project area in 2021. It is a pelagic species that spends most of its time in coastal waters less than 50 m deep and migrates seasonally according to prey abundance. The species has a patchy but very wide distribution across all tropical and warm temperate oceans, and it is extremely unlikely that the size of the population using Manila Bay (a tiny portion of the total EOO) in any given year would approach 0.5% of the global population.	Unknown	-	Extremely low
Mobula tarapacana Sicklefin Devilray (EN)	Primarily an oceanic species, which is occasionally seen in shallow waters, especially in areas with prominent upwelling, such as around seamounts. The species was reported by locals in interviews conducted in the BCIB project area in 2021. Given a circumglobal distribution, the modest amount of habitat available in Manila Bay would be extremely unlikely to harbor as much as 0.5% of the global population.	Unknown	-	Extremely low
Mobula thurstoni Bentfin Devilray (EN)	Thought likely to be globally distributed in tropical and warm temperate seas, this species has a planktivorous diet and frequents areas with robust upwelling such as seamounts, continental shelf edges and insular coasts. The West Philippine Sea (South China Sea) is within its confirmed range. The Bentfin Devil Ray can be considered possibly present in Manila Bay, but given its global distribution, this relatively small area of marginal habitat is extremely unlikely to support a population approaching 0.5% of the global population.	Unknown	-	Extremely low
Montipora setosa (EN)	This digitate coral species is found on reef slopes as deep as 20 m, and can be considered unlikely in Manila Bay, as the relatively high turbidity conditions that prevail there favor massive and encrusting coral species. If present on the limited area of low-density reefs within Manila Bay, it would certainly not meet the 0.5% threshold, as the species is widely distributed across the Coral Triangle.	Unknown	-	Extremely low

Species	Habitat and Range Notes[1]	Global population[2]	0.5% threshold	Probability of meeting Criterion 1 Threshold(a)
Pectinia maxima (EN)	This laminar coral species is known to favor somewhat turbid conditions. It occurs in shallow, sheltered locations protected from wave action, and thus may have limited habitat around the relatively exposed reef areas near the mouth of Manila Bay. The species is distributed across the Coral Triangle and the Solomon Islands; any small population that might exist in Manila Bay would be extremely unlikely to approach 0.5% of the global population.	Unknown	-	Extremely low
Porites eridani (EN)	This laminar and sometimes partially digitate coral species can be considered relatively unlikely in Manila Bay, as the relatively high turbidity conditions that prevail there favor massive and encrusting coral species. If present on the limited area of low-density reefs within Manila Bay, it would certainly not meet the 0.5% threshold, as the species is widely distributed across the entire Coral Triangle.	Unknown	-	Extremely low
Porites ornata (EN)	This branching coral species can be considered unlikely in Manila Bay, as the relatively high turbidity conditions that prevail there favor massive and encrusting coral species. If present on the limited area of low-density reefs within Manila Bay, it would certainly not meet the 0.5% threshold, as the species is widely distributed across the Coral Triangle.	Unknown	-	Extremely low
Pristis pristis Largetooth Sawfish (CR)	Range maps indicate that the presence of this shallow-water estuary-favoring species is uncertain throughout the Philippines, due to long-term overfishing. Based on this, it can be considered very unlikely that Manila Bay would sustain a substantial population, despite offering suitable habitat. With more viable populations in other parts of the world, it is extremely unlikely that a tiny remnant population in Manila would approach the 0.5% threshold.	Unknown	-	Extremely low
Pristis zijsron Green Sawfish (CR)	Range maps for the Green Sawfish indicate that most of the Philippine archipelago, including western Luzon, is a 'presence uncertain' zone. However, interviews with local informants in the BCIB project area in 2021 revealed that the species is locally known. Estuaries are preferred habitat for the species. Given that the Green Sawfish has known distribution across large areas along the North Australian coast and southern New Guinea, as well as all around Borneo, Java, Sumatra and the Malay Peninsula, the likely small population in Manila Bay can be considered very unlikely to constitute as much as 0.5% of the global population.	Unknown	-	Very low
Rhina ancylostoma Bowmouth Guitarfish (CR)	Manila Bay offers favorable habitat for this species, which lives in shallow waters from very near shore to 70 m depth, and feeds on sandy and muddy substrates and around rocky and coral reefs. The species is widely distributed in shallow areas across the Indo-Pacific, from Korea to Australia, and around the northern and western Indian Ocean all the way to Madagascar. Thus, even a thriving population in Manila Bay would be very unlikely to constitute as much as 0.5% of the global population.	Unknown	-	Extremely low
Rhincodon typus Whale Shark (EN)	The Whale Shark is known to frequent both open oceanic and coastal waters, and aggregate on an opportunistic basis in areas of high planktonic production. Whale Sharks have been documented within Manila Bay. Given the estimated global population size, it can be considered inconceivable that individuals using Manila Bay habitat in any given year would do so in numbers sufficient to meet the 0.5% threshold.	119,000–238,000	595–1,190	Zero

Species	Habitat and Range Notes[1]	Global population[2]	0.5% threshold	Probability of meeting Criterion 1 Threshold(a)
Rhinoptera javanica Javanese Cownose Ray (EN)	Preferred habitats for this species include open seas, shallow seas, subtidal aquatic beds, coral reefs, estuarine waters, and coastal saline lagoons, in depths from 0–50 m. Manila Bay offers such conditions, and the species is likely to be present; however, the species has a wide distribution in shallow coastal waters throughout the Indo-Pacific, from Japan to the Red Sea and as far south as Indonesia and possibly northern Australia, and any population in Manila Bay would be extremely unlikely to approach 0.5% of the global population.	Unknown	-	Extremely low
Rhynchobatus australiae Bottlenose wedgefish (CR)	Preferred habitat for this species is soft substrate in shallow coastal waters to 60 m depth, and it is also sometimes found over coral reefs. Manila Bay can be considered to offer such habitat in abundance. Distribution for this species is widespread across shallow coastal waters throughout the Indo-Pacific and Indian Ocean, so a population in Manila Bay, while probable, is highly unlikely to approach 0.5% of the global population.	Unknown	-	Extremely low
Rhynchobatus springeri Broadnose wedgefish (CR)	Range maps for this species indicate patchy distribution in the Philippines but show Manila Bay as one of the more substantial areas of probable extent in the country. The species is considered a probable estuarine habitat specialist. Much larger portions of the species' EOO are to be found in northern Borneo, western Sumatra, the Malay Peninsula and Gulf of Thailand, suggesting that a population in Manila Bay would be quite unlikely to approach the 0.5% threshold	Unknown	-	Very low
Sphyrna lewini Scalloped Hammerhead (CR)	This coastal and semi-oceanic pelagic shark frequents continental and insular shelves and nearby deep water. In inshore locations, it is found over sandy, sand-mud and muddy bottoms. Based on habitat requirements, the species is likely in and around Manila Bay. However, the species is very widely distributed in nearshore areas around the world, in all tropical and warm temperate seas, so it is extremely unlikely that a population the limited area of Manila Bay would approach 0.5% of the global population.	Unknown	-	Extremely low
Sphyrna mokarran Great Hammerhead (CR)	A coastal and semi-oceanic shark species that is found both close inshore and well offshore and is reported to enter enclosed bays and estuaries, the Great Hammerhead would be considered likely to use habitat within and around Manila Bay. However, as the species has a circumglobal distribution in almost all tropical and warm temperate seas, it is extremely unlikely that any population using Manila Bay would constitute as much as 0.5% of the global population.	Unknown	-	Extremely low
Stegostoma tigrinum Zebra Shark (EN)	This inshore shark species is typically found on sand, rubble or coral bottoms on continental shelves and around islands, and sometimes also ventures into freshwater systems. The species has a wide distribution in nearshore areas all around the Indian Ocean, throughout Southeast Asia and as far east as Tonga. Manila Bay can be considered likely habitat for this species but is very unlikely to harbor more than 0.5% of the global population, given the species' large global range.	Unknown	-	Extremely low

Species	Habitat and Range Notes[1]	Global population[2]	0.5% threshold	Probability of meeting Criterion 1 Threshold(a)
Thelenota ananas Prickly Redfish (EN)	This sea cucumber is known to favor shallow coral reef areas, particularly patchy reef slopes with rubble and coral patches interspersed with sandy passes; the reefs around the mouth of Manila Bay fit this description and are likely to be good habitat. As the species is widely distributed on reefs across Polynesia and the Indo-Pacific, and around the Indian Ocean and Red Sea, a population existing on the few reefs in Manila Bay would be extremely unlikely to meet the 0.5% threshold.	Unknown	-	Extremely low

[1] Information for habitat and range notes is sourced primarily from species profiles on redlist.org, supplemented as needed from other online sources.
[2] Global population estimates are sourced primarily from redlist.org, and other online sources where necessary.

The by-species evaluations presented in Exhibit 5 indicate that none of the EN and CR species identified in the marine IBAT screening can be considered likely to meet Threshold (a) under Criterion 1. This conclusion has been made using the AoA and will be reassessed and updated as appropriate when sufficient data to enable application of EAAAs are available for all relevant terrestrial and marine species. Assessment of VU and National and Regional Red List species data will also be integrated at that time, and adjustments made to the same conclusion if needed.

3.2 Criterion 2: Restricted Range and Endemic Species

3.2.1 Terrestrial Species

The IBAT data identified 22 terrestrial species considered to have a spatially limited EOO, a characteristic which may indicate special vulnerability to certain threats, most particularly habitat loss. Such species are evaluated in the context of critical habitat assessment regardless of their present IUCN-assigned conservation status. Findings from evaluation of the restricted range species list are summarized in Exhibit 6. Range maps and sources consulted for each species are presented in Appendix 3.

Exhibit 6: By-Species Evaluation in Relation to Criterion 2 (Terrestrial Species)

Species	Habitat and Range Notes[1]	Global population[2]	10% threshold	Probability of meeting Criterion 2 threshold
Abditomys latidens Luzon Broad-Toothed Rat (DD)	Very little is known of this species, which is only known from two specimens collected in a lowland rice field in Laguna Province and on Mt. Data in the Central Cordillera Range, respectively. There is no basis for concluding that any populations of this species that might be found in the AoA could constitute anywhere near 10% of the global population. This species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	Unknown	-	Extremely low
Apomys sacobianus Long-Nosed Luzon Forest Mouse (LC)	Also known as the Pinatubo Volcano Mouse, this small forest-dwelling rodent species is only known from forest above 365 masl in the area around Mt. Pinatubo. The nearest portion of the species' mapped range is about 30 km from the AoA. This species can be considered extremely unlikely to be present within the AoA. This species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	<10,000	1,000	Zero
Apomys zambalensis Zambales Forest Mouse (LC)	This species is known mainly from the Zambales Mountains, including Mt. Natib and Mt. Pinatubo, within the range of 365–1,690 masl. It is also considered to be possibly present on Mt. Mariveles. The small portion of the AoA around the southern base of Mt. Mariveles (which lies below the lower end of the known altitudinal range) would be extremely unlikely to support more than a tiny percentage of the global population. This species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	Unknown	-	Zero
Dasylophus superciliosus Red-Crested Malkoha (LC)	This species is found mainly in the Sierra Madre Range along the east side of Luzon, although range mapping indicates presence as a resident on Mt. Mariveles. The species was not found during field surveys in the BCIB project area in 2020 and 2021/2022. The EOO for this species is estimated at 144,000 km^2, which suggests that the terrestrial portion of the AoA in Bataan (about 75 km^2) would not be expected to support more than a tiny fraction of the global population.	Unknown	-	Extremely low
Erythropitta kochi Whiskered Pitta (NT)	Range maps for this upland forest species indicate likely presence around Mt. Mariveles in Bataan, and around Mts. Palay-Palay Mataas na Gulod and the Taal volcano in Cavite. The lower end of the bird's reported altitudinal range is 360 masl, which suggests that it is unlikely to be present within the AoA, whose highest point (in Bataan) would be about 300 masl. A lack of forest habitat within the AoA would also tend to rule out this species' presence.	10,000–19,999	1,000–2,000	Extremely low
Ficedula disposita Furtive Flycatcher (NT)	This species, which prefers dense lowland secondary forest, is known to occur across the entire Bataan peninsula, and on Corregidor Island. It was recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022. However, the terrestrial portion of the AoA (less than 80 km^2) contains a tiny portion of the known EOO (60,000 km^2), which also covers other zones of north and central Luzon. Accordingly, it is very unlikely that the AoA would support as much as 10% of the global population.	<10,000	1,000	Extremely low

Species	Habitat and Range Notes[1]	Global population[2]	10% threshold	Probability of meeting Criterion 2 threshold
Fregata minor Great Frigatebird (LC)	This species has an enormous EOO, estimated at 126,000,000 km^2, and is not a restricted range species. Nesting colonies are found on small, isolated oceanic islands lacking predators, and dispersal outside of breeding season is very wide but generally focused on high-productivity ocean areas with upwelling, divergences and convergences. It is possible that individuals of the species may make their way to the outer reaches of Manila Bay to feed, but certainly not in numbers approaching the 12,000 individuals needed to meet the 10% threshold. This species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	120,000 mature individuals	12,000 mature individuals	Zero
Lepidogrammus cumingi Scale-Feathered Malkoha (LC)	Most of this species' mapped range is in the Sierra Madre Range along the eastern side of Luzon, but it is reported from Mt. Mariveles. The species was not found during field surveys in the BCIB project area in 2020 and 2021/2022. The EOO for this species is estimated at 168,000 km^2, which suggests that the terrestrial portion of the AoA in Bataan (about 75 km^2) would not be expected to support anywhere near 10% of the global population.	Unknown	-	Extremely low
Oriolus albiloris White-Lored Oriole (LC)	Occurrence of this species is restricted to parts of northern Luzon, including Mt. Mariveles. The species prefers forest but is known to use highly disturbed areas as marginal habitat. It was not observed in field surveys in the BCIB project area in 2020 and 2021/2022. The estimated EOO for this species is 85,100 km^2, which suggests that any individuals that may be found within the Bataan terrestrial portion of the AoA (75 km^2) would be extremely unlikely to comprise anywhere near 10% of the global population.	Unknown	-	Extremely low
Oriolus isabellae Isabela Oriole (CR)	This forest-dependent species is present in only a few localities in the northern Sierra Madre Mountains. It was formerly reported from southern Bataan but is now considered likely to be extinct in this area, as it has not been seen there since 1947. The AoA contains very little preferred habitat (primary and secondary bamboo forest) for this species, and the very limited forest area within the Bataan portion (an estimated maximum area of 10 km^2 on the lower slopes of Mt. Mariveles) would constitute about 0.1% of the EOO for the species (8,900 km^2). Even if still present in this part of Bataan, local population numbers would be extremely unlikely to meet the 10% threshold. The Isabella Oriole was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	250	25	Extremely low
Phoenicurus bicolor Luzon Water-Redstart (NT)	This bird's main range is in mountainous areas of northern Luzon (Sierra Madre Range and Central Cordillera). It is considered possibly extant in the Zambales Mountains, about 100 km north of the AoA. Given this, it can be considered highly improbable that the AoA could contain anywhere near 10% of the global population.	<10,000	1,000	Zero
Phylloscopus ijimae Ijama's Leaf-Warbler (VU)	The AoA is within the known range of this species, which is found all over Luzon, Taiwan and a number of islands in Japan. Based on the size of the terrestrial portions of the AoA with suitable habitat (forest and scrubland) as compared to the extensive global EOO (133,000 km^2), it can be considered very unlikely that anywhere near 10% of the global population would be found in the AoA. This species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	3,750–14,999	375–1,500	Extremely low

Species	Habitat and Range Notes[1]	Global population[2]	10% threshold	Probability of meeting Criterion 2 threshold
Platymantis luzonensis (NT)	Range maps for this frog species indicate that the AoA is some distance from known areas of occurrence, the nearest of which is 40 km away, south of Laguna de Bay. It is very unlikely that this species would be present at all in the AoA. It was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	<10,000	1,000	Zero
Platymantis mimulus Diminutive Forest Frog (LC)	This frog species has a scattered distribution across parts of Luzon and is also reported from Marinduque. One node of the mapped EOO extends into the far southwest portion of the AoA, in the hills along the border of Cavite and Batangas. The species is thought to have a narrow altitudinal range in the vicinity of 400 masl, which would tend to rule out all of the AoA. The estimated EOO for this species is 38,800 km^2, while the terrestrial portion of the AoA is just 163 km^2, which suggests that any populations within the AoA would be extremely unlikely to approach 10% of the global population. This species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	Unknown	-	Extremely low
Platymantis montanus (VU)	This frog species is confirmed present only in three mountainous areas of central and southern Luzon, putting the Manila Bay area outside the EOO. The lower end of the altitudinal range of the species is 800 masl, more than 500 m higher than the highest point in the AoA. The species has a very low probability of being present. It was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	<10,000	1,000	Zero
Rhabdornis grandis Grand Rhabdornis (LC)	A forest species, this bird is thought to be 'possibly extant' on Mt. Mariveles but can be considered unlikely in the disturbed habitat that predominates in the nearby AoA. Estimated EOO for this species is 41,600 km^2, which suggests extremely low probability that any individuals present in the Bataan portion of the AoA would constitute more than a tiny percentage of global population. This species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	Unknown	-	Zero
Robsonius sorsogonensis Bicol Ground-Warbler (NT)	Range maps indicate this species is confined to the central and southern Sierra Madre Range and the southern Bicol Peninsula and would therefore be very unlikely to be present in the AoA. In view of this, it can be considered highly improbable that the AoA could contain anywhere near 10% of the global population. The species can be found around limestone outcroppings and moss-covered boulders in broadleaf evergreen forest, habitat characteristics not represented within the AoA. This species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	<10,000	1,000	Zero
Scolopax bukidnonensis Bukidnon Woodcock (LC)	A ground bird that lives in clearings in montane forest at elevations of 700–2760 masl, this species is not known to be present anywhere near the AoA, according to available range maps. The nearest known portion of the species' range is around Mt. Natib, some 25 km to the north. This species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	Unknown	-	Zero

Species	Habitat and Range Notes[1]	Global population[2]	10% threshold	Probability of meeting Criterion 2 threshold
Sterrhoptilus nigrocapitatus Black-Crowned Babbler (LC)	Range maps for this forest species indicate likely presence around Mt. Mariveles and in the forested hills along the Cavite-Batangas border, both on the margins of the AoA. The species was not observed in surveys in the BCIB project area in 2020 and 2021/2022. The estimated EOO for this species is 174,000 km^2, which suggests extremely low probability that individuals found within the limited marginal-habitat areas of the AoA could approach 10% of global population.	Unknown	-	Extremely low
Tryphornys adustus Luzon Short-Nosed Rat DD	This generalist species is thought to prefer wet lowland habitats such as rice fields and other lowland agricultural lands but has also been recorded in secondary forest habitat up to 2,500 masl. It is only known from three areas of Luzon, the closest of which to the AoA is Mt. Makiling in Laguna Province. The species was not observed in field surveys in the BCIB project area in 2020 and 2021/2022. There is no basis for concluding that any populations of this species that might be found in the AoA could constitute anywhere near 10% of the global population.	Unknown	-	Zero
Zosterornis striatus Luzon Striped Babbler (NT)	This forest-dependent bird's main range is in the Sierra Madre Mountains, although occurrence is also indicated on Mt. Mariveles, which suggests possible overlap with the AoA. Given this, it can be considered possible that the species could be found within the AoA, but as the applicable portion of the AoA comprises at most 15 km^2 and the EOO for the species is estimated at 58,000 km^2, it is highly improbable that the AoA could contain anywhere near 10% of the global population. This species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	<10,000	1,000	Extremely low
Zosterornis whiteheadi Chestnut-Faced Babbler (LC)	This forest and scrubland species is considered 'possibly extant' across all of northern and central Luzon, but its typical altitudinal range of 800–2,600 masl makes it quite unlikely to be found within the AoA. It was not observed during field surveys in the BCIB project area in 2020 and 2021/2022. The species has an estimated EOO of 138,000 km^2, which indicates that any individuals that may use parts of the AoA's limited terrestrial areas would have no chance of constituting a significant percentage of the global population.	Unknown	-	Zero
[1] Information for habitat and range notes is sourced primarily from species profiles on redlist.org. Sources and range maps for each species are presented in Appendix 3. [2] Global population estimates are sourced from redlist. org.				

The findings presented in Exhibit 6 indicate that no terrestrial species are likely to meet the threshold necessary to be considered qualifying species for a critical habitat determination under Criterion 2. This conclusion has been made using the AoA and will be reassessed when data availability permits definition and evaluation of EAAAs for all relevant terrestrial species.

3.2.2 Marine Species

Only one of the CR and EN aquatic species identified in the marine IBAT screening can be considered a restricted range species: *Clupea manulensis*. Although it seems quite doubtful that this species still exists, any population present in the limited inland aquatic habitat contained within the AoA would be unlikely to exceed 10% of the global population. It is therefore determined that the AoA is not appropriately designated as critical habitat for any marine species in relation to Criterion 2.

3.3 Criterion 3: Migratory and Congregatory Species

3.3.1 Terrestrial Species

Of the 19 EN and CR animal species listed in the terrestrial IBAT data, two are known migrants and also congregatory: the Far Eastern Curlew (*Numenius madagascariensis*) and Great Knot (*Calidris tenuirostris*). A third species, the Golden-Capped Fruit Bat (*Acerodon jubatus*) is congregatory but not migratory. Based on review of global population and global EOO data, together with consideration of probable local occupancy, it is concluded that none of these species would have a strong probability of exceeding either of the thresholds under Criterion 3. The spatial extent of the AoA's terrestrial portions is extremely small relative to the global range of all of these species, and there is no evidence that any of them actually exist in significant numbers in the AoA. Exhibit 7 illustrates the factors contributing to the low probability that each species would be a qualifying species for a critical habitat determination under Criterion 3, Threshold (a). The Manila Bay ecosystem is not known as a concentrator site for individuals of any of these species during times of special environmental stress, so Threshold (b) is deemed not to apply.

Exhibit 7: By-Species Evaluations in Relation to Criterion 3 (Terrestrial Species)

Species	Habitat and Range Notes[1]	Global population[2]	1% threshold	Probability of meeting Criterion 3 Threshold(a)
Acerodon jubatus Golden-Capped Fruit Bat (EN)	Endemic to the Philippines and widely distributed across most of the archipelago, this forest-dependent species' preferred feeding habitats are primary forest and high-quality secondary forest. This bat shares mixed-species roosts in locations inaccessible to humans, such as steep slopes, cliff edges and mangrove islands. The AoA has almost no sites that match these descriptors well, although there may be some minor mangrove islands near the head of the bay, and some suitable secondary forest within the AoA on the lower slopes of Mt. Mariveles. Terrestrial portions of the AoA, especially when narrowed by habitat type, comprise a tiny fraction of the global EOO for this species, making it very unlikely that any population present could comprise as much as 1% of the Philippines-wide (i.e., global) population. This species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	10,000–20,000	100–200	Very low
Calidris tenuirostris Great Knot (EN)	Preferred wintering habitat for this migratory species is sheltered coastal habitats such as bays, estuaries and lagoons with large intertidal mud and sand flats, oceanic sandy beaches with nearby mudflats, sandy spits and muddy shorelines. Preferred wintering food is molluscs and crustaceans plucked from intertidal muds and sands. The global EOO is 331,000 km^2, of which the terrestrial portion of the AoA comprises less than 0.1%. Data from bird counts in areas of Manila Bay with preferred habitat from 2003–2018 indicate that no more than 500 individuals were ever documented across all count sites in any year. It can be considered very improbable that this species would meet the 1% threshold consistently. The species was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	292,000–295,000	2,920–2,950	Low

Species	Habitat and Range Notes[1]	Global population[2]	1% threshold	Probability of meeting Criterion 3 Threshold(a)
Numenius madagascariensis Far Eastern Curlew (EN)	Preferred wintering habitat for this migratory species is estuaries, mangrove swamps, saltmarshes and intertidal flats, particularly those with extensive seagrass meadows; this kind of habitat is found around the northern and some eastern fringe portions of Manila Bay. Data from bird counts in areas of Manila Bay with preferred habitat from 2003–2018 indicate that no more than 68 individuals were ever documented across all count sites in any year, which suggests very low probability that the wintering population within the AoA would exceed 1% of the global population. The Far Eastern Curlew was not recorded during faunal surveys of the BCIB project area in 2020 and 2021/2022.	32,000	320	Low

[1] Information for habitat and range notes is sourced primarily from species profiles on redlist.org. Sources and range maps for each species are presented in Appendix 3.
[2] Global population estimates are sourced from redlist. org.

As noted in the critical habitat screening report by SCE, Ltd., 16 waterbird species documented in the northern part of the AoA were highlighted by a 2018 report of Wetlands International and IUCN as having local winter populations in excess of 1% of the population thought to use the East Asian-Australasian Flyway.[11] This raised the possibility that some or all of these species (none of which are CR or EN species) might also exceed the Threshold (a) value (1% of global population), and perhaps even the Threshold (b) 10% level. For the present critical habitat assessment, the 2017-2018 bird count data for these 16 species were compared to global population estimates gathered from the IUCN Red List species profiles. The results of the comparison are presented in Exhibit 8. It will be noted that global population data are typically presented as a range, so the percentage calculations also generated a ranged output.

The data presented in Exhibit 8 indicate that six migratory waterbird species exceed the Threshold (a) value of 1% of global population, and are thus considered qualifying species for a critical habitat determination for the AoA. These six species are the Red-Necked Stint (*Calidris ruficollis*), Long-Toed Stint (*Calidris subminuta*), Kentish Plover (*Charadrius alexandrinus*), Whiskered Tern (*Chlidonius hybrida*), Black-Winged Stilt (*Himantopus himantopus*) and Pacific Golden Plover (*Pluvialis fulva*).

It can also be seen from Exhibit 8 that the 2017-2018 survey populations of two of the waterbird species evaluated (*Chlidonius hybrida* and *Pluvialis fulva*) represent especially high percentages of the respective global populations; the upper end of the ranged proportions are in excess of 10%, and mid-range percentages are in the vicinity of 10% (*Chlidonius hybrida* = 10.7%; *Pluvialis fulva* = 8.9%). These numbers approach or slightly exceed the 10% threshold that pertains to Threshold (b), but there is no indication that the concentrations observed are related to a time of special environmental stress, nor is Manila Bay known to predictably serve as an important refuge for these or any other species during times of stress. Accordingly, these species are not considered to trigger a critical habitat determination in relation to Threshold (b). It is noteworthy, however, that the Manila Bay

[11] Jensen, A.E. 2018. Internationally Important Waterbird Sites in Manila Bay, Philippines, October 2018. Technical Report. Wetlands International and IUCN National Committee of the Netherlands.

ecosystem appears to be of heightened importance for these two species, one of which (*Chlidonius hybrida*) was recently documented feeding in the BCIB project area.

Exhibit 8: Populations of Selected Waterbirds in Manila Bay (2017-2018 Census) as Percentage of Global Population

Species name	Common name	IUCN status	Counted in Manila Bay 2017-2018[1]	Global Population (low)[2]	Global Population (high)[2]	% in Manila Bay 2017-2018 (low)	% in Manila Bay 2017-2018 (high)	Criterion 3 Threshold(a) (>1%)
Ardea alba	Great Egret	LC	4,664	590,000	2,200,000	0.2	0.8	NO
Calidris ruficollis	Red-Necked Stint	NT	4,741	315,000	315,000	1.5	1.5	YES
Calidris subminuta	Long-Toed Stint	LC	553	25,000	25,000	2.2	2.2	YES
Charadrius alexandrinus	Kentish Plover	LC	5,246	100,000	499,999	1.0	5.2	YES
Charadrius dubius	Little Ringed Plover	LC	280	280,000	530,000	0.1	0.1	NO
Charadrius leschenaultii	Greater Sand Plover	LC	769	150,000	340,000	0.2	0.5	NO
Charadrius mongolus	Lesser Sand Plover	LC	831	310,000	390,000	0.2	0.3	NO
Chlidonias hybrida	Whiskered Tern	LC	53,647	300,000	1,500,000	3.6	17.9	YES
Chroicocephalus ridibundus	Black-Headed Gull	LC	27,779	4,800,000	8,900,000	0.3	0.6	NO
Egretta eulophotes	Chinese Egret	VU	35	3,800	15,000	0.2	0.9	NO
Egretta intermedia	Intermediate Egret	LC	363	unknown	unknown	<1.0[3]	<1.0[3]	NO
Himantopus himantopus	Black-winged Stilt	LC	6,854	450,000	780,000	0.9	1.5	YES
Pluvialis fulva	Pacific Golden Plover	LC	19,164	190,000	250,000	7.7	10.1	YES
Tringa nebularia	Common Greenshank	LC	1,850	440,000	1,500,000	0.1	0.4	NO
Tringa totanus	Common Redshank	LC	1,629	1,300,000	3,100,000	0.1	0.1	NO

Notes
[1] As reported in Jensen, A.E. 2018. Internationally Important Waterbird Sites in Manila Bay, Philippines, October 2018. Technical Report. Wetlands International and IUCN National Committee of the Netherlands.
[2] Low and high global population estimates were collected from redlist.org (accessed 20 April 2022).
3 Global population estimates for *Egretta intermedia* are very uncertain due to recent taxonomic changes, but Wetlands International suggests the 1% level would be at least 1,000 observed individuals (see Delaney, S. and D. Scott, eds. 2006. Waterbird Population Estimates, 4th edition. Wageningen, The Netherlands: Wetlands International).

3.3.2 Marine Species

Of the 44 EN and CR aquatic species listed in the marine IBAT output report, 35 are mobile marine animals. Of these, 10 are known migrants, and five are thought to be significantly congregatory (see Exhibit 9). All of these species have been evaluated above in relation to Criterion 1, and none were found likely to be present in the AoA in numbers sufficient to exceed 0.5% of global population. Accordingly, none would meet the significantly higher threshold values under Criterion 3, i.e., 1% of global population for Threshold (a), and 10% of global population for Threshold (b). Therefore, the AoA is determined not to qualify as critical habitat in relation to migratory marine and congregatory species.

Exhibit 9 Migratory and Congregatory Marine Species From IBAT Screening (EN and CR)

Species	IUCN Status	Migratory	Congregatory
Eretmochelys imbricata Hawksbill Turtle	CR	YES	YES
Balaenoptera borealis Sei Whale	EN	YES	YES
Balaenoptera musculus Blue Whale	EN	YES	YES
Chelonia mydas Green Turtle	EN	YES	NO
Rhincodon typus Whale Shark	EN	YES	NO
Isurus oxyrinchus Shortfin Mako	EN	YES	NO
Stegostoma tigrinum Zebra shark	EN	YES	NO
Mobula tarapacana Sicklefin Devilray	EN	YES	YES
Mobula thurstoni Bentfin Devilray	EN	NO	YES
Mobula birostris Giant Manta Ray	EN	YES	NO
Mobula mobular Spinetail Devilray	EN	YES	NO

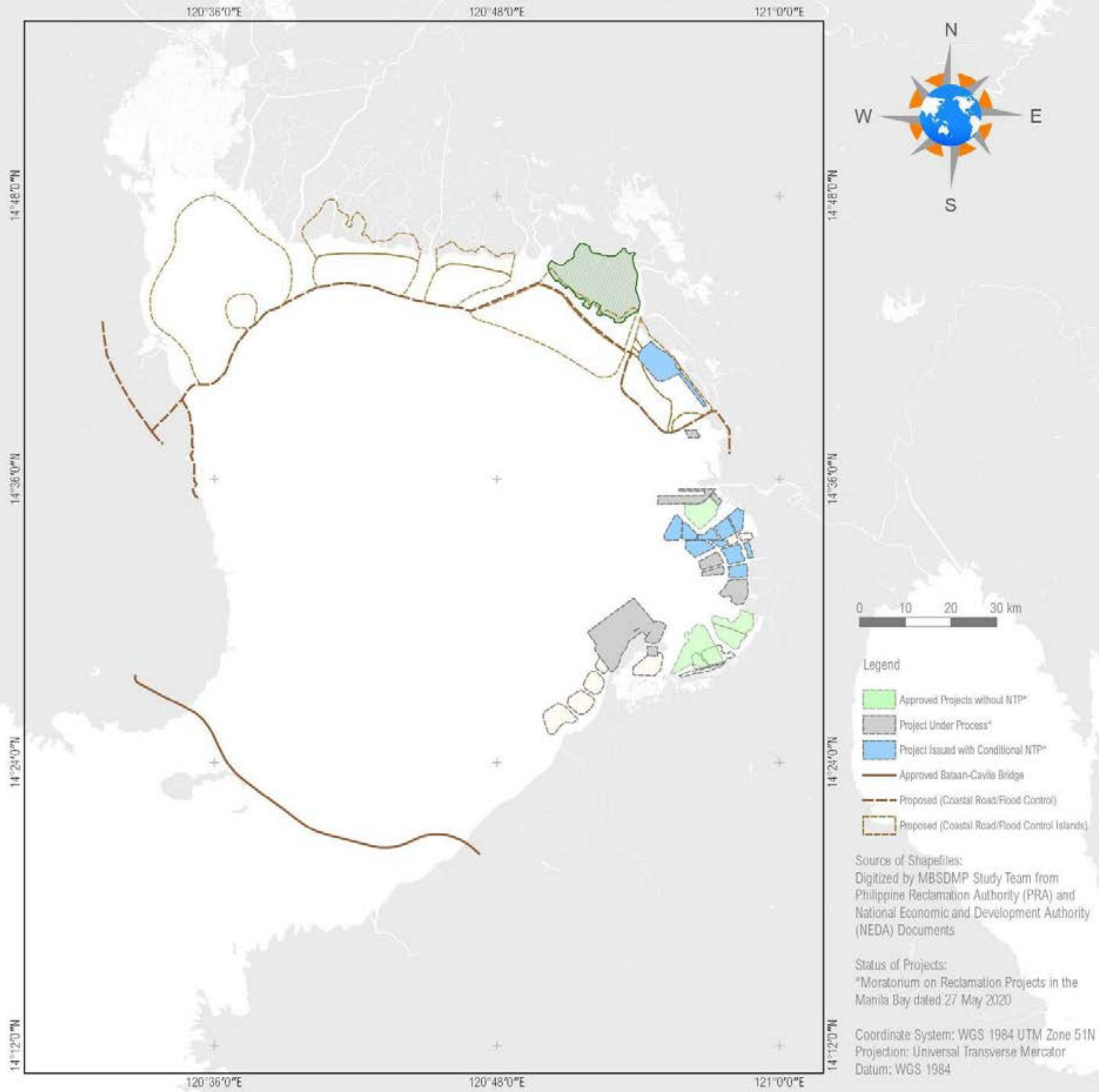
3.4 Criterion 4: Highly Threatened or Unique Ecosystems

The 2020 critical habitat screening report by SCE Ltd. suggested that Manila Bay may meet the requirements to be considered critical habitat based on Criterion 4, Threshold (b): *Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning*. The rationale for this suggestion points to the presence of coral reefs, which are widely acknowledged as a globally threatened ecosystem type, and the presence of a migratory bird concentration of global importance, as well as the evident interest at the local, regional and national level in reversing the decades-long decline of the Manila Bay ecosystem, as manifest in the Manila Bay Sustainable Development Master Plan process. As noted earlier, the Manila Bay ecosystem has not been evaluated under the IUCN Red List of Ecosystems framework, so Threshold (a) is not applicable.

3.4.1 Threats to the Manila Bay Ecosystem

There can be little doubt that Manila Bay is, in general, a significantly threatened ecosystem, with many active stressors and worsening conditions in relation to many indicators. The Manila Bay ecosystem is host to a megacity and a busy major port, and receives large quantities of untreated human waste, industrial effluents, urban stormwater and agricultural runoff from surrounding land areas. Rivers flowing into the bay from all directions are widely acknowledged not to meet national freshwater quality standards, and national marine water quality standards are sometimes not fully met over substantial portions of the bay, most particularly near river mouths and more heavily populated and industrialized portions of the shoreline. Hypoxic conditions develop in parts of the bay during certain times of the year. Much of the formerly vast area of mud flats, mangroves and brackish backwaters across the head of the bay has been converted to salt pans and aquaculture ponds, the latter of which are a major source of nutrients that contribute to hypoxia, harmful algal blooms and elevated turbidity. Fishing is a historical mainstay of coastal communities around the bay, but fisheries resources have been over-exploited and declining for decades. These and other problems have been documented and scrutinized in numerous academic works conducted across several scientific disciplines, as well as major comprehensive assessments such as those carried out under the auspices of the Manila Bay Environmental Management Project in the early 2000s and the more recent Manila Bay Sustainable Development Master Plan process (both are discussed below).

The factors mentioned above have contributed to declines in the health of the marine environment of Manila Bay over many decades. With regards to emerging threats to marine life, two significant concerns stand out: land reclamation and seabed mining. Metro Manila and surrounding areas continue to grow in population, density and spatial extent, and there is an ever-expanding list of development projects that would impinge upon the marine environment, including artificial islands, wharfs, jetties, shipping terminals, airports, coastal roads and flood control works. This is not a new problem, as shoreline development has long reshaped the coastal zone in the bay, especially in the vicinity of Metro Manila. However, the collective magnitude of currently proposed reclamation schemes represents something of a quantum leap in the threat level. The map in Exhibit 10 shows a partial accounting of reclamation proposals, and conveys a sense of the scope of projects that threaten to rework the coastal zone if approved and financed.



Source: NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 3: Manila Bay Atlas.

Exhibit 10: Proposed Reclamation Works Around Manila Bay

Linked in part to the aforementioned surge in land reclamation proposals, commercial and governmental interest in seabed mining poses a direct physical threat to water quality, benthic habitat and fisheries across nearly the entirety of Manila Bay. Most of the bay's area has been staked out as seabed mining tenements under the permitting process administered by the Department of Environment and Natural Resources – Mines and Geosciences Bureau (see Exhibit 11). The areas shown are at varying stages of the exploration and development process, but each is a potential mining zone, in which wholesale removal of seafloor habitat would take place, and from which vast quantities of suspended sediment could be released. As of early 2022, dredging activity is ongoing in two of the areas subject to approved extraction permits, both around the San Nicolas Shoals off Cavite.

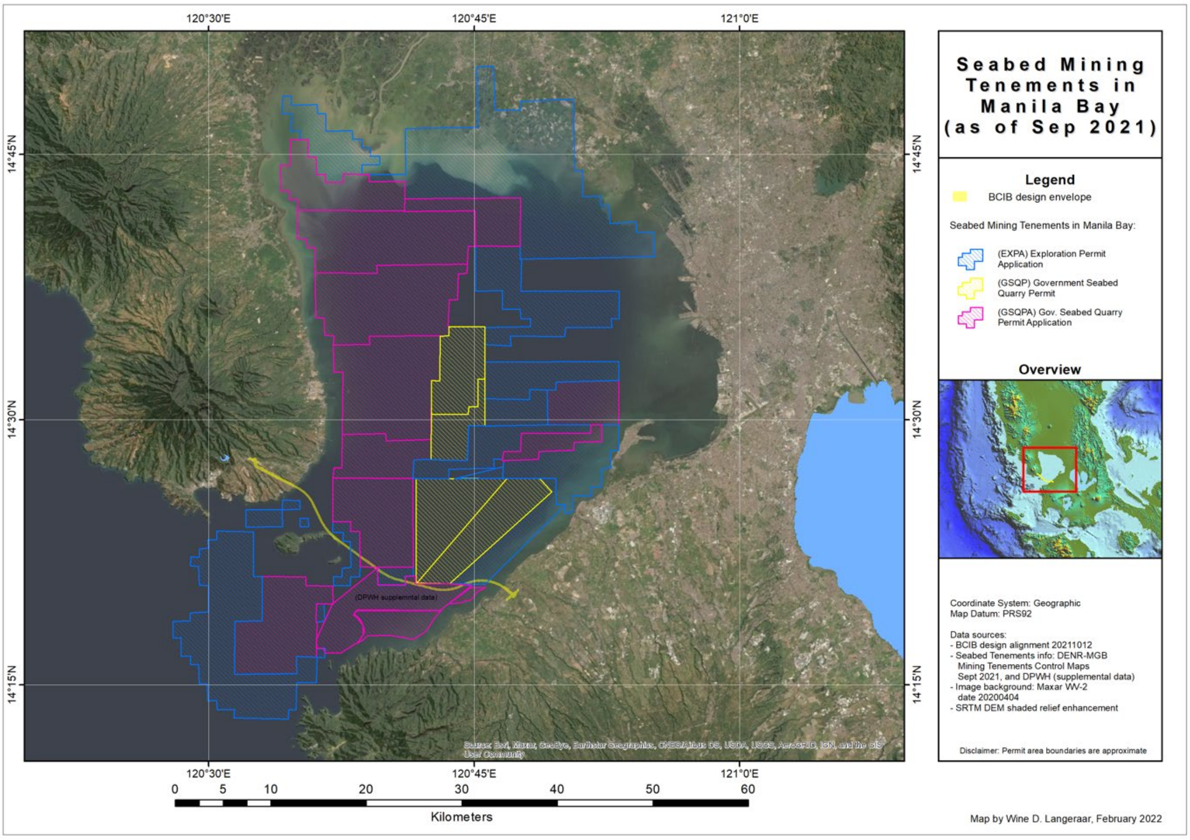


Exhibit 11: Mining Tenements in Manila Bay

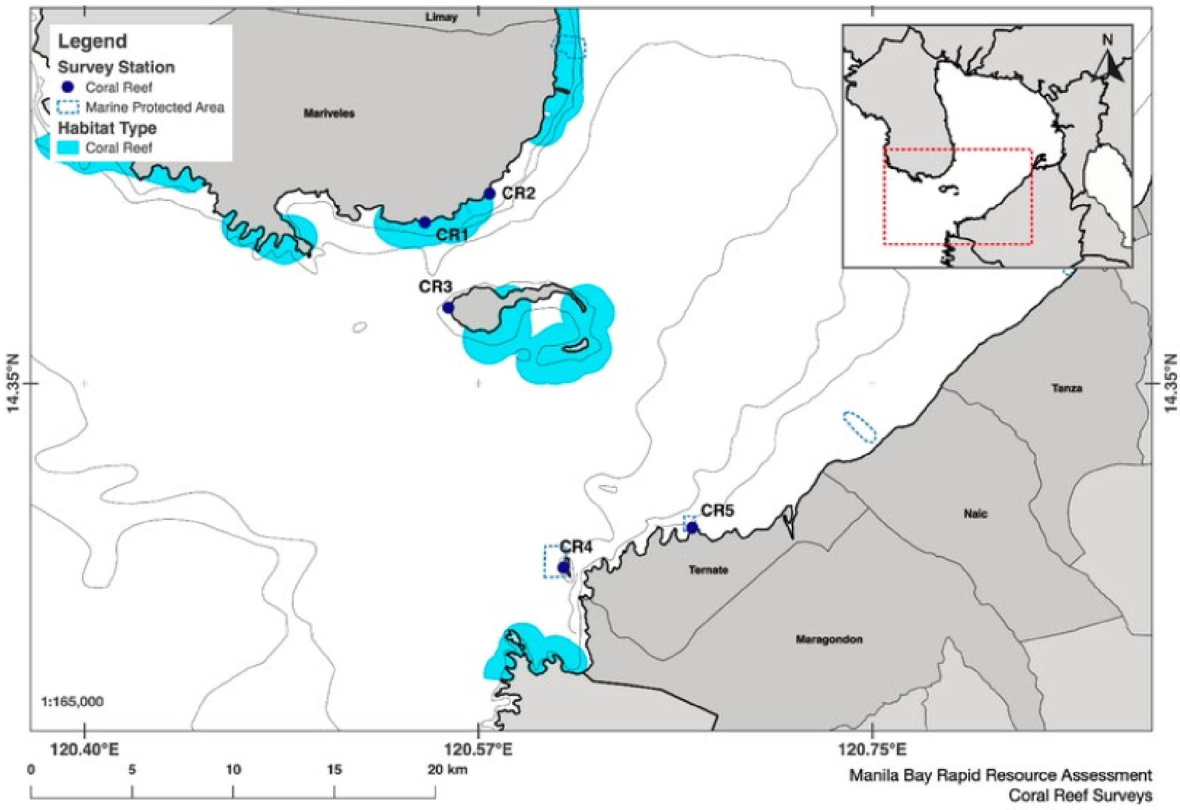
3.4.2 Threatened Ecosystem Components

With regards to specific biodiversity elements and values, Manila Bay contains locally significant remnants of ecosystem types that are under threat worldwide, including coral reefs, mudflats, mangroves and seagrass meadows. These habitats are known to play vital roles in supporting fisheries and bird life and their progressive loss and degradation are understood in the local context as a constraint on the development of sustainable fishing livelihoods, and as a threat to globally significant concentrations of migratory waterbirds that use Manila Bay as a stopover or wintering ground.

3.4.2.1 Coral reefs

Coral reefs in Manila Bay are thought to have been in decline for decades, threatened by overfishing, use of destructive fishing practices (particularly dynamite), increased sedimentation, and declines in water quality. It is probable that the reefs in Manila Bay, in common with reefs around the world, are also feeling the effects of climate change (i.e., warming and acidification), although this has not been documented. Coral reefs are not considered to have occupied large portions of Manila Bay historically, as a paucity of hard substrate for colonization, a dynamic sediment transport regime and naturally elevated turbidity pose basic biophysical constraints on reef establishment, but it is probable that the decline in this ecosystem has involved both a loss of overall reef area and a substantial reduction in the remaining reefs' biodiversity and habitat values. Corals are found mostly in fringing reefs around the rocky shores of Corregidor and Caballo Islands, southern

Mariveles, and far western Cavite and northern Batangas, all near the bay's mouth.[12] Loss and decline in coral reef habitats is understood to limit fish biomass available for harvest, as well as ecotourism potential. One representation of the distribution of coral reefs in Manila Bay is shown in Exhibit 12.



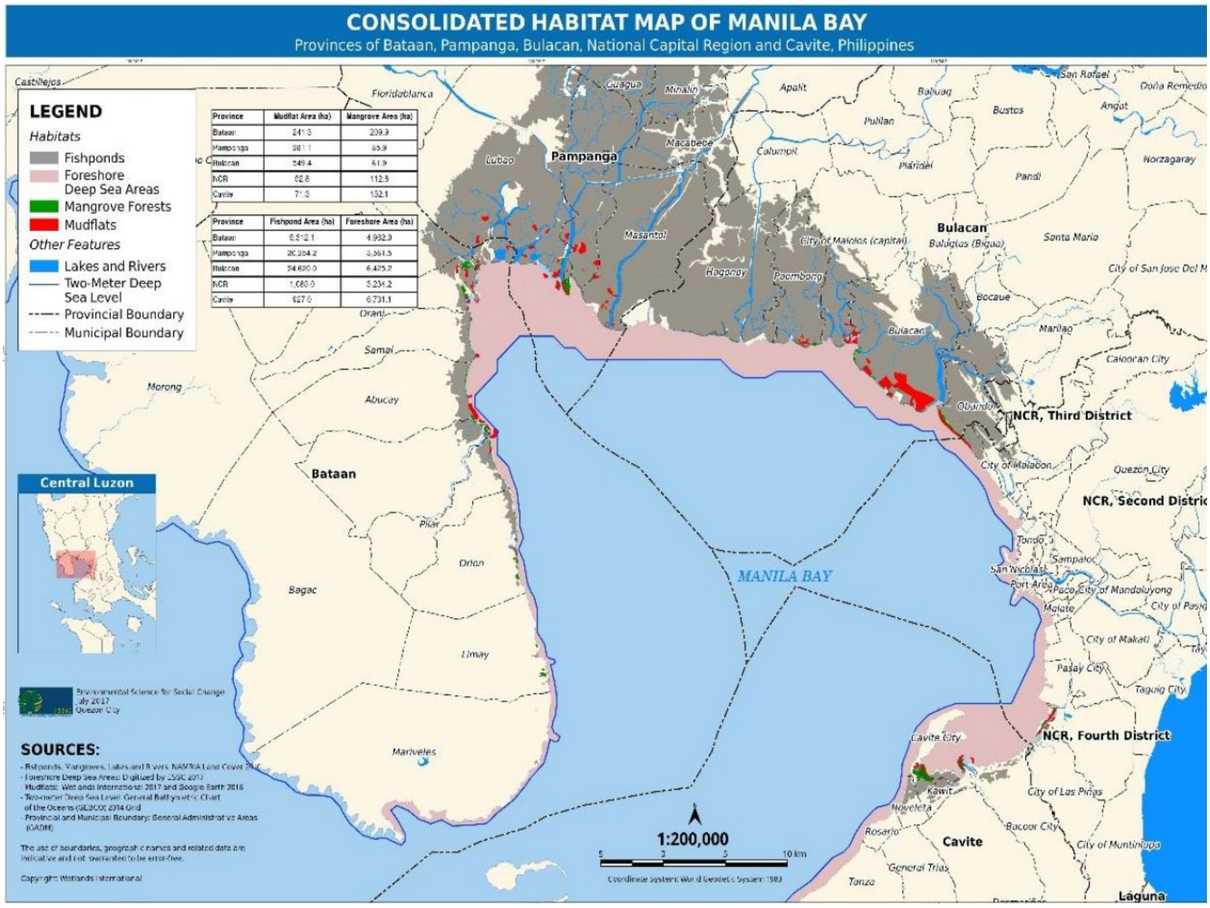
Source: NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 9: Rapid Resource Inventory. December 2020.

Exhibit 12: Distribution of Coral Reefs in Manila Bay

3.4.2.2 Mudflats

Mudflats are thought to have occupied a much larger area historically than they do today, with major expanses in the Pampanga River floodplain and near the mouths of other rivers, particularly around the northern and eastern fringes of Manila Bay. Declines in mudflat area are tied principally to conversion for aquaculture and salt pans, with encroachment and reclamation also taking their toll. Mudflats are prime habitat for invertebrates and the birds and fish that feed on them, and the loss of the remaining mudflat areas would be a significant blow to the value of Manila Bay as a wintering and stopover site for migratory waterbirds, which it has been historically.[13] The distribution of mudflats in Manila Bay can be seen on the map in Exhibit 13.

[12] NEDA. 2018. Manila Bay Sustainable Development Master Plan – Situation Analysis. Focal Theme Report, Environmental Protection. December 2018.
[13] Ibid.

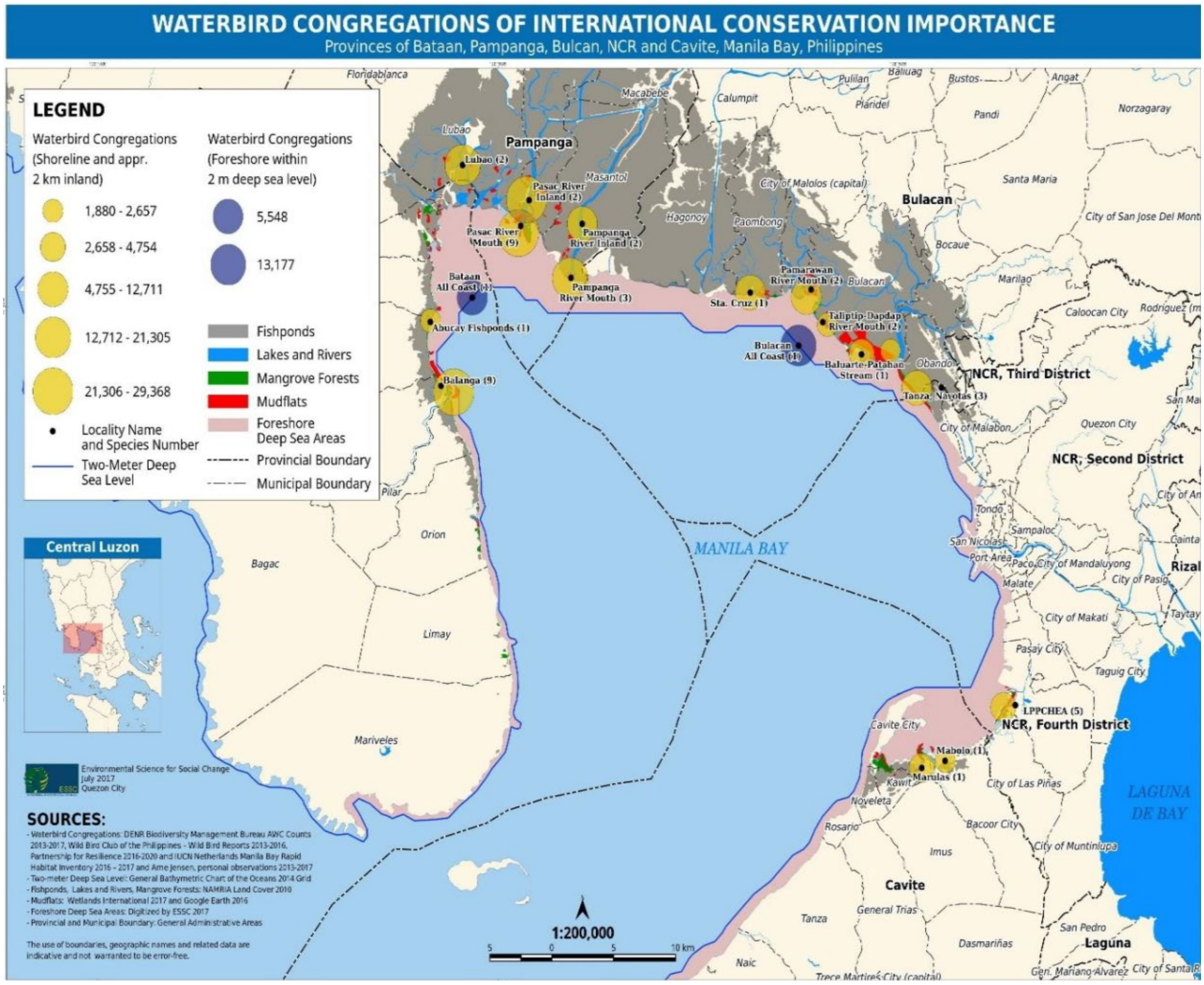


Source: Jensen, A.E. 2018. Internationally Important Waterbird Sites in Manila Bay, Philippines, October 2018. Technical Report. Wetlands International and IUCN National Committee of the Netherlands.

Exhibit 13: Distribution of Key Habitat Types, Including Mudflats

The role of mudflats and associated foreshore areas in supporting avian life is of heightened significance in Manila Bay, which is recognized as having both national and global importance for waterbirds. Manila Bay hosts the most significant concentration of waterbirds in the Philippines, and accounts for very high proportions of the country's overall populations of several species. The bay is also a major node in the eastern branch of the East Asian-Australasian Flyway, providing habitat to numerous migratory waterbird species, including transient populations that may approach 10% of global population for a handful of species (see Section 3.3.1 above). Mudflats are considered the most important habitat type for the waterbirds extant in Manila Bay.[14] The map in Exhibit 14 illustrates the strong spatial affinity between mudflat distribution and waterbird concentrations in Manila Bay.

[14] Jensen, A.E. 2018. Internationally Important Waterbird Sites in Manila Bay, Philippines, October 2018. Technical Report. Wetlands International and IUCN National Committee of the Netherlands.



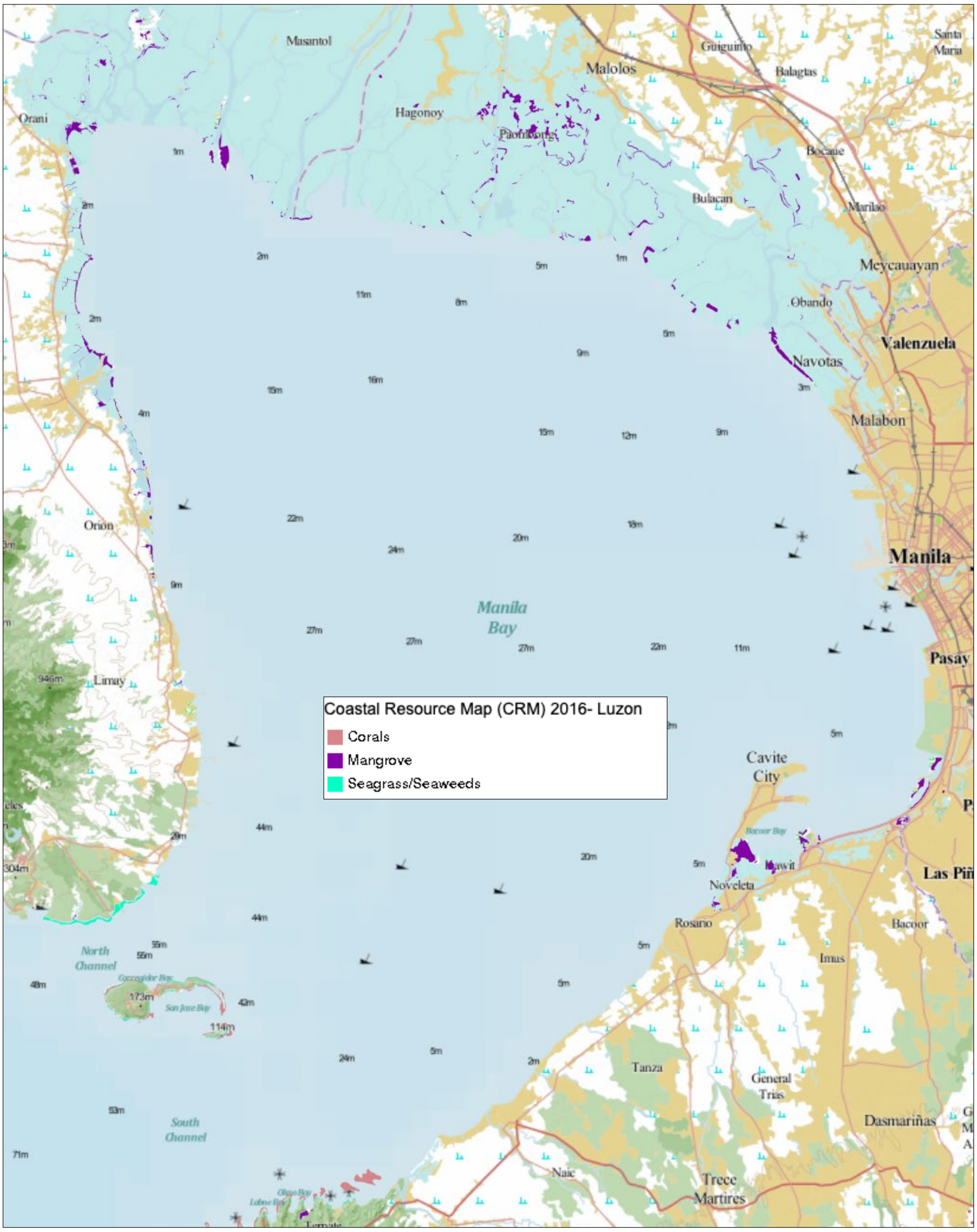
Source: Jensen, A.E. 2018. Internationally Important Waterbird Sites in Manila Bay, Philippines, October 2018. Technical Report. Wetlands International and IUCN National Committee of the Netherlands.

Exhibit 14: Distribution of Waterbirds in Numbers of Global Importance in Manila Bay

3.4.2.3 Mangroves

Mangrove forests around the fringes of Manila Bay are very much reduced from historical levels, due to conversion for aquaculture, salt pans and settlements, as well as over-exploitation for lumber and fuelwood, effects of water pollution, and natural factors such as insect infestations and suffocation by lahar flows. It is estimated that mangroves covered about 54,000 ha around Manila Bay at the beginning of the 20th century, but only 1–4% of that area remains today.[15] As mangroves play such an important role in the life cycles of many marine species (as breeding grounds and nurseries) and also provide roosting sites for numerous bird and bat species, loss of the remaining mangrove areas would have knock-on effects on the sustainability of fisheries and wildlife. Restoration efforts (mainly plantations) have resulted in an overall increase in mangrove area across the Manila Bay area in recent years, but mangrove habitat remains under threat in many places.[16] The distribution of mangroves around Manila Bay is shown in Exhibit 15.

[15] NEDA. 2018. Manila Bay Sustainable Development Master Plan – Situation Analysis. Focal Theme Report, Environmental Protection. December 2018.
[16] Ibid.



Source: NAMRIA. 2015. Coastal Resource Map 2016 – Luzon. geoportal.gov.ph.

Exhibit 15: Distribution of Mangroves Around Manila Bay

3.4.2.4 *Seagrass*

Seagrass meadows are thought to have occupied substantial portions of the seabed in the shallower fringes of Manila Bay at one time. These sensitive habitats support grazers such as dugongs and some marine turtles, and the modern absence of dugongs within the bay can likely be attributed principally to the loss of seagrass. Seagrass meadows also offer shelter to numerous invertebrates and fish, and are increasingly recognized as having major potential to capture and store carbon, thereby helping to mitigate climate change. Historical seagrass extent in Manila Bay is not well understood, but the prevailing scientific consensus is that this habitat type has experienced heavy losses due to increased sedimentation from land-based activity; elevated turbidity; coastal eutrophication; conversion for aquaculture, salt production and development; bottom trawling and dredging.[17] The present state of knowledge regarding seagrass distribution in Manila is very weak, but the clear water conditions necessary for seagrass to thrive are most likely near the mouth of the bay. As there are relatively few locations near the mouth of the bay that also have favorable sandy or muddy substrate at shallow depths, distribution is expected to be quite narrow. A seagrass distribution map generated from satellite imagery by the Allen Coral Atlas (see Exhibit 16) shows the entire predicted distribution for Manila Bay, all of it around Corregidor and Caballo Islands, as well as the south shore of Mariveles.

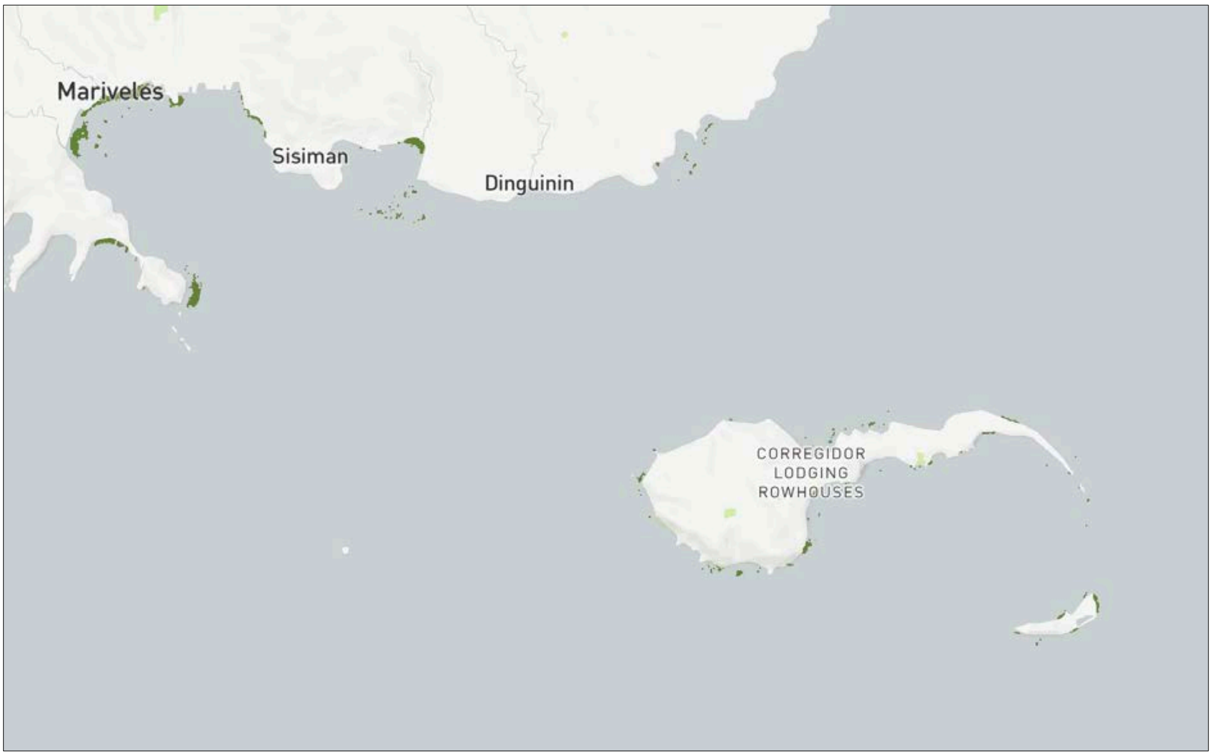


Image credit: Allen Coral Atlas

Exhibit 16: Predicted Seagrass Distribution in Manila Bay

3.4.2.5 Summary

In view of the foregoing, Manila Bay can reasonably be considered to qualify as a highly threatened ecosystem, both in relation to specific remnant areas of globally threatened ecosystem types, and as a whole integral ecosystem in its own right. As such, the AoA is appropriately evaluated in relation to Criterion 4. It remains, then, to establish whether the Manila Bay ecosystem has been 'determined to be of high priority for conservation by regional or national systematic conservation planning', as per Threshold (b).

3.4.3 Prioritization of Manila Bay Ecosystem Components as Conservation Targets

Governmental and multi-sectoral attempts to reverse declining water quality in Manila Bay go back to at least 1973, when the Pasig River Development Council was created with a mandate to clean up the Pasig River, which discharges to Manila Bay at the present South

[17] Ibid.

Harbor of the Port of Manila.[18] It was in the late 1990s and early 2000s that concerted institutional attention really began to focus in a more comprehensive and integrated way on the ecological health of Manila Bay as a whole. A major catalyst was the identification, by the Global Environment Facility, United Nations Development Program and International Maritime Organization, through their joint Program on Building Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), of Manila Bay as one of three subregional marine pollution hotspots in the region. The Manila Bay Environmental Management Project (MBEMP) was launched under the auspices of PEMSEA in 2000. One of the major outputs of the MBEMP was a comprehensive Manila Bay Coastal Strategy, which was formulated in late 2001.

Around the same time, the Protected Areas and Wildlife Bureau of the Department of Environment and Natural Resources (since renamed as the Biodiversity Management Bureau) was engaged, in collaboration with Conservation International–Philippines and the University of the Philippines, in a systematic effort to take stock of biodiversity resources, as a prelude to shaping of national commitments in the context of the Convention on Biological Diversity. Numerous locations around Manila Bay were identified as potential conservation targets in that assessment, which was put forward as the second iteration of the National Biodiversity Strategy and Action Plan in 2002.

Another major catalyst for attention and effort focused on the ecological health of Manila Bay during the early 2000s was the so-called Mandamus Writ, a directive issued in 2008 by the Supreme Court following a lengthy legal process that had originated in a 1999 complaint filed in a Regional Trial Court in Cavite by a group of concerned citizens, accusing multiple agencies of the national government of neglecting their statutory responsibilities for preventing environmental degradation affecting Manila Bay. The Mandamus Writ ordered 13 government agencies with mandates related in some way to water quality to develop and implement plans for cleaning up, rehabilitating and protecting Manila Bay. Although defined primarily in relation to water quality (the agencies are required to keep giving implementation progress reports on their Court-approved plans until such time as the bay's waters are found to meet the national SB water quality standards), the effect of the directive has been to focus significant purposive governmental attention on not just preventing further degradation of Manila Bay, but on restoring the integrity of a range of natural attributes, ecosystem functions and ecosystem services on land and in riverine, estuarine and marine environments.

More recently, in what can in many ways be understood as a direct follow-up to the MBEMP, work got underway on a Manila Bay Sustainable Development Master Plan in 2018. Under the leadership of the National Economic and Development Authority (NEDA) and with the support of the Government of the Netherlands, the master planning process brought renewed focus to conservation of the natural features and ecosystem services of Manila Bay, within a comprehensive approach that recognizes the interdependencies of natural and human systems in the region.

The major systematic assessment and planning efforts mentioned above are discussed in more detail below. Marine habitat protection efforts promoted by coastal municipalities, principally marine protected areas of various types, are also outlined.

[18] Vallejo. B.M. Jr., AB. Aloy, M. Ocampo, J. Conejar-Espedido, and L.M. Manubag. 2019. Manila Bay Ecology and Associated Invasive Species. Pp. 145–169 in C. Makowski and W. Finkl, eds. Impacts of Invasive Species on Coastal Environments. Coastal Research Library 29, https://doi.org/10.1007/978-3-319-91382-7_5.

3.4.3.1 Manila Bay Coastal Strategy

A key early output of the MBEMP was the 2001 formulation, in consultation with a broad array of institutional stakeholders, of a Manila Bay Coastal Strategy (MBCS). The release of the MBCS was marked by the signing of a Manila Bay Declaration affirming dedication to the strategy's implementation by over 100 representatives of key stakeholders implicated in the strategy.[19] A significant research and information compilation effort was developed under the MBEMP, including a risk assessment study and environmental atlas that examined Manila Bay as a single unit from ecological, social and economic vantage points. An Operational Plan for the Manila Bay Coastal Strategy was formulated in 2005 and updated periodically, with the most recent version covering the 2017–2022 period.

The MBCS articulated an environmental problematic with eight major dimensions:

1. Water pollution;
2. Solid waste;
3. Overexploitation of resources (including overfishing, deforestation, overextraction of groundwater, and uncontrolled mining activity);
4. Siltation and sedimentation;
5. Habitat degradation;
6. Natural hazards;
7. Sea level rise; and
8. Conflicts between resource uses.

Five general strategies were formulated to address the challenges identified, including Protect, Mitigate, Develop, Communicate and Direct. The most directly applicable to habitat and biodiversity conservation is the 'Protect' strategy, which has two key objectives: (1) Improvement of the health and well-being of the coastal and non-coastal communities in Manila Bay; and (2) Protection of natural features, and cultural, historical and religious sites. Supporting these objectives is a broad array of 'action programs' collectively seeking simultaneous and linked improvement in environmental quality; engagement and empowerment of communities in natural resource stewardship; rationalized and holistic resource management in agricultural, forestry and fisheries sectors; integrated coastal zone planning; and establishment and competent management of various types of terrestrial and marine protected areas to conserve and protect priority habitats and species. Action Program 3 (Protect and Conserve Biological Diversity) calls for:

1. Establishing sanctuaries for fish, birds, etc. in selected areas;
2. Establishing protected areas for critical habitats, and providing buffer zones around these areas;
3. Organizing community-based management of coastal habitats of Bay-wide significance; and
4. Developing legal, economic and financial mechanisms to ensure the maintenance of sanctuaries and protected areas.

[19] Manila Bay Environmental Management Project. 2001. Manila Bay Coastal Strategy.

3.4.3.2 Philippines Biodiversity Strategy and Action Plan

The Second Iteration of the Philippines Biodiversity Strategy and Action Plan, issued in 2002, identified over 400 locations and features around the country as Conservation Priority Areas (CPAs) in relation to particular classes of species or positioning within regional corridors.[20] Six sites in the Manila Bay area were included in the CPA list, as follows:

1. Bataan Natural Park and Subic Bay Forest Reserve (CPA 28), shown on a map as covering the entire Bataan peninsula, and identified as 'very high' priority in relation to terrestrial mammals;

2. Mariveles Mountains (CPA 29), listed as being of 'very high' priority for conservation of birds;

3. Manila Bay (CPA 30), around the head of the bay and identified as being of 'extremely high/critical' priority for birds;

4. Mts. Palay-Palay-Mataas na Gulod National Park (CPA 41), considered a 'very high' priority for birds;

5. Zambales Coast and Offshore (CPA 286), shown on a map as extending around the southern tip of the Bataan peninsula and partway into Manila Bay west of Corregidor Island, and identified as being of importance for conservation of marine turtles; and

6. Manila Bay (CPA 288), covering the entire bay and listed as a priority for conservation of reef fishes.

A follow-up effort by Conservation International, the Haribon Foundation and DENR's Protected Areas and Wildlife Bureau in 2006 combined the CPA list with a list of 177 Important Bird Areas (IBAs) developed by BirdLife International and the Haribon Foundation to formulate recommendations for designation of KBAs. The resulting list included 128 recommended KBAs and 51 areas identified as having the potential to be recommended as KBAs after further study (candidate KBAs).[21] Of the Manila Bay-area CPAs listed above, the first four were substantially reflected in KBA designations; this can be seen in the map in Exhibit 17.

Two of the recommended KBAs (Mariveles Mountains KBA and Manila Bay KBA) overlap slightly with the AoA as defined for this critical habitat assessment. Four other KBAs (Mts. Palay-Palay Mataas na Gulod National Park KBA; Bataan National Park and Subic Bay Forest Reserve KBA; Mt. Makiling Forest Reserve KBA; and Taal Volcano Protected Landscape KBA) also appeared in the IBAT screening report for the BCIB project, but these are all outside the AoA.

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[20] Ong, P.S., L.E. Afuang and R.G. Rosell-Ambal (eds.) 2002. Philippine Biodiversity Conservation Priorities: A Second Iteration of the National Biodiversity Strategy and Action Plan. Department of Environment and Natural Resources–Protected Areas and Wildlife Bureau, Conservation International Philippines, Biodiversity Conservation Program–University of the Philippines Center for Integrative and Development Studies, and Foundation for the Philippine Environment, Quezon City, Philippines.

[21] Conservation International/Haribon Foundation/DENR–PAWB. 2006. Priority Sites for Conservation in the Philippines: Key Biodiversity Areas.

Neither of the last two CPAs listed above, both marine areas, was accorded KBA status; however, as will be discussed below, sea areas of the Manila Bay ecosystem remain of significant interest in relation to establishment of marine protected areas.

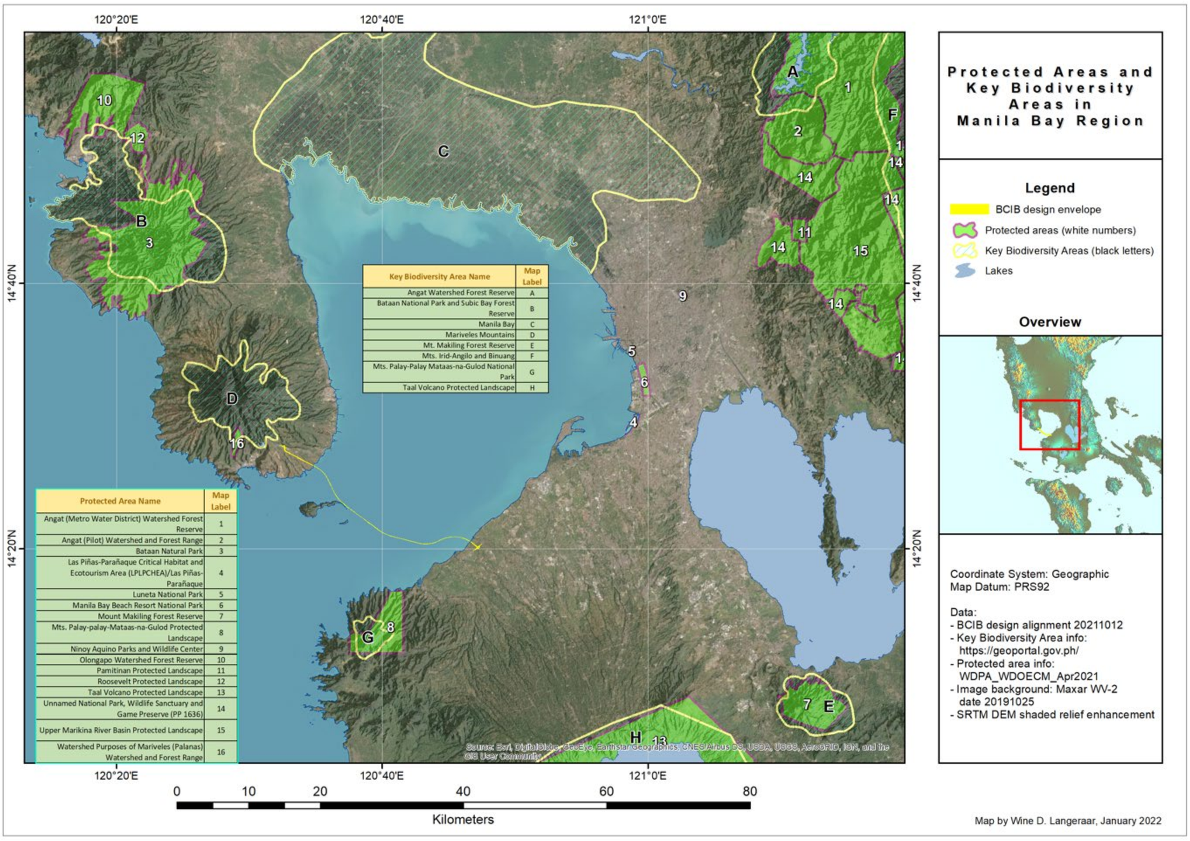


Exhibit 17: Terrestrial Protected Areas and Key Biodiversity Areas in Central Luzon

3.4.3.3 Expanded Integrated National Protected Areas System (E-NIPAS)

The IBAT screening reports identified 14 terrestrial protected areas within 50 km of the BCIB project alignment; two protected areas were noted within 10 km of the project alignment; all are listed as permanent or initial components of the Expanded Integrated National Protected Areas System (ENIPAS).

The first National Integrated Protected Areas System (NIPAS) came into being in 1992 via RA 7586, and represented an attempt to secure a coordinated direction for the assortment of protected areas of different types and objectives that had grown up over the decades as a result of presidential decrees, executive orders and acts of congress. The ENIPAS (established through RA 11038 in 2018) is an extension and further refinement and rationalization of the NIPAS, and places greater emphasis on biodiversity conservation as a focal goal of natural protected areas. Neither the ENIPAS nor the NIPAS is founded on a systematic targeting process like the one described above in relation to KBAs. However, the existence of component protected areas in the Manila Bay area is substantially linked to public and governmental perceptions over the decades with respect to patches of wild nature deemed worthy of permanent protection.

The practical relevance of particular protected areas in the context of the critical habitat assessment depends to a great extent on their location relative to the AoA, the extent to which they actually represent significant biodiversity resources, and the centrality of in-situ biodiversity conservation to management objectives. Exhibit 18 outlines the findings of desktop research on the areas listed in the IBAT screening reports. The protected areas discussed can be located on the map in Exhibit 17.

Exhibit 18: Protected Areas Identified in IBAT Screening Report

Listed site	Distance from BCIB footprint	Within AoA	Relevance to In-Situ Biodiversity Conservation in AoA
Mts. Palay-Palay Mataas-na-Gulod Protected Landscape	12 km	Partially	The northern portion of this protected area extends to the Cavite coast, and thus into the AoA. The strict preservation zone, which is considered a site of some importance for forest-associated birds among other things, and is the last remaining tract of lowland tropical rainforest in Cavite, covers the forested hills in its southwest portion and is outside the AoA. The small portion of the protected landscape near the coast that is within the AoA is significantly disturbed by roads, resorts and a golf course; a recent land cover study indicated that perennial crops, sparse vegetation and built-up areas are the predominant land cover types in this area, with dense forest being absent. The protected landscape may nevertheless be considered a potentially significant biodiversity resource in the context of the critical habitat assessment.
Watershed Purposes of Mariveles (Palanas) Watershed and Forest Range	5.8 km	No	Also known as Mariveles Watershed Forest Preserve, this 347-ha protected area was first designated over a century ago; its name suggests that protecting a water supply for Mariveles town was its principal originating rationale. The preserve retains significant forest cover in higher-elevation portions, which are within the Mariveles Mountains KBA and can be assumed to have significant biodiversity values. The preserve is outside the AoA.
Bataan Natural Park	28 km	No	This mostly forested protected area is centered on Mt. Natib. The park has significant biodiversity values, but has no direct relevance to biodiversity conservation in the AoA, given its distant location.
Las Piñas-Parañaque Critical Habitat and Ecotourism Area	27 km	Yes	This 181-ha protected area comprises two artificial islands created off the shore of Metro Manila as an offshoot of a coastal highway development project in the 1980s, which subsequently became forested with diverse mangrove species and acquired significant value as wildlife habitat, together with the surrounding brackish wetlands and mudflats. Designated as a Ramsar site, this protected area is well known as a refuge for migratory and resident waterbirds. It is within the AoA, and can be considered to have very significant biodiversity values.
Luneta National Park	45 km	No	This is an urban park with no significance for biodiversity conservation.
Manila Bay Beach Resort National Park	46 km	No	Officially gazetted in 1954 but not implemented, this park still exists on paper but has been completely urbanized, and has no biodiversity values.
Mount Makiling Forest Reserve and ASEAN Heritage Park	47 km	No	A mostly forested mountain area south of Laguna de Bay, this protected area is known to harbor numerous endemic species. The reserve is recognized as a center of plant diversity in the Philippines. Although the reserve has very high biodiversity values, it is well outside the AoA, and has little direct relevance in the context of the critical habitat assessment.
Ninoy Aquino Parks and Wildlife Center	54 km	No	This is an urban park with a botanical garden and significant values as a venue for environmental education, but no significance for in-situ biodiversity conservation in the AoA.
Olongapo Naval Base Perimeter National Park	56 km	No	Located near Subic Bay, this park is a tiny adjunct to the adjacent Olongapo Watershed Forest Reserve (see next).
Olongapo Watershed Forest Reserve	56 km	No	Located outside Subic Bay and apparently created largely to protect the water supply, this 6,300-ha park is mostly forest and natural grassland and likely has significant biodiversity values, but is far from the AoA and has no relevance for the critical habitat assessment.

Listed site	Distance from BCIB footprint	Within AoA	Relevance to In-Situ Biodiversity Conservation in AoA
Roosevelt Protected Landscape	55 km	No	A 768-ha park on the outskirts of Subic Bay that is known to offer habitat for numerous threatened species. Given its distance from the AoA, this protected area has no direct relevance for the critical habitat assessment.
Taal Volcano Protected Landscape	32 km	No	This large protected landscape has significant biodiversity values, including rare endemic species known to have evolved as a response to the area's volcanic dynamism. It is well outside the AoA, however, and has no direct relevance to biodiversity conservation in Manila Bay.

The findings presented in Exhibit 17 indicate that only two of the 12 protected areas identified in the IBAT screening overlap with the AoA. Both of these protected areas (Mts. Palay-Palay Mataas na Gulod Protected Landscape, and Las Piñas-Parañaque Critical Habitat and Ecotourism Area) represent significant biodiversity resources and are subject to biodiversity-driven management objectives. They are indicative of historical and still-ongoing conservation interest on the part of the national government and regional and local stakeholders in the Manila Bay ecosystem.

3.4.3.4 Manila Bay Sustainable Development Master Plan

Like the MBCS, the Manila Bay Sustainable Development Master Plan (MBSDMP) takes a broad approach, conceptualizing conservation issues and actions within a framework explicitly linking human prosperity and social life with environmental quality and ecosystem services. Within this overall sustainable development framework, biodiversity and natural habitats are targeted for protection and restoration for both their intrinsic and utilitarian values:

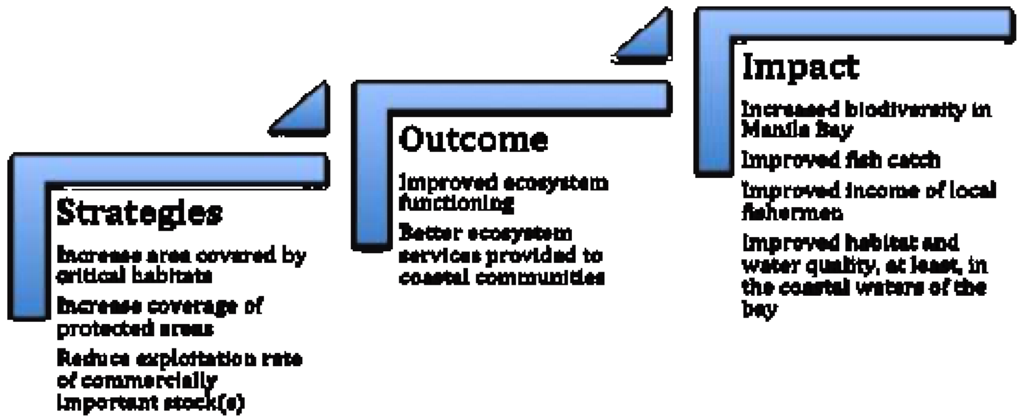
> Improved management of Natural Protected areas contributes to the overall productivity and resilience of Manila Bay by providing habitats to a diverse community of species, enhancing ecosystem productivity and biodiversity, and increasing the capacity of the system to assimilate pollution.[22]

This linked conception is evident in the results chain presented in relation to ecosystem protection within the rubric of the MBSDMP, as shown in Exhibit 19.

One of the six major thematic areas of the MBSDMP is 'Restore Natural Habitat', and the principal mechanism designated for protection and restoration is the marine protected area (MPA). The MBSDMP establishes targets for both establishment of new MPAs and improving protection and management of existing ones. The rationale is explained as follows:

> Protected areas established in Manila Bay comprise less than 1% of its total area. This is not sufficient to sustain not only the biodiversity of the bay, but also the ecological services they provide. Furthermore, protection and management of some of these existing MPAs remain weak and ineffective. Hence, increasing well-managed protected areas is a critical undertaking to ensure the sustainability of Manila Bay.[23]

[22] NEDA. 2020. Manila Bay 2040 – Final Master Plan. September 2020. (p. 35)
[23] NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan + Investment Report. Annex 6: PAPs Profiles. December 2020.



Source: NEDA. 2018. Manila Bay Sustainable Development Master Plan – Situational Analysis Report: Ecosystem Protection. December 2018.

Exhibit 19: Ecosystem Conservation Results Chain of MBSDMP

The MBSDMP proposals for increasing MPA coverage and enhancing MPA management take advantage of existing institutional configurations for MPA establishment and administration, as provided for under the Philippine Fisheries Code of 1986 (RA 8550). This law and its supporting regulations, which are implemented by the Bureau of Fisheries and Aquatic Resources (BFAR) under the Department of Agriculture, delegate responsibility for MPAs to the Local Government Units (LGUs) in whose municipal waters they are established.[24] The Locally Managed Marine Protected Area (LMMPA) is thus the predominant instrument for marine habitat protection and biodiversity conservation in the Manila Bay context. It may be noted that LMMPAs are also central to another major thrust of the MBSDMP, which is 'Increase Fish Biomass'. As articulated in the MBSDMP, LMMPAs are assumed to serve as nodes of fish biomass production due to their protection of benthic habitat supportive of feeding, reproduction, refuge and juvenile development:

> Restoration of natural habitats by increasing the number of marine protected areas and fish sanctuaries in Manila Bay will eventually affect fish biomass in the bay. The increase in restored marine habitats and the maintenance of existing protected critical habitats is expected to increase fish biomass and other marine life in Manila Bay.[25]

It will be noted in the passage reproduced above that the concept of 'critical habitat' is used to define targets for conservation; although the term is not formally defined in any of the MBSDMP documents, it appears from target-related discussions that it includes coral reefs, mudflats, mangroves, and seagrass. Use of the term reflects a sense that these ecosystem components are vital to the overall ecosystem, including the fishing economy, and thus deserve priority in conservation. This usage is not equivalent to the IFC conceptualization of critical habitat. A situational analysis report focused on ecosystem protection proposes eight indicators, of which four are defined by these marine 'critical habitat' categories, for measuring progress in the context of the MBSDMP, as follows:[26]

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[24] Philippines Fisheries Code of 1986 (R.A. 8550).
[25] NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan + Investment Report. Annex 6: PAPs Profiles. December 2020. (p.85)
[26] NEDA. 2018. Manila Bay Sustainable Development Master Plan – Situational Analysis Report: Ecosystem Protection. December 2018.

1. Mudflat cover;
2. Mangrove cover;
3. Seagrass cover;
4. Coral cover;
5. Forest cover;
6. Number of migratory waterbirds of international importance residing in Manila Bay;
7. Exploitation rate of fish stocks; and
8. Number of marine protected areas in Manila Bay.

One of the key action items being pursued under the auspices of the MBSDMP is the Locally Managed Marine Protected Area Project, which is composed of a series of sub-projects aimed at increasing the number and size of MPAs in Manila Bay by (1) assisting LGUs towards establishing LMMPAs; (2) increasing local capabilities through training and learning-by-doing though pilot projects; and (3) increasing capacities through participation and engagement of communities in managing marine protected areas in their jurisdictions. Collectively, the sub-projects formulated to date aim to establish 22,515 ha of new LMMPAs in the municipal waters of 30 coastal municipalities (see Exhibit 20). The proposed new LMMPAs are understood as pilots. Tools and best practices in establishing, institutionalization and management of LMMPAs under the pilot initiative are to be documented and made available to inform future expansion of the seafloor area under protection across Manila Bay.[27]

Exhibit 20: Targets for New Marine Protected Areas in Manila Bay Under MBSDMP

Province/Region	LGU	Target for New MPAs in Pilot Phase (ha)
Bataan	Abucay	294
	Balanga	9
	Limay	1,615
	Mariveles	1,732
	Orion	1,369
	Pilar	457
	Samal	214
Bulacan	Bulacan	877
	Hagonoy	1,529
	Malolos	409
	Obando	231
	Paombong	540
Cavite	Bacoor	100
	Cavite City	4,283
	Kawit	58
	Maragondon	1,184
	Naic	691
	Noveleta	417
	Rosario	722

[27] NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan + Investment Report. Annex 6: PAPs Profiles. December 2020.

Province/Region	LGU	Target for New MPAs in Pilot Phase (ha)
	Tanza	1,157
	Ternate	1,163
Metro Manila	Las Piñas	52
	Manila	1,558
	Navotas	531
	Parañaque	166
	Pasay City	76
Pampanga	Labao	71
	Macabebe	800
	Sasmuan	210
	Total	22,515 ha

Source: NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan + Investment Report. Annex 6: PAPs Profiles. December 2020.

3.4.3.5 Existing Municipal Marine Protected Areas

As has been noted above, the marine protected areas initiative developed under the auspices of the MBSDMP intends not only to establish new LMMPAs, but also to strengthen management of existing LMMPAs. A number of MPAs of various types have been established over the last three decades by coastal municipalities within Manila Bay, reflecting substantial interest in protecting marine habitat. Most early designations were conceived of as fish sanctuaries and fishery reserves, and are referenced to the typology indicated in the Philippine Fisheries Code RA 8550.[28] Consistent with a country-wide trend, establishment and management of such MPAs has been increasingly understood as an integral element of integrated coastal management (ICM), and implemented through the institutional supports available for ICM.[29] Establishment of MPAs by municipalities is encouraged as a coastal management best practice by the DENR's Biodiversity Management Bureau (DENR-BMB).[30] Municipal governments in both Bataan and Cavite, as well as Bulacan, are actively working on identifying further areas for protection, including both nearshore open water zones and coastal mangrove areas.[31] Existing MPAs exhibit various states of implementation status, institutional and financial support, management effort and effectiveness. Exhibit 21 lists the known LMMPAs established within Manila Bay as of the time of writing.

Exhibit 21: Municipal Marine Protected Areas in Manila Bay

MPA Name	Year established	Area (ha)	Municipality	Distance from BCIB (km)
Orion Kent Fish Sanctuary	1994	25	Orion (Bataan)	~23*
PNOC Fishery Reserve Area	2001	25	Mariveles (Bataan)	10
Naic Fish Sanctuary	2003	59	Naic (Cavite)	0.8
Tanza Fish Sanctuary	2009	45	Tanza (Cavite)	10
Bulaklakin Reef Fish Sanctuary	2005	13	Ternate (Cavite)	7
Limay Fish Sanctuary	2005	8	Limay (Bataan)	~16*

[28] R.A. 8550 – Philippine Fisheries Code of 1998, as Amended by R.A. 10654 (2013).
[29] See White, A.T., R. Eisma-Osorio and S.J. Green. 2005. Integrated Coastal Management and Marine Protected Areas: Complementarity in the Philippines. Ocean & Coastal Management 48()11-12): 948–971.
[30] DENR-BMB Technical Bulletin NO. 2017-14 – Guidelines on the Application of Integrated Coastal Management (ICM) as a Strategy in the Implementation of the Coastal and Marine Ecosystems Management Program (CMEMP).
[31] (1) Provincial Government of Cavite. 2017. State of the Coasts of Cavite Province.; (2) Provincial Government of Bataan. 2017. State of the Coasts of Bataan Province.

Rosario Marine Protected Area	2013	nd	Rosario (Cavite)	~15*
Carabao Island Fish Sanctuary	2015	57	Maragondon (Cavite)	12
Ternate Marine Park	2019	614	Ternate (Cavite)	5
Corregidor Islands Marine Park	2021	508	Cavite City (Cavite)	overlapping
Abucay Fish Sanctuary	nd	500	Abucay (Bataan)	~31*
Bulakan Mangrove Reserve Area	nd	23	Bulakan (Bulacan)	~45*

* Distance is approximated, as no mapping of this MPA was available

Sources

(1) MPA Support Network. Marine Protected Areas List. https://database.mpasupportnetwork.com/#mpa-list. Accessed 12 November 2021; (2) Provincial Government of Cavite. 2017. State of the Coasts of Cavite Province.; (3) Provincial Government of Bataan. 2017. State of the Coasts of Bataan Province.; (3) Provincial profiles of progress in integrated coastal management compiled by Sea Knowledge Bank. https://seaknowledgebank.net/content/bulacan. Accessed 1 December 2021.

In recent years, the more comprehensive MPA concept of the multi-use marine park has risen to prominence in the Manila Bay context, as reflected in the establishment of the Ternate Marine Park (2019) and Corregidor Islands Marine Park (2021). These are more substantial and ambitious conservation undertakings than the small sanctuaries and reserves that had been prevalent, and have a biodiversity conservation mandate that goes beyond the linkage between protection of benthic habitat and increased (or at least stable) fish biomass available to support fisherfolk livelihoods that underpins earlier MPAs. The management plans for both the Ternate Marine Park and Corregidor Islands Marine Park use a zoning approach that recognizes a range of biodiversity values, including intrinsic existence value, enablement of scientific research, fisheries productivity enhancement, eco-touristic potential, and sustainable extraction.[32] This is illustrated in the map of Corregidor Islands Marine Park shown in Exhibit 22.

3.4.4 Summary Evaluation of the Manila Bay AoA Against Criterion 4

Based on the foregoing consideration of (1) the threats facing the Manila Bay ecosystem; and (2) the extent to which key elements of the Manila Bay ecosystem have been identified as targets for conservation, it is clear that the AoA used in the present critical habitat assessment meets the definition as per Criterion 4, Threshold (b): *Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning*.

Key habitats in Manila Bay are both highly threatened and subject to long-standing and progressively developing systematic efforts to ensure their conservation. A determination as critical habitat is therefore appropriate in relation to Criterion 4. The determination is applicable to those components of the Manila Bay ecosystem that are prioritized by existing conservation initiatives, including coral reefs, mangroves, mudflats and seagrass, as well as areas designated as marine protected areas and other sites within the AoA that are recognized as targets for in-situ biodiversity conservation, i.e., the southern margin of the Mariveles Mountains KBA, the northern coastal tip of the Mts. Palay-Palay Mataas na Gulod Protected Landscape, the seaward fringe of the Manila Bay KBA, and the Las Piñas-Parañaque Critical Habitat and Ecotourism Area.

[32] (1) DENR-PENRO Cavite. 2020. Ternate Marine Park Management Plan CY 2020–2022.; (2) Cavite City LGU. 2021. Corregidor Islands Marine Park Management Plan 2021–2025.

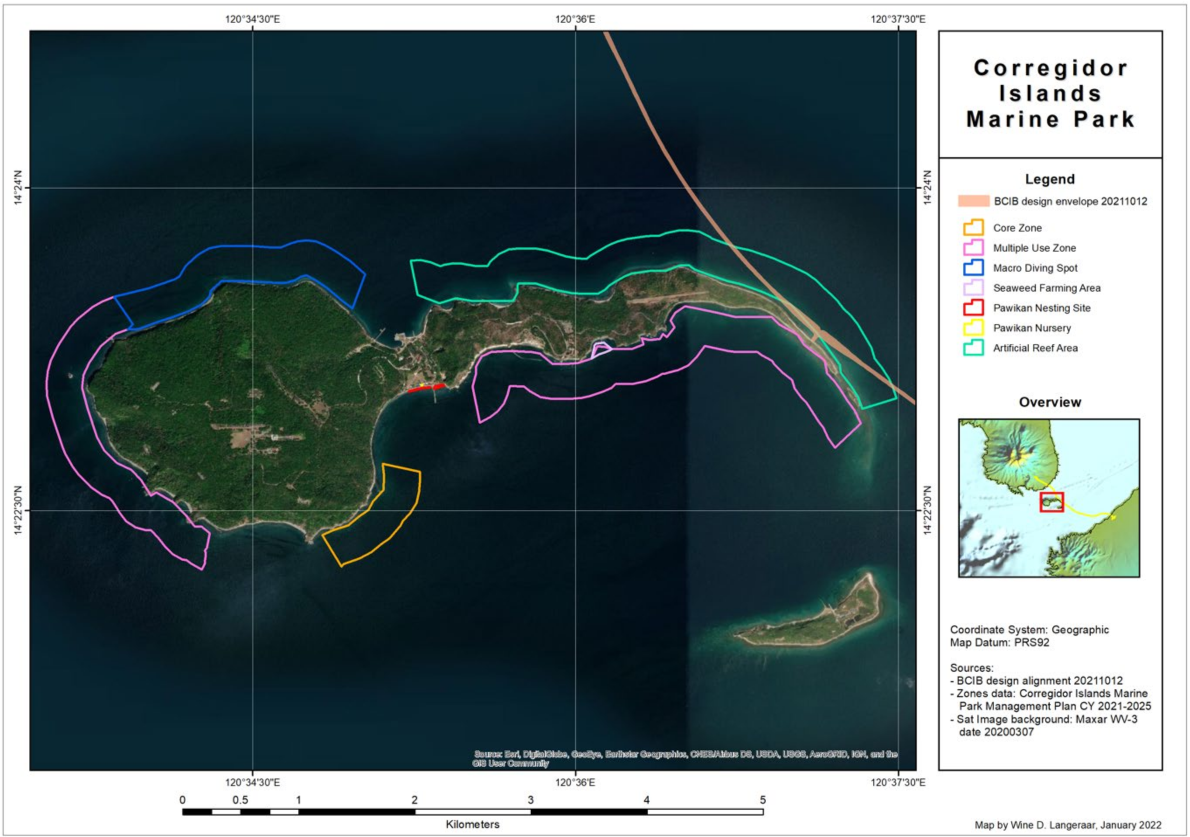

Exhibit 22: Multi-Use Zonation of Corregidor Islands Marine Park

3.5 Criterion 5: Key Evolutionary Processes

As concluded in SCE Ltd.'s screening report, Manila Bay is not considered to have any features that would indicate particular importance to sustaining or exhibiting key evolutionary processes. Accordingly, Criterion 5 is not considered relevant to this critical habitat assessment.

4 CONCLUSIONS AND NEXT STEPS

4.1 Summary of Critical Habitat Determinations

This critical habitat assessment has found that one avian species meets Threshold (b) specified under Criterion 1, and six avian species meet Threshold (a) under Criterion 3, thus leading to a finding that the AoA should be considered critical habitat for these species. In addition, the Manila Bay ecosystem has been found to meet Threshold (b) under Criterion 4, due to the presence of exemplars of globally threatened ecosystem types targeted as a high priority by systematic regional or national conservation planning. A generalized critical habitat determination is made for those elements of the AoA that have been identified as priorities for in-situ biodiversity conservation; this includes:

1. all areas of coral habitat, mudflats, mangroves and seagrass in the bay;
2. all marine protected areas;

3. the southern margin of the Mariveles Mountains KBA;
4. the northern near-coastal portion of the Mts. Palay-Palay Mataas na Gulod Protected Landscape;
5. the seaward fringe of the Manila Bay KBA; and the Las Piñas-Parañaque Critical Habitat and Ecotourism Area.

4.2 Implications of Critical Habitat Determinations for Project Development

As specified in PS6, a critical habitat determination for the habitat areas within which a project is proposed requires that a number of conditions are applied to the project's further consideration and implementation. If a project is proposed for implementation in critical habitat, the proponent must demonstrate all of the following:

1. No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical;
2. The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values;
3. The project does not lead to a net reduction in the global and/or national/regional population in any Critically Endangered or Endangered Species over a reasonable period of time; and
4. Robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the proponent's management program.

With regards to the first requirement, it is difficult to foresee a viable alternative for developing the project—whose core purpose is to meet an identified need for a cross-bay road transport link between Bataan and Cavite, and one of whose objectives is to enable an eventual road link to Corregidor Island—that would not impinge on or otherwise affect critical habitat. Virtually all of the nearshore slope in southern Mariveles, and all-around Corregidor Island, is thought to have at least some coral habitat, and even if the project footprint could be designed to avoid direct impingement upon coral reefs, water quality and other potentially far-reaching impacts derived from construction and operation of the infrastructure would still extend the project's area of influence into these habitats. A bored tunnel crossing, which could avoid impacts on benthic habitat altogether, was not considered amongst the alternatives for the BCIB project, for technical and cost reasons. So practically speaking, there is no viable alternative for development of the BCIB project that completely avoids critical habitat.

Meeting the second and third requirements is, in the case of the BCIB, very likely to require implementation of carefully formulated mitigation to prevent and minimize impacts on critical habitat areas and EN and CR species known to frequent the project area. It is inevitable that some of the biodiversity values relevant to the critical habitat finding will be degraded by construction activity, and to a lesser extent by long-term operations, even with aggressive mitigation, so compensatory measures to offset lost or degraded biodiversity values will be needed to ensure that the project can, on balance, meet the second and third requirements. In view of the already existing, demonstrated interest amongst institutional stakeholders in protection and restoration of marine habitat, there is ample scope for the

BCIB project to tie into, support and advance ecosystem restoration efforts that should significantly enhance biodiversity values in the project area.

The fourth requirement, for a robust long-term biodiversity monitoring and management program, can be met by the BCIB project, provided the appropriate resources are allocated for establishing supporting institutional arrangements and for long-term funding of the monitoring program. A Biodiversity Action Plan will be developed to provide clarity and guidance on how the project will achieve a net gain for each receptor that triggers critical habitat.

It is relevant to note here that PS6 also stipulates conditions for projects proposed for implementation in protected areas, which typically represent or contain significant biodiversity values, and whose continued or enhanced protection may strongly support mitigation of losses to biodiversity values at the landscape scale. The BCIB project will directly impinge upon the Corregidor Islands Marine Park (CIMP), traversing approximately 1,950 m of the park's Artificial Reef Area management zone.

In accordance with PS6, proponents of projects proposed within legally recognized protected areas must:

1. Demonstrate that the proposed development in such areas is legally permitted.
2. Act in a manner consistent with any government recognized management plans for such areas;
3. Consult protected area sponsors and managers, Affected Communities, Indigenous Peoples and other stakeholders on the proposed project, as appropriate; and
4. Implement additional programs, as appropriate, to promote and enhance the conservation aims and effective management of the area.

With respect to the first of these requirements for projects in protected areas, it is surmised that the BCIB project can legally be developed within the CIMP. The Cavite City LGU, which has jurisdiction over Corregidor Island and the surrounding waters and the legal prerogative to establish marine protected areas in its municipal waters, issued a formal endorsement of the BCIB project in October of 2019, prior to establishing the CIMP through enactment of a Sangguniang Panlungsod ordinance. The selection of the BCIB alignment (early 2019) and the project's application for an ECC (application January 2021, granted April 2021) appear to pre-date the formal establishment of the park.[33] The CIMP is not a part of the Expanded National Integrated Protected Area System (ENIPAS).

Regarding the second condition, the Cavite City LGU and other stakeholders in the CIMP management team are aware of the BCIB's planned impingement upon the Artificial Reef Area management zone of the CIMP, and the CIMP's management plan is to be updated to reflect the planned presence of the BCIB infrastructure and allow for its operation.[34] As of October 2022, the updated management plan had not yet been issued.

The CIMP's multi-stakeholder management board has been consulted twice to date regarding the overlap between the BCIB project and the CIMP: first in October 2021, and

[33] At the time of writing, the actual date of the passing of the ordinance remains subject to confirmation.
[34] This was indicated by a representative of the Cavite City planning department during a consultation meeting held with institutional stakeholders in the CIMP's management, March 30, 2022, at the Cavite provincial capitol building, Trece Martires.

again in March 2022. In both instances, consultation took the form of a meeting between representatives of the project proponent (including members of the team updating the EIA) and representatives of multiple entities with a place on the management board. In the March 2022 meeting (actually two meetings held on consecutive days to accommodate schedule constraints of the member entities), discussion centered on the anticipated impacts of the project on marine life within and in the vicinity of the CIMP, and some initial informal scoping of possible mitigation and habitat offset options was also undertaken. Further engagement is anticipated as mitigation planning proceeds.

With respect to the last condition, there is substantial scope and potential for the implementation of additional programs to promote and enhance the biodiversity conservation aims of the CIMP. In particular, compensatory measures may be configured to expand and strengthen initiatives already indicated in the CIMP management plan, including surveillance and enforcement activity, shoreline cleanup work, a marine turtle hatchery program, inventory of park resources and other research, installation and maintenance of artificial reefs, long-term monitoring, and environmental education for fisherfolk and park visitors.

4.3 Implications of Critical Habitat Determinations for Mitigation Planning

As indicated above, the second essential requirement of the proponent of a project in critical habitat is 'The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values'. According to GN6, this should be interpreted as emphasizing the importance of considering biodiversity values across a broader scale, and therefore, the requirement "means that project-related direct and indirect impacts will not jeopardize the long-term persistence of the biodiversity value(s) for which the critical habitat was designated, considering the range of mitigation measures implemented by the client throughout the life of the project and in alignment with the mitigation hierarchy." GN6 (Para. 86).

Importantly, it can be noted here that the shift from critical habitat assessment to mitigation planning necessarily entails a spatial sharpening of focus from the broader AoA used in critical habitat determination to the narrower AoI, in which impacts on qualifying species and habitat types have the potential to be realized. In the case of the BCIB, the AoI (150 km^2) is much smaller than the AoA (2,000 km^2), and contains a limited subset of the critical habitat elements identified in relation to the Criterion 4 determination, i.e., coral reefs, mangroves, mudflats, seagrass, protected areas and KBAs. It is anticipated that some of the biodiversity values implicated in the critical habitat assessment will be found, upon further consideration during site-specific impact assessment, to be very unlikely to be affected by project impacts, and thus may not be subject to mitigative action.

As per PS6, for projects proposed in critical habitat (and where it has been established that the proponent can meet all conditions), the proponent's mitigation strategy as it relates to biodiversity shall be formulated in a Biodiversity Action Plan (BAP), which shall be designed to achieve net gains in relation to those biodiversity values for which the critical habitat was designated, and which may be affected by project activities. For the purposes of the BAP, net gains are to be understood as additional positive conservation outcomes over and above maintenance of existing values, or 'no net loss-plus'. The BAP is to be formulated and implemented as a stand-alone plan, but should be cross-referenced to and integrated as appropriate with the project's Environmental Management Plan (EMP). A long-term biodiversity monitoring program is required to ensure that net gains are achieved and maintained.

4.3.1 Critical Habitat Determinations Under Criteria 1 and 3

The critical habitat determinations made in relation to Criterion 1 and Criterion 3 pertain to individual species; these species (all birds) thus assume the role of 'biodiversity values for which the critical habitat was designated’ and will be subject to compensatory or additional efforts designed to ensure net gain. Net gains for individual qualifying species will have to be achieved by means of additional conservation actions, which may include direct habitat restoration and habitat protection, or indirect action through financial, in-kind, logistical or institutional support for existing programs that do these things. Such measures will be scoped and formulated in consultation with relevant stakeholders, most particularly those people and entities who may play a role in their implementation and monitoring.

4.3.2 Critical Habitat Determination Under Criterion 4

The critical habitat determination made under Criterion 4 is generalized to the Manila Bay ecosystem, but is focused on a specific set of critical ecosystem components. Accordingly, the BAP should develop measures to ensure that the BCIB project's implementation will result in a measurable net gain in the functional habitat value of such habitats found within the project's AoI. Functional habitat value may be measured in terms of both habitat area and habitat quality, and success in achieving net gains will have to be verified through time by means of a long-term biodiversity monitoring program. Such a monitoring program needs to be specified and funded under the auspices of the BAP.

Efforts to ensure net gain of biodiversity values in relation to affected critical habitat elements may involve direct action (i.e., implemented by the Proponent) or indirect action (implemented by other parties with support from the Proponent). As has been illustrated above, there is no shortage of existing marine habitat conservation efforts in Manila Bay, including within and nearby the BCIB project area. There should thus be ample opportunity to shape the BAP to complement and support existing programs, and this should be the favored approach unless specific circumstances make it reasonable to expect a greater probability of measurable success and cost-effectiveness from direct implementation of habitat restoration by the Proponent. The entities involved in the multi-stakeholder management of the CIMP are likely to be essential partners in the formulation and implementation of the BAP, as the CIMP will be directly and substantially affected by project impacts, and also because the park's management agenda already includes multiple nascent programs that may offer significant potential vehicles for biodiversity offsets. Set asides and offsets contemplated for terrestrial areas may fruitfully be pursued in partnership with municipal and provincial environment agencies in particular.

4.4 Next Steps

This critical habitat assessment has developed the project's understanding of critical habitat and introduces potential critical habitat triggers. At the time of writing however, insufficient data was available to define species-level EAAAs, and as such, a wider and more generalized AOA was used to determine the presence of critical habitat. This live assessment must therefore continue to be updated and reassessed as pre-construction field surveys and more advanced consultation provide better and more robust data, and improved understanding of the ecological receptors relevant. This assessment must therefore be updated using EAAAs for any relevant receptors before the BAP is finalized.

APPENDIX 1

IBAT SCREENING REPORTS

Integrated Biodiversity Assessment Tool
World Bank Group Biodiversity Risk Screen

BCIB CENTERLINE

- **Country:** Philippines
- **Location:** [14.4, 120.7]
- **IUCN Red List Biomes:** Terrestrial
- **Created by:** Bing Rufo

Overlaps with:

Protected Areas	1 km: 0	10 km: 2	50 km: 12	14
World Heritage (WH)	1 km: 0	10 km: 0	50 km: 0	0
Key Biodiversity Areas	1 km: 0	10 km: 1	50 km: 5	6
Alliance for Zero Extinction (AZE)	1 km: 0	10 km: 0	50 km: 0	0
IUCN Red List				25
Critical Habitat				Likely

Displaying project location and buffers: 1 km, 10 km, 50 km

WORLD BANK GROUP

This report is based on IFC Performance Standard 6 (PS6) but applies to World Bank Environmental and Social Standard 6 (ESS6)

About this report

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- 'Assess for biodiversity risk' is stated if the report identifies any other type of protected area.

Key Biodiversity Areas:

- 'Highest risk. Seek expert help' is stated if the report identifies an Alliance for Zero Extinction site.
- 'Assess for Critical Habitat' is stated if the report identifies Critically Endangered or Endangered species OR species with restricted ranges OR congregatory species as coded in the IUCN Red List of Threatened Species.
- 'Assess for biodiversity risk' is stated if the report identifies any other type of Key Biodiversity Area.

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Priority Species

Habitat of significant importance to priority species will trigger Critical Habitat status (See PS6: para 16). IBAT provides a preliminary list of priority species that could occur within the 50km buffer. This list is drawn from the IUCN Red List of Threatened Species (IUCN RL). This list should be used to guide any further assessment, with the aim of confirming knownor likely occurrence of these species within the project area. It is also possible that further assessment may confirm occurrence of additional priority species not listed here. It is strongly encouraged that any new species information collected by the project be shared with species experts and/or IUCN wherever possible in order to improve IUCN datasets.

IUCN Red List of Threatened Species - CR & EN

The following species are potentially found within 50km of the area of interest.
For the full IUCN Red List please refer to the associated csv in the report folder.

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Crocodylus mindorensis	Philippine Crocodile	REPTILIA	CR	Decreasing	Terrestrial, Freshwater
Eretmochelys imbricata	Hawksbill Turtle	REPTILIA	CR	Decreasing	Terrestrial, Marine
Cacatua haematuropygia	Philippine Cockatoo	AVES	CR	Decreasing	Terrestrial
Pithecophaga jefferyi	Philippine Eagle	AVES	CR	Decreasing	Terrestrial
Oriolus isabellae	Isabela Oriole	AVES	CR	Decreasing	Terrestrial
Drepanosticta makilingia		INSECTA	CR	Decreasing	Terrestrial, Freshwater
Drepanosticta trimaculata		INSECTA	CR	Decreasing	Terrestrial, Freshwater
Acerodon jubatus	Golden-capped Fruit Bat	MAMMALIA	EN	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Chelonia mydas	Green Turtle	REPTILIA	EN	Decreasing	Terrestrial, Marine
Cuora amboinensis	Southeast Asian Box Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Dipterocarpus grandiflorus		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Pterocarpus indicus	Burmese Rosewood	MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Cerberus microlepis	Lake Buhi Bockadam	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
Camptostemon philippinense		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial, Marine
Prioniturus luconensis	Green Racquet-tail	AVES	EN	Decreasing	Terrestrial
Numenius madagascariensis	Far Eastern Curlew	AVES	EN	Decreasing	Terrestrial, Marine, Freshwater
Calidris tenuirostris	Great Knot	AVES	EN	Decreasing	Terrestrial, Marine
Lonchura oryzivora	Java Sparrow	AVES	EN	Decreasing	Terrestrial
Nisaetus philippensis	North Philippine Hawk-eagle	AVES	EN	Decreasing	Terrestrial
Pterospermum cumingii		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial
Calostoma insigne		AGARICOMYCETES	EN	Decreasing	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Adelmeria dicranochila		LILIOPSIDA	EN	Unknown	Terrestrial
Pericnemis bonita		INSECTA	EN	Decreasing	Terrestrial, Freshwater
Pericnemis incallida		INSECTA	EN	Decreasing	Terrestrial, Freshwater
Macromia negrito		INSECTA	EN	Decreasing	Terrestrial, Freshwater

Restricted Range Species

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Oriolus isabellae	Isabela Oriole	AVES	CR	Decreasing	Terrestrial
Platymantis montanus		AMPHIBIA	VU	Stable	Terrestrial
Phylloscopus ijimae	Ijima's Leaf-warbler	AVES	VU	Decreasing	Terrestrial
Platymantis luzonensis		AMPHIBIA	NT OR LR/NT	Decreasing	Terrestrial
Erythropitta kochi	Whiskered Pitta	AVES	NT OR LR/NT	Decreasing	Terrestrial
Ficedula disposita	Furtive Flycatcher	AVES	NT OR LR/NT	Decreasing	Terrestrial
Phoenicurus bicolor	Luzon Water-redstart	AVES	NT OR LR/NT	Decreasing	Terrestrial, Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Zosterornis striatus	Luzon Striped Babbler	AVES	NT OR LR/NT	Decreasing	Terrestrial
Robsonius sorsogonensis	Bicol Ground-warbler	AVES	NT OR LR/NT	Decreasing	Terrestrial
Apomys sacobianus	Long-nosed Luzon Apomys	MAMMALIA	LC OR LR/LC	Unknown	Terrestrial
Platymantis mimulus		AMPHIBIA	LC OR LR/LC	Stable	Terrestrial
Dasylophus superciliosus	Red-crested Malkoha	AVES	LC OR LR/LC	Decreasing	Terrestrial
Lepidogrammus cumingi	Scale-feathered Malkoha	AVES	LC OR LR/LC	Decreasing	Terrestrial
Fregata minor	Great Frigatebird	AVES	LC OR LR/LC	Decreasing	Terrestrial, Marine
Oriolus albiloris	White-lored Oriole	AVES	LC OR LR/LC	Decreasing	Terrestrial
Sterrhoptilus nigrocapitatus	Black-crowned Babbler	AVES	LC OR LR/LC	Decreasing	Terrestrial
Zosterornis whiteheadi	Chestnut-faced Babbler	AVES	LC OR LR/LC	Stable	Terrestrial
Rhabdornis grandis	Grand Rhabdornis	AVES	LC OR LR/LC	Decreasing	Terrestrial
Scolopax bukidnonensis	Bukidnon Woodcock	AVES	LC OR LR/LC	Unknown	Terrestrial
Apomys zambalensis	Zambales Forest Mouse	MAMMALIA	LC OR LR/LC	Stable	Terrestrial

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Tryphomys adustus	Luzon Tryphomys	MAMMALIA	DD	Unknown	Terrestrial
Abditomys latidens	Luzon Broad-toothed Rat	MAMMALIA	DD	Unknown	Terrestrial

Biodiversity features which are likely to trigger Critical Habitat

Protected Areas

The following protected areas are found within 1 km and 10 km and 50 km of the area of interest. For further details please refer to the associated csv file in the report folder.

Area name	Distance	IUCN Category	Status	Designation	Recommendation
Mts. Palay-palay-Mataas-na-Gulod Protected Landscape	10 km	V	Designated	Protected Landscape	Assess for biodiversity risk
Watershed Purposes of Mariveles (Palanas) Watershed and Forest Range	10 km	Not Assigned	Designated	Watershed and Forest Range	Assess for biodiversity risk
Bataan Natural Park	50 km	II	Designated	Natural Park	Assess for critical habitat
Las Piñas-Parañaque Critical Habitat and Ecotourism Area	50 km	Not Reported	Designated	Ramsar Site, Wetland of International Importance	Assess for biodiversity risk
Las Piñas-Parañaque Critical Habitat and Ecotourism Area (LPLPCHEA)/Las Piñas-Parañaque	50 km	IV	Designated	Wetland Park	Assess for biodiversity risk
Luneta National Park	50 km	Not Assigned	Designated	National Park	Assess for biodiversity risk
Manila Bay Beach Resort National Park	50 km	Not Assigned	Designated	National Park	Assess for biodiversity risk

Area name	Distance	IUCN Category	Status	Designation	Recommendation
Mount Makiling Forest Reserve	50 km	Not Assigned	Designated	ASEAN Heritage Park	Assess for biodiversity risk
Mount Makiling Forest Reserve	50 km	Not Assigned	Designated	Forest Reserve	Assess for biodiversity risk
Ninoy Aquino Parks and Wildlife Center	50 km	Not Assigned	Designated	Parks and Wildlife Center	Assess for biodiversity risk
Olongapo Naval Base Perimeter National Park	50 km	Not Assigned	Designated	National Park	Assess for biodiversity risk
Olongapo Watershed Forest Reserve	50 km	Not Assigned	Designated	Watershed Forest Reserve	Assess for biodiversity risk
Roosevelt Protected Landscape	50 km	V	Designated	Protected Landscape	Assess for biodiversity risk
Taal Volcano Protected Landscape	50 km	V	Designated	Protected Landscape	Assess for biodiversity risk

Key Biodiversity Areas

The following key biodiversity areas are found within 1 km and 10 km and 50 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

Area name	Distance	IBA	AZE	Recommendation

Area name	Distance	IBA	AZE	Recommendation
Mariveles mountains	10 km	Yes	No	Assess for critical habitat
Bataan Natural Park and Subic Bay Forest Reserve	50 km	Yes	No	Assess for critical habitat
Manila Bay	50 km	Yes	No	Assess for critical habitat
Mount Makiling	50 km	Yes	No	Assess for critical habitat
Mounts Palay-Palay-Mataas Na Gulod National Park	50 km	Yes	No	Assess for critical habitat
Taal Volcano Protected Landscape	50 km	No	No	Assess for biodiversity risk

Species with potential to occur

Area Taxonomic group	Total assessed species	Total (CR, EN & VU)	CR	EN	VU	NT	LC	DD
REPTILIA	63	11	2	3	6	5	38	9
AVES	341	24	3	5	16	32	283	2
INSECTA	89	9	2	3	4	6	68	6
MAMMALIA	61	5	0	1	4	3	49	4
MAGNOLIOPSIDA	189	10	0	4	6	3	171	5
AGARICOMYCETES	1	1	0	1	0	0	0	0

Area Taxonomic group	Total assessed species	Total (CR, EN & VU)	CR	EN	VU	NT	LC	DD
LILIOPSIDA	22	2	0	1	1	0	20	0
AMPHIBIA	22	1	0	0	1	2	19	0
ARACHNIDA	5	1	0	0	1	0	4	0
GASTROPODA	3	0	0	0	0	0	1	2
MALACOSTRACA	5	0	0	0	0	0	1	4
ACTINOPTERYGII	1	0	0	0	0	0	1	0
POLYPODIOPSIDA	1	0	0	0	0	0	1	0

Recommended citation

IBAT PS6 & ESS6 Report. Generated under licence 4846-21885 from the Integrated Biodiversity Assessment Tool on 13 September 2021 (GMT). www.ibat-alliance.org

Recommended Experts and Organizations

For projects located in Critical Habitat, clients must ensure that external experts with regional expertise are involved in further assessment (GN6: GN22). Clients are encouraged to develop partnerships with recognized and credible conservation organizations and/or academic institutes, especially with respect to potential developments in natural or Critical Habitat (GN6: GN23). Where Critical Habitats are triggered by priority species, species specialists must be involved. IBAT provides data originally collected by a large network of national partners, while species information is sourced via the IUCN Red List and affiliated Species Specialist Groups. These experts and organizations are listed below. **Please note that this is not intended as a comprehensive list of organizations and experts. These organizations and experts are under no obligation to support any further assessment and do so entirely at their discretion and under their terms. Any views expressed or recommendations made by these stakeholders should not be attributed to the IFC or IBAT for IFC partners.**

Birdlife Partners

URL: https://www.birdlife.org/worldwide/partnership/birdlife-partners

Directory for Species Survival Commission (SSC) Specialist Groups and Red List Authorities

URL: https://www.iucn.org/commissions/ssc-groups

IBAT

Integrated Biodiversity Assessment Tool
World Bank Group Biodiversity Risk Screen

BCIB CENTERLINE

- **Country:** Philippines
- **Location:** [14.4, 120.7]
- **IUCN Red List Biomes:** Marine
- **Created by:** Bing Rufo

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Alliance for Zero Extinction (AZE)	1 km: 0	10 km: 0	50 km: 0	0

IUCN Red List	47
Critical Habitat	Likely

Displaying project location and buffers: 1 km, 10 km, 50 km

WORLD BANK GROUP

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Eretmochelys imbricata	Hawksbill Turtle	REPTILIA	CR	Decreasing	Terrestrial, Marine
Hemitriakis leucoperiptera	Whitefin Topeshark	CHONDRICHTHYES	CR	Unknown	Marine
Carcharhinus longimanus	Oceanic Whitetip Shark	CHONDRICHTHYES	CR	Decreasing	Marine
Sphyrna lewini	Scalloped Hammerhead	CHONDRICHTHYES	CR	Decreasing	Marine
Sphyrna mokarran	Great Hammerhead	CHONDRICHTHYES	CR	Decreasing	Marine
Pristis zijsron	Green Sawfish	CHONDRICHTHYES	CR	Decreasing	Marine
Rhina ancylostoma	Bowmouth Guitarfish	CHONDRICHTHYES	CR	Decreasing	Marine
Rhynchobatus australiae	Bottlenose Wedgefish	CHONDRICHTHYES	CR	Decreasing	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Rhynchobatus springeri	Broadnose Wedgefish	CHONDRICHTHYES	CR	Decreasing	Marine
Pristis pristis	Largetooth Sawfish	CHONDRICHTHYES	CR	Decreasing	Marine, Freshwater
Clupea manulensis		ACTINOPTERYGII	CR	Unknown	Marine, Freshwater
Cephaloscyllium fasciatum	Reticulated Swellshark	CHONDRICHTHYES	CR	Decreasing	Marine
Balaenoptera borealis	Sei Whale	MAMMALIA	EN	Increasing	Marine
Balaenoptera musculus	Blue Whale	MAMMALIA	EN	Increasing	Marine
Chelonia mydas	Green Turtle	REPTILIA	EN	Decreasing	Terrestrial, Marine
Rhincodon typus	Whale Shark	CHONDRICHTHYES	EN	Decreasing	Marine
Isurus oxyrinchus	Shortfin Mako	CHONDRICHTHYES	EN	Decreasing	Marine
Carcharhinus amblyrhynchos	Grey Reef Shark	CHONDRICHTHYES	EN	Decreasing	Marine
Eusphyra blochii	Winghead Shark	CHONDRICHTHYES	EN	Decreasing	Marine
Stegostoma tigrinum	Zebra Shark	CHONDRICHTHYES	EN	Decreasing	Marine
Gymnura zonura	Zonetail Butterfly Ray	CHONDRICHTHYES	EN	Decreasing	Marine
Aetomylaeus vespertilio	Ornate Eagle Ray	CHONDRICHTHYES	EN	Decreasing	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Rhinoptera javanica	Javanese Cownose Ray	CHONDRICHTHYES	EN	Unknown	Marine
Mobula tarapacana	Sicklefin Devilray	CHONDRICHTHYES	EN	Decreasing	Marine
Mobula thurstoni	Bentfin Devilray	CHONDRICHTHYES	EN	Decreasing	Marine
Isurus paucus	Longfin Mako	CHONDRICHTHYES	EN	Decreasing	Marine
Porites eridani		ANTHOZOA	EN	Unknown	Marine
Anacropora spinosa		ANTHOZOA	EN	Decreasing	Marine
Lobophyllia serratus		ANTHOZOA	EN	Unknown	Marine
Porites ornata		ANTHOZOA	EN	Unknown	Marine
Montipora setosa		ANTHOZOA	EN	Decreasing	Marine
Alveopora excelsa		ANTHOZOA	EN	Unknown	Marine
Alveopora minuta		ANTHOZOA	EN	Unknown	Marine
Pectinia maxima		ANTHOZOA	EN	Unknown	Marine
Mobula kuhlii	Shortfin Devilray	CHONDRICHTHYES	EN	Decreasing	Marine
Alopias pelagicus	Pelagic Thresher	CHONDRICHTHYES	EN	Decreasing	Marine
Camptostemon philippinense		MAGNOLIOPSIDA	EN	Decreasing	Terrestrial, Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Holothuria scabra	Golden Sandfish	HOLOTHUROIDEA	EN	Decreasing	Marine
Holothuria lessoni	Golden Sandfish	HOLOTHUROIDEA	EN	Decreasing	Marine
Holothuria whitmaei	Black Teatfish	HOLOTHUROIDEA	EN		Marine
Thelenota ananas	Prickly Redfish	HOLOTHUROIDEA	EN	Decreasing	Marine
Mobula birostris	Giant Manta Ray	CHONDRICHTHYES	EN	Decreasing	Marine
Numenius madagascariensis	Far Eastern Curlew	AVES	EN	Decreasing	Terrestrial, Marine, Freshwater
Calidris tenuirostris	Great Knot	AVES	EN	Decreasing	Terrestrial, Marine
Platalea minor	Black-faced Spoonbill	AVES	EN	Increasing	Marine, Freshwater
Maculabatis macrura	Sharpnose Whipray	CHONDRICHTHYES	EN	Decreasing	Marine
Mobula mobular	Spinetail Devil Ray	CHONDRICHTHYES	EN	Decreasing	Marine

Restricted Range Species

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Platalea minor	Black-faced Spoonbill	AVES	EN	Increasing	Marine, Freshwater

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Fregata minor	Great Frigatebird	AVES	LC OR LR/LC	Decreasing	Terrestrial, Marine

Biodiversity features which are likely to trigger Critical Habitat

Protected Areas

The following protected areas are found within 1 km and 10 km and 50 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

Area name	Distance	IUCN Category	Status	Designation	Recommendation
Mts. Palay-palay-Mataas-na-Gulod Protected Landscape	10 km	V	Designated	Protected Landscape	Assess for biodiversity risk
Watershed Purposes of Mariveles (Palanas) Watershed and Forest Range	10 km	Not Assigned	Designated	Watershed and Forest Range	Assess for biodiversity risk
Bataan Natural Park	50 km	II	Designated	Natural Park	Assess for critical habitat
Las Piñas-Parañaque Critical Habitat and Ecotourism Area	50 km	Not Reported	Designated	Ramsar Site, Wetland of International Importance	Assess for biodiversity risk
Las Piñas-Parañaque Critical Habitat and Ecotourism Area (LPLPCHEA)/Las Piñas-Parañaque	50 km	IV	Designated	Wetland Park	Assess for biodiversity risk
Luneta National Park	50 km	Not Assigned	Designated	National Park	Assess for biodiversity risk
Manila Bay Beach Resort National Park	50 km	Not Assigned	Designated	National Park	Assess for biodiversity risk

Area name	Distance	IUCN Category	Status	Designation	Recommendation
Mount Makiling Forest Reserve	50 km	Not Assigned	Designated	ASEAN Heritage Park	Assess for biodiversity risk
Mount Makiling Forest Reserve	50 km	Not Assigned	Designated	Forest Reserve	Assess for biodiversity risk
Ninoy Aquino Parks and Wildlife Center	50 km	Not Assigned	Designated	Parks and Wildlife Center	Assess for biodiversity risk
Olongapo Naval Base Perimeter National Park	50 km	Not Assigned	Designated	National Park	Assess for biodiversity risk
Olongapo Watershed Forest Reserve	50 km	Not Assigned	Designated	Watershed Forest Reserve	Assess for biodiversity risk
Roosevelt Protected Landscape	50 km	V	Designated	Protected Landscape	Assess for biodiversity risk
Taal Volcano Protected Landscape	50 km	V	Designated	Protected Landscape	Assess for biodiversity risk

Key Biodiversity Areas

The following key biodiversity areas are found within 1 km and 10 km and 50 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

Area name	Distance	IBA	AZE	Recommendation

Area name	Distance	IBA	AZE	Recommendation
Mariveles mountains	10 km	Yes	No	Assess for critical habitat
Bataan Natural Park and Subic Bay Forest Reserve	50 km	Yes	No	Assess for critical habitat
Manila Bay	50 km	Yes	No	Assess for critical habitat
Mount Makiling	50 km	Yes	No	Assess for critical habitat
Mounts Palay-Palay-Mataas Na Gulod National Park	50 km	Yes	No	Assess for critical habitat
Taal Volcano Protected Landscape	50 km	No	No	Assess for biodiversity risk

Species with potential to occur

Area Taxonomic group	Total assessed species	Total (CR, EN & VU)	CR	EN	VU	NT	LC	DD
REPTILIA	19	5	1	1	3	1	13	0
CHONDRICHTHYES	85	56	10	16	30	12	15	2
ACTINOPTERYGII	1891	20	1	0	19	9	1746	116
MAMMALIA	22	4	0	2	2	2	15	1
ANTHOZOA	564	168	0	8	160	147	200	49

Area Taxonomic group	Total assessed species	Total (CR, EN & VU)	CR	EN	VU	NT	LC	DD
MAGNOLIOPSIDA	33	2	0	1	1	2	27	2
HOLOTHUROIDEA	73	9	0	4	5	0	25	39
AVES	104	6	0	3	3	14	84	0
HYDROZOA	7	1	0	0	1	1	5	0
LILIOPSIDA	13	1	0	0	1	0	12	0
GASTROPODA	190	0	0	0	0	0	179	11
BIVALVIA	10	0	0	0	0	0	4	6
MALACOSTRACA	42	0	0	0	0	0	37	5
POLYPODIOPSIDA	1	0	0	0	0	0	1	0
MYXINI	1	0	0	0	0	0	0	1

Recommended citation

IBAT PS6 & ESS6 Report. Generated under licence 4846-21884 from the Integrated Biodiversity Assessment Tool on 13 September 2021 (GMT). www.ibat-alliance.org

Recommended Experts and Organizations

For projects located in Critical Habitat, clients must ensure that external experts with regional expertise are involved in further assessment (GN6: GN22). Clients are encouraged to develop partnerships with recognized and credible conservation organizations and/or academic institutes, especially with respect to potential developments in natural or Critical Habitat (GN6: GN23). Where Critical Habitats are triggered by priority species, species specialists must be involved. IBAT provides data originally collected by a large network of national partners, while species information is sourced via the IUCN Red List and affiliated Species Specialist Groups. These experts and organizations are listed below. **Please note that this is not intended as a comprehensive list of organizations and experts. These organizations and experts are under no obligation to support any further assessment and do so entirely at their discretion and under their terms. Any views expressed or recommendations made by these stakeholders should not be attributed to the IFC or IBAT for IFC partners.**

Birdlife Partners

URL: https://www.birdlife.org/worldwide/partnership/birdlife-partners

Directory for Species Survival Commission (SSC) Specialist Groups and Red List Authorities

URL: https://www.iucn.org/commissions/ssc-groups

APPENDIX 2

CONSULTATIONS

Date and location	Event type	Entities/Individuals Consulted	Key Topics of Discussion Relevant to Assessment
21 October 2021	Group consultation (online)	Corregidor Islands Marine Park Technical Committee (multi-stakeholder entity)	• Proximity of proposed BCIB alignment to Corregidor Islands Marine Park management zones
22 March 2022	Group consultation	Municipal Environment and Natural Resources Office, Mariveles	• Active coastal conservation programs, including marine turtle hatchery • Potential long-term effects of BCIB project on forests of Mt. Mariveles
22 March 2022	Group consultation	Alas-Asin Fisherfolk Barangay Alas-Asin	• Locations of fishing activity around Mariveles shore and Corregidor Island • Scoping of possible benthic restoration in context of environmental mitigation related to the BCIB project
28 March 2022	Individual interview	Corregidor Foundation, Inc. (Mr. Jerry Rollin, Consultant)	• Ecology of Corregidor Island and surrounding waters • Existing threats to marine ecosystem around Corregidor Island • Planned environmental management activities for Corregidor Islands Marine Park
29 March 2022	Group consultation	Provincial Environment and Natural Resources Office, Cavite	• Proximity of proposed BCIB alignment to Corregidor Islands Marine Park management zones • Threats to marine ecology of BCIB project area • Scoping of possible benthic restoration in context of environmental mitigation related to the BCIB project
29 March 2022	Group consultation	Municipal Environment and Natural Resources Office, Naic Municipal Agriculture Office, Naic	• Active coastal conservation programs, including marine turtle hatchery • Naic Fish Sanctuary
30 March 2022	Group consultation	Corregidor Islands Marine Park Technical Committee	• Proximity of proposed BCIB alignment to Corregidor Islands Marine Park management zones • Threats to marine ecology of BCIB project area • Scoping of possible benthic restoration in context of environmental mitigation related to the BCIB project
12 May 2022	Small-group interview	Ms. Eva Pangilinan Municipal Environment and Natural Resources Office, Naic Mr. John Nepomuceno, Dean Cavite State University	• Naic marine turtle hatchery program • History and management of Naic Fish Sanctuary
[TO RE-CHECK]	Individual interview	Dr. Lemuel Aragones Institute of Environmental Science and Meteorology, University of the Philippines	• State of knowledge regarding presence, distribution and abundance of cetaceans in Manila Bay
[TO RE-CHECK]	Individual interview	Dr. Yaptinchay, Executive Director Marine Wildlife Watch of the Philippines	• State of knowledge regarding presence, distribution and abundance of marine wildlife in Manila Bay

Date and location	Event type	Entities/Individuals Consulted	Key Topics of Discussion Relevant to Assessment
[TO RE-CHECK]	Individual interview	Kester Yu, Marine conservationist and previous officer of National Environmental Protection Council of the Philippines	• State of knowledge regarding presence, distribution and abundance of marine wildlife in Manila Bay
[TO RE-CHECK]	Individual interview	Oceana (Diovanie de Jesus, Campaign and Science Specialist)	• State of knowledge regarding presence, distribution and abundance of marine wildlife in Manila Bay

APPENDIX 3

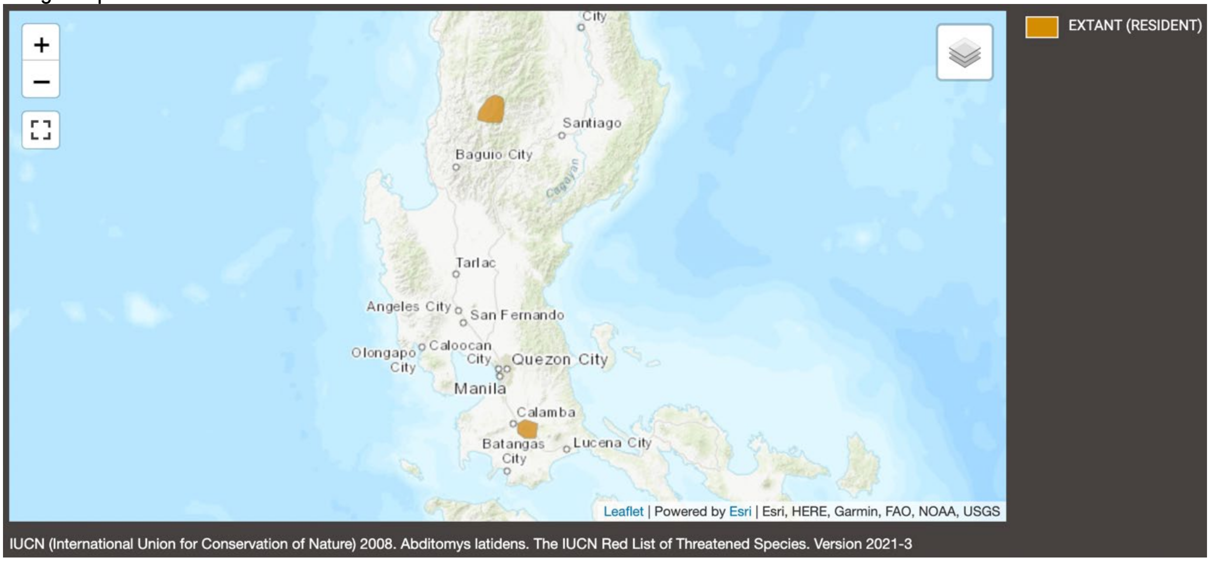
INFORMATION SOURCES AND RANGE MAPS FOR BY-SPECIES EVALUATIONS

Abditomys latidens
Luzon Broad-Toothed Rat
(DD)

Sources consulted

(1) Gerrie, R. & Kennerley, R. 2016. *Abditomys latidens* (errata version published in 2017). *The IUCN Red List of Threatened Species* 2016: e.T42641A115198627. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T42641A22454309.en. Accessed on 17 June 2022.
(2) Heaney, L.R., Balete, D.S. and Rickart, E.A. 2016. The Mammals of Luzon Island: Biogeography and Natural History of a Philippine Fauna. Johns Hopkins University Press, Baltimore, USA.

Range map



Source: Gerrie, R. & Kennerley, R. 2016. *Abditomys latidens* (errata version published in 2017). *The IUCN Red List of Threatened Species* 2016: e.T42641A115198627. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T42641A22454309.en. Accessed on 17 June 2022.

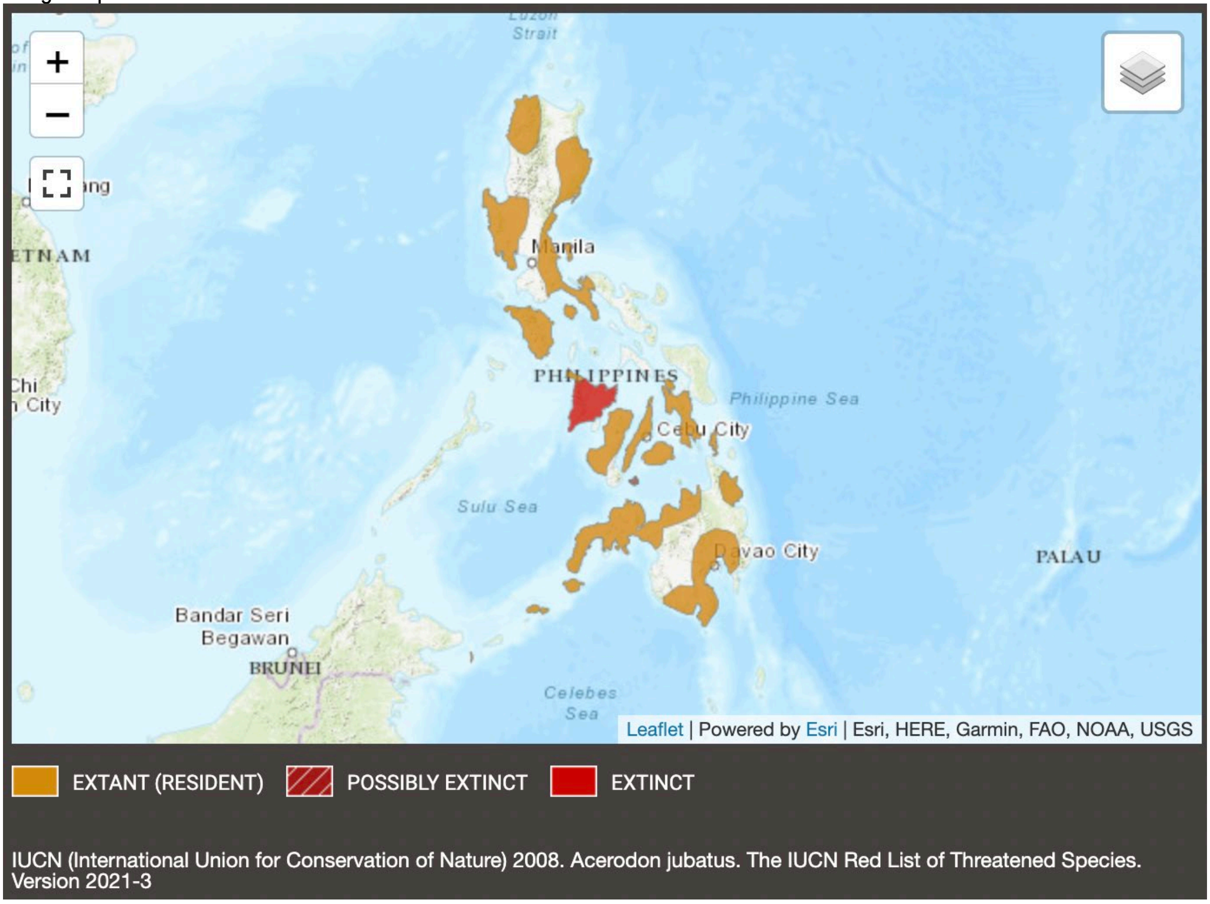
Acerodon jubatus
Golden-Capped Fruit Bat
(EN)

Sources consulted

(1) Mildenstein, T. & Paguntalan, L. 2016. *Acerodon jubatus*. *The IUCN Red List of Threatened Species* 2016: e.T139A21988328. https://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T139A21988328.en. Accessed on 17 June 2022.

(2) Heinen, V. 2009. "Acerodon jubatus" (On-line), Animal Diversity Web. Accessed June 17, 2022 at https://animaldiversity.org/accounts/Acerodon_jubatus/

Range map



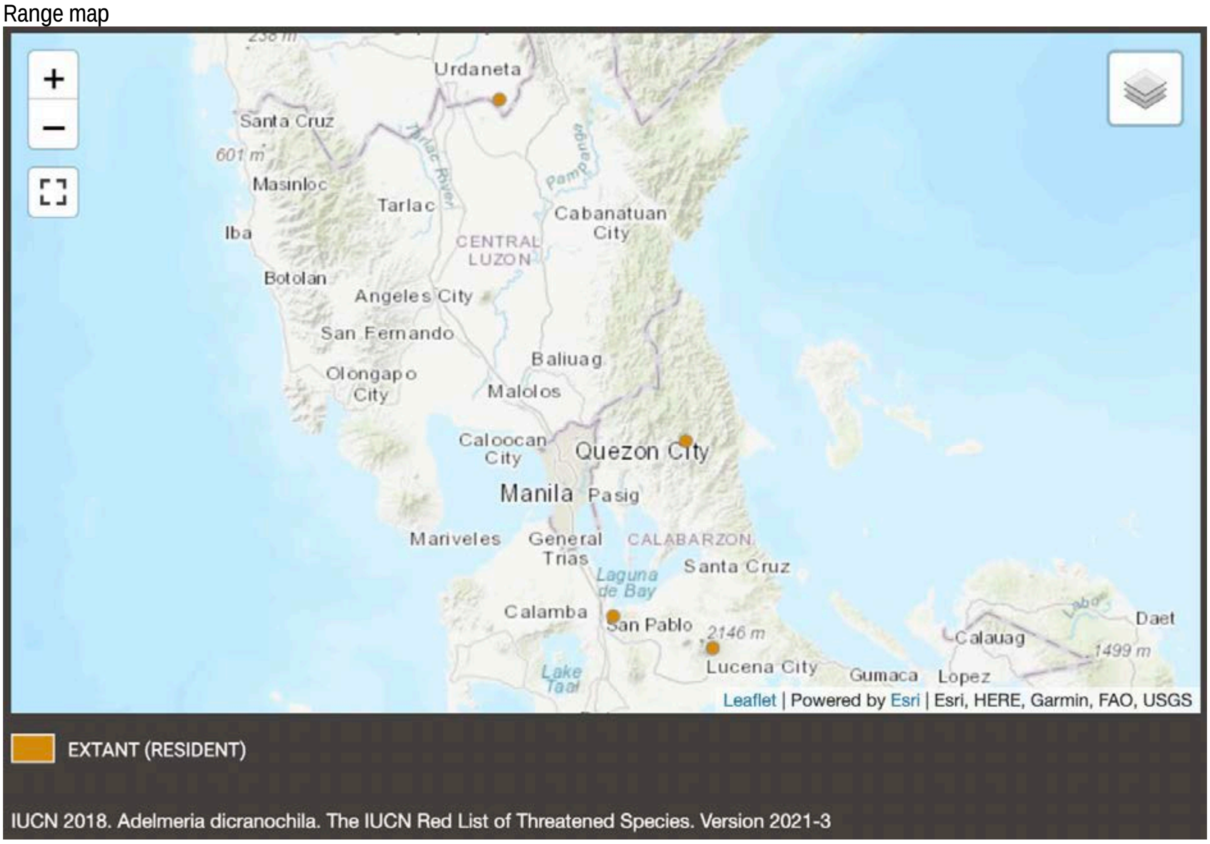
Source: Mildenstein, T. & Paguntalan, L. 2016. *Acerodon jubatus*. *The IUCN Red List of Threatened Species* 2016: e.T139A21988328. https://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T139A21988328.en. Accessed on 17 June 2022.

Adelmeria dicranochila
(EN)

Sources consulted

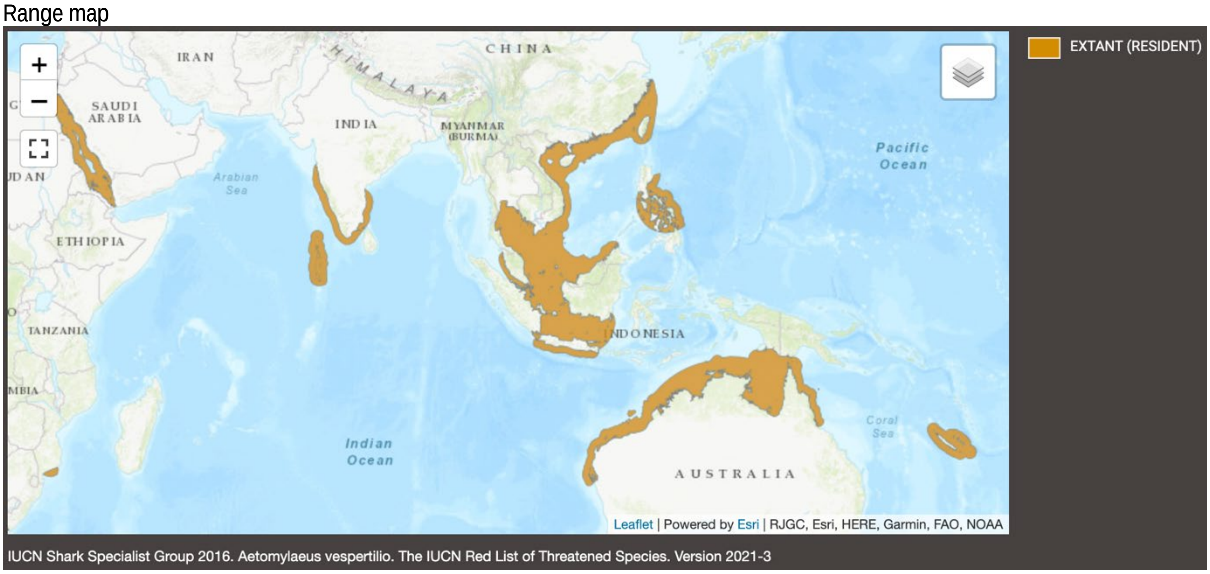
(1) Docot, R.V.A. 2020. *Adelmeria dicranochila*. *The IUCN Red List of Threatened Species* 2020: e.T132925112A132925153. https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T132925112A132925153.en. Accessed on 20 June 2022.

Range map



Source: Docot, R.V.A. 2020. *Adelmeria dicranochila*. *The IUCN Red List of Threatened Species* 2020: e.T132925112A132925153. https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T132925112A132925153.en. Accessed on 20 June 2022.

Aetomylaeus vespertilio Ornate Eagle Ray (EN)
Sources consulted
(1) White, W.T. & Kyne, P.M. 2016. *Aetomylaeus vespertilio*. *The IUCN Red List of Threatened Species* 2016: e.T60121A68607665. https://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T60121A68607665.en. Accessed on 17 June 2022. (2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.
Range map



Source: White, W.T. & Kyne, P.M. 2016. *Aetomylaeus vespertilio*. *The IUCN Red List of Threatened Species* 2016: e.T60121A68607665. https://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T60121A68607665.en. Accessed on 17 June 2022.

Alopias pelagicus
Pelagic Thresher
(EN)

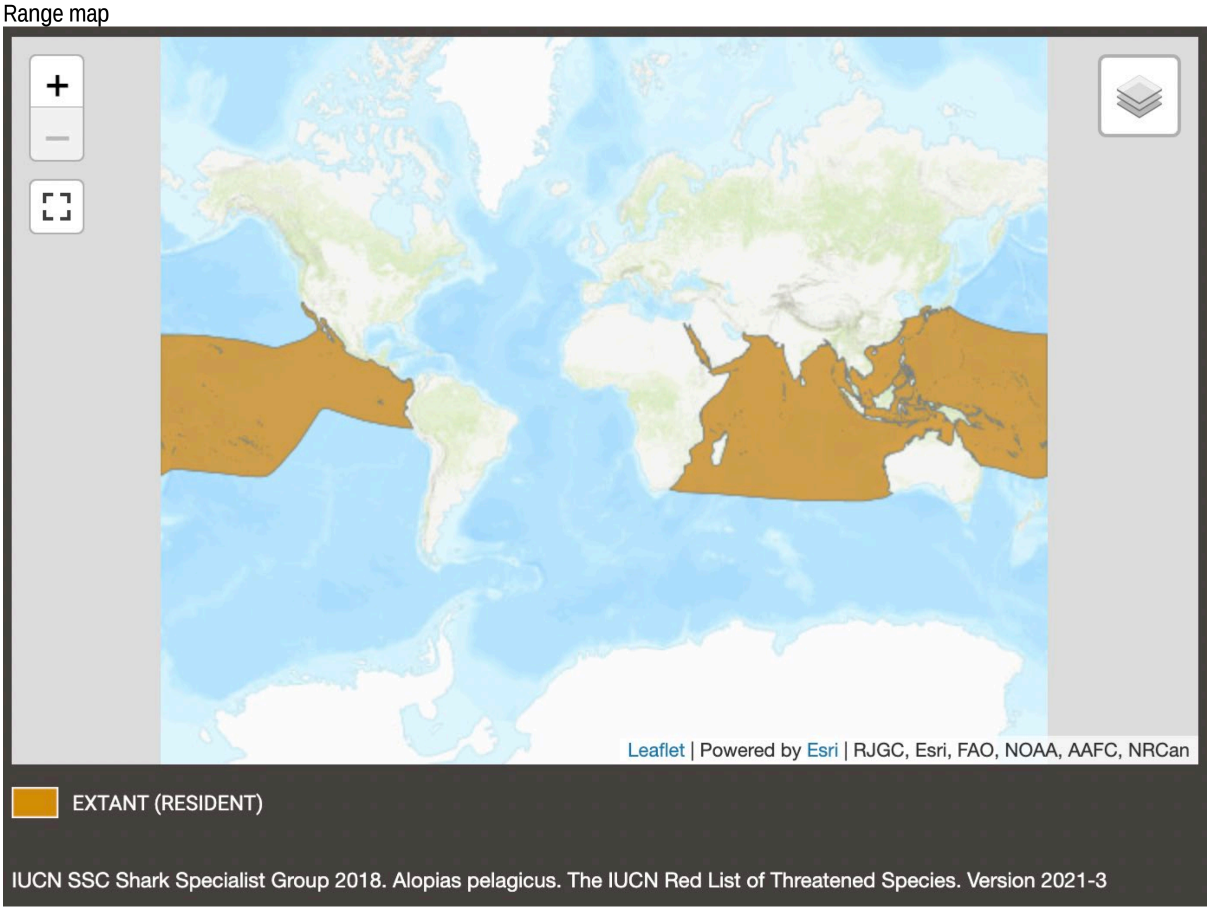
Sources consulted

(1) Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. *Alopias pelagicus*. *The IUCN Red List of Threatened Species* 2019: e.T161597A68607857. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T161597A68607857.en. Accessed on 17 June 2022.

(2) ReefQuest Center for Shark Research. Undated. Biology of the Pelagic Thresher(*Alopias pelagicus*). http://www.elasmo-research.org/education/shark_profiles/a_pelagicus.htm. Accessed 17 May 2022.

(3) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



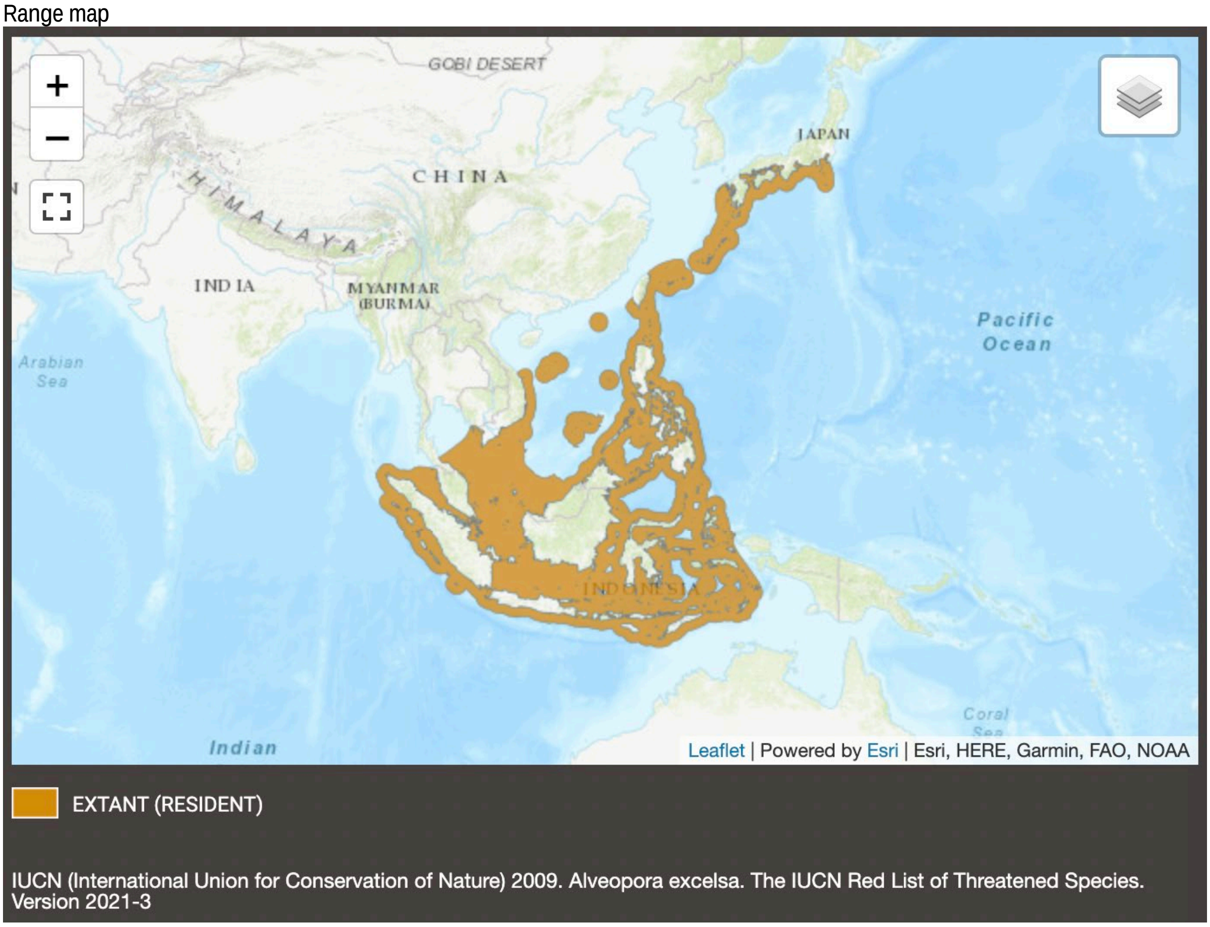
Source: Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. *Alopias pelagicus*. *The IUCN Red List of Threatened Species* 2019: e.T161597A68607857. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T161597A68607857.en. Accessed on 17 June 2022.

Alveopora excelsa
(EN)

Sources consulted

(1) Sheppard, A., Fenner, D., Edwards, A., Abrar, M. & Ochavillo, D. 2008. *Alveopora excelsa*. *The IUCN Red List of Threatened Species* 2008: e.T133464A3758346. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T133464A3758346.en. Accessed on 17 June 2022.
(2) Corals of the World. Factsheet – Alveopora excelsa. http://www.coralsoftheworld.org/species_factsheets/species_factsheet_summary/alveopora-excelsa/. Accessed 15 May 2022.
(3) Coral Trait Database. 2022. *Alveopora excelsa*. https://coraltraits.org/species/212?search=alveopora+excelsa. Accessed 28 June 2022.

Range map



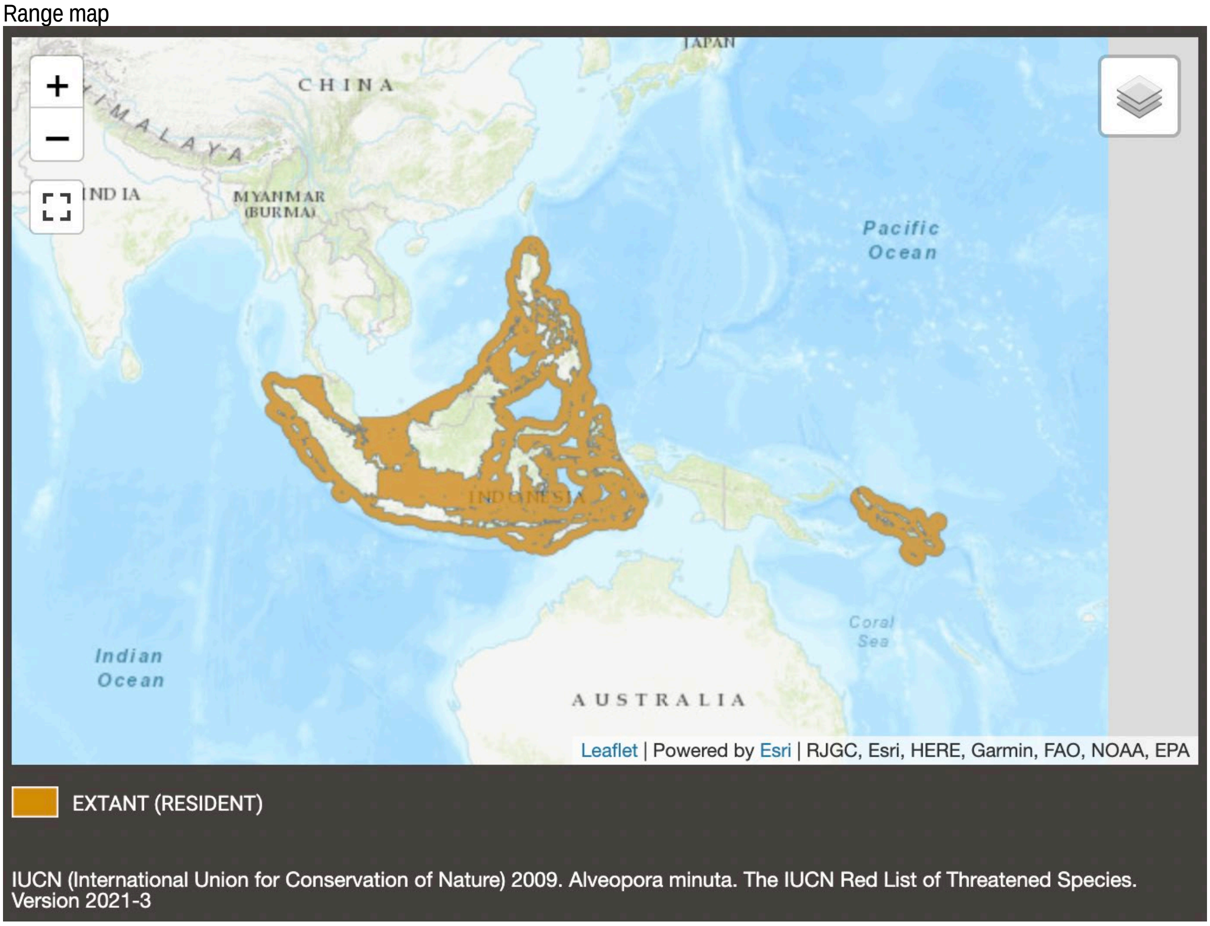
Source: Sheppard, A., Fenner, D., Edwards, A., Abrar, M. & Ochavillo, D. 2008. *Alveopora excelsa*. *The IUCN Red List of Threatened Species* 2008: e.T133464A3758346. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T133464A3758346.en. Accessed on 17 June 2022.

Alveopora minuta
(EN)

Sources consulted

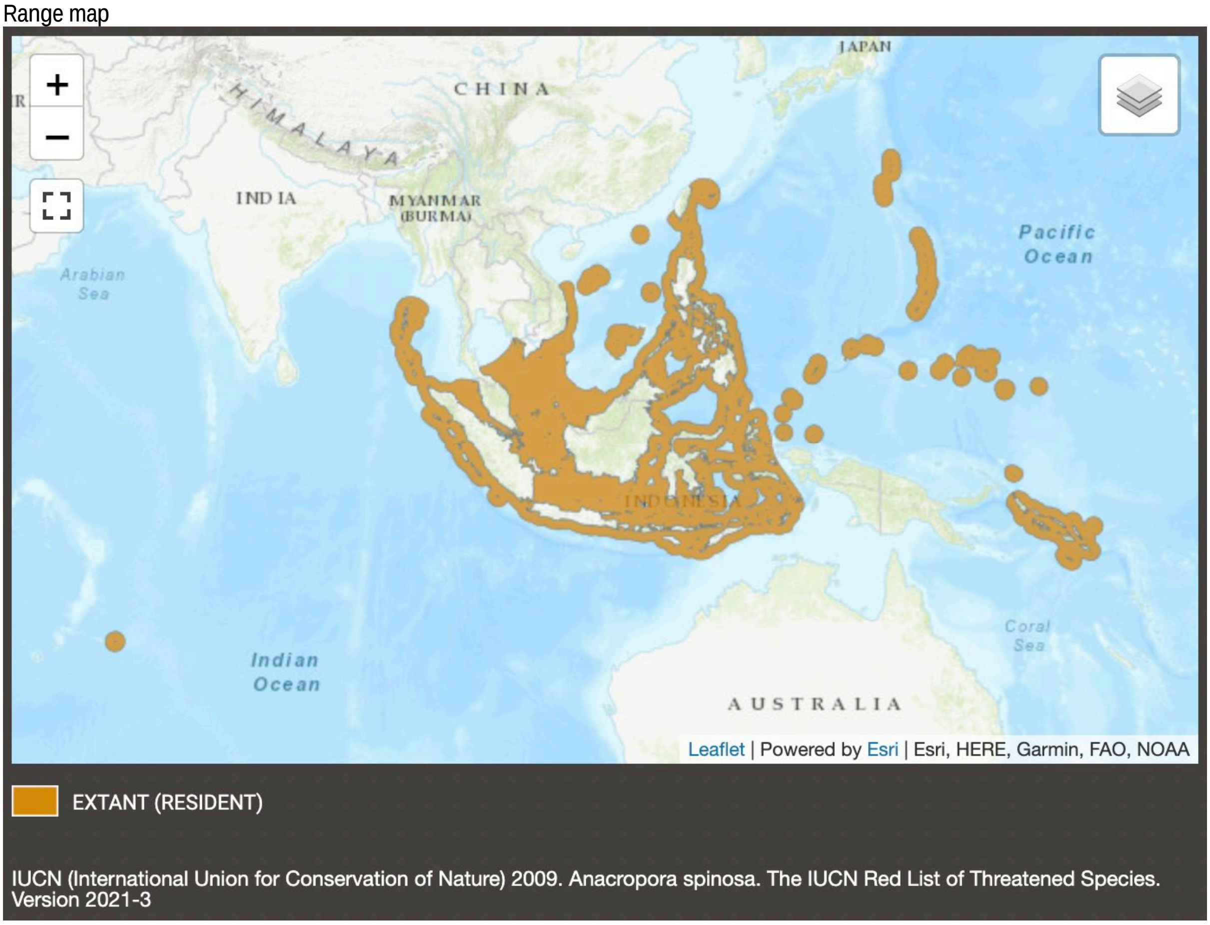
(1) Sheppard, A., Fenner, D., Edwards, A., Abrar, M. & Ochavillo, D. 2008. *Alveopora minuta*. *The IUCN Red List of Threatened Species* 2008: e.T133467A3759369. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T133467A3759369.en. Accessed on 17 June 2022.
(2) Corals of the World. Factsheet – Alveopora minuta. http://www.coralsoftheworld.org/species_factsheets/species_factsheet_summary/alveopora-minuta/. Accessed 15 May 2022.
(3) Coral Trait Database. 2022. *Alveopora minuta*. https://coraltraits.org/species/217?search=alveopora+minuta. Accessed 28 June 2022.

Range map



Source: Sheppard, A., Fenner, D., Edwards, A., Abrar, M. & Ochavillo, D. 2008. *Alveopora minuta*. *The IUCN Red List of Threatened Species* 2008: e.T133467A3759369. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T133467A3759369.en. Accessed on 17 June 2022.

Anacropora spinosa (EN)
Sources consulted
(1) Richards, Z.T., Delbeek, J.T., Lovell, E.R., Bass, D., Aeby, G. & Reboton, C. 2014. *Anacropora spinosa*. *The IUCN Red List of Threatened Species* 2014: e.T133046A54185058. https://dx.doi.org/10.2305/IUCN.UK.2014-1.RLTS.T133046A54185058.en. Accessed on 17 June 2022. (2) Corals of the World. Factsheet – Anacropora spinosa. http://www.coralsoftheworld.org/species_factsheets/species_factsheet_summary/anacropora-spinosa/. Accessed 15 May 2022. (3) Coral Trait Database. 2022. *Anacropora spinosa*. https://coraltraits.org/species/228?search=anacropora+spinosa. Accessed 28 June 2022.
Range map



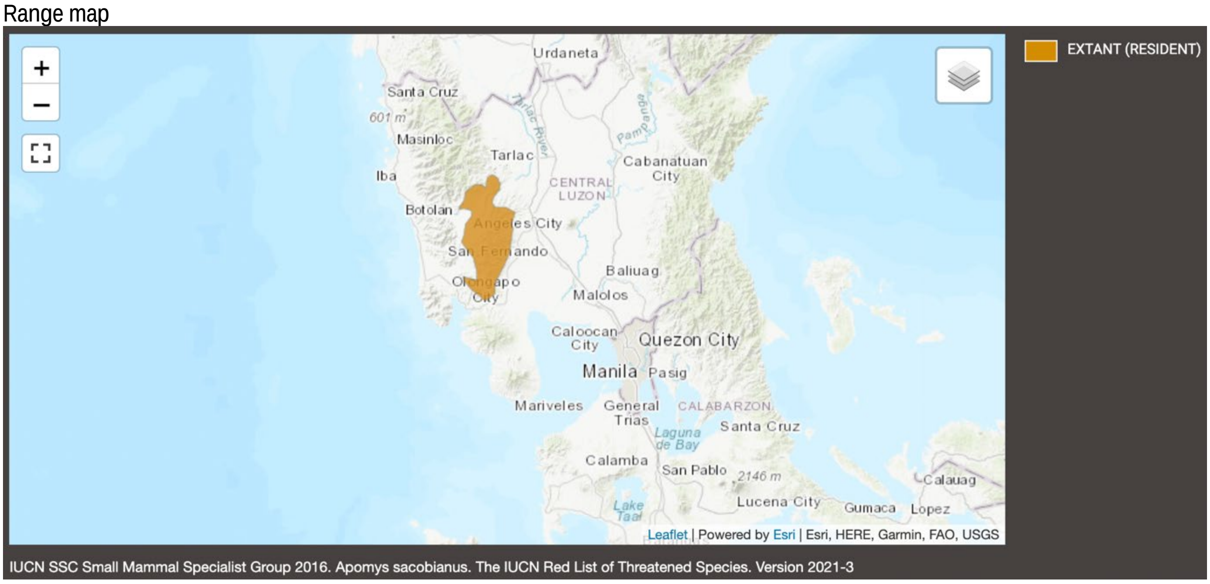
Source: Richards, Z.T., Delbeek, J.T., Lovell, E.R., Bass, D., Aeby, G. & Reboton, C. 2014. *Anacropora spinosa*. *The IUCN Red List of Threatened Species* 2014: e.T133046A54185058. https://dx.doi.org/10.2305/IUCN.UK.2014-1.RLTS.T133046A54185058.en. Accessed on 17 June 2022.

Apomys sacobianus
Long-Nosed Luzon Forest Mouse
(LC)

Sources consulted

(1) Kennerley, R. 2016. *Apomys sacobianus*. *The IUCN Red List of Threatened Species* 2016: e.T1916A22431969. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T1916A22431969.en. Accessed on 19 June 2022.

Range map



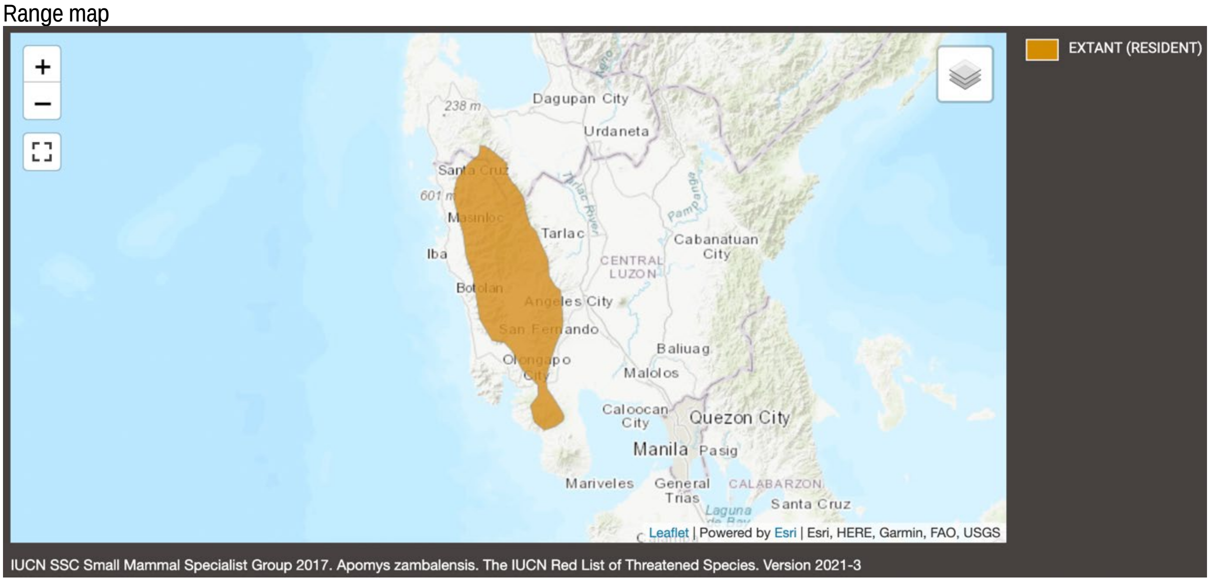
Source: Kennerley, R. 2016. *Apomys sacobianus*. *The IUCN Red List of Threatened Species* 2016: e.T1916A22431969. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T1916A22431969.en. Accessed on 19 June 2022.

Apomys zambalensis
Zambales Forest Mouse
(LC)

Sources consulted

(1) Engelbrektsson, P. & Kennerley, R. 2017. *Apomys zambalensis*. *The IUCN Red List of Threatened Species* 2017: e.T45954013A45972996. https://dx.doi.org/10.2305/IUCN.UK.2017-2.RLTS.T45954013A45972996.en. Accessed on 19 June 2022.
(2) Heaney, L.R., Balete, D.S. and Rickart, E.A. 2016. The Mammals of Luzon Island: Biogeography and Natural History of a Philippine Fauna. Johns Hopkins University Press, Baltimore, USA.

Range map



Source: Engelbrektsson, P. & Kennerley, R. 2017. *Apomys zambalensis*. *The IUCN Red List of Threatened Species* 2017: e.T45954013A45972996. https://dx.doi.org/10.2305/IUCN.UK.2017-2.RLTS.T45954013A45972996.en. Accessed on 19 June 2022.

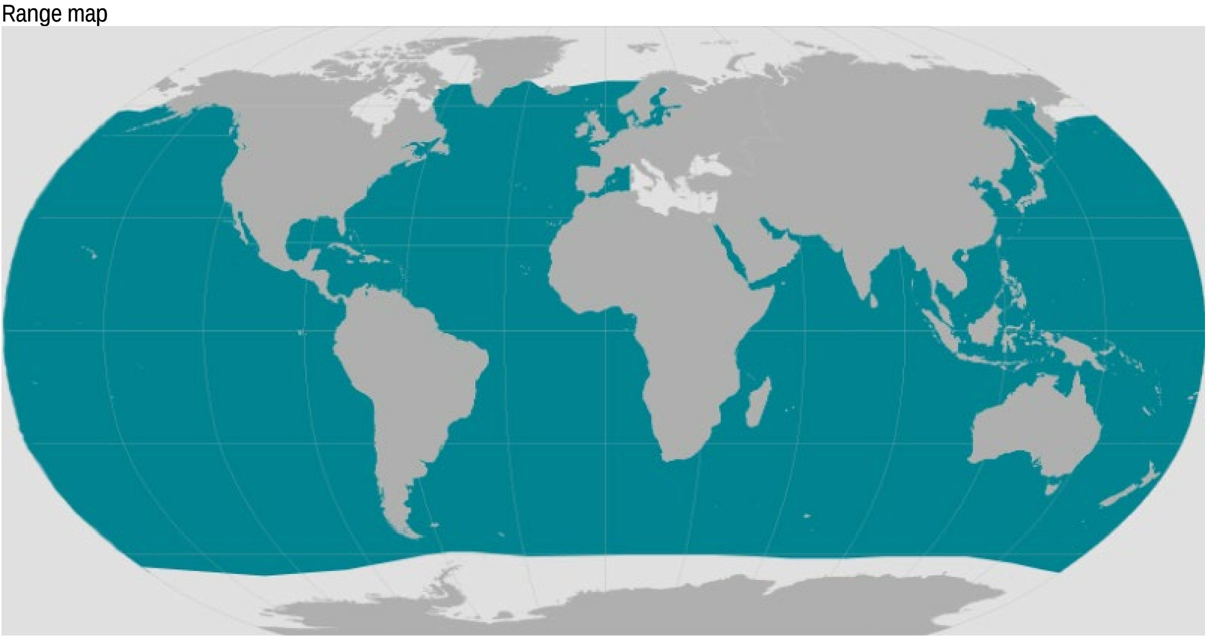
Balaenoptera borealis
Sei Whale
(EN)

Sources consulted

(1) Cooke, J.G. 2018. Balaenoptera borealis. The IUCN Red List of Threatened Species 2018: e.T2475A130482064. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T2475A130482064.en. Accessed on 20 April 2022

(2) MarineBio. Undated. Sei Whales, *Baleanoptera borealis*. https://www.marinebio.org/species/sei-whales/balaenoptera-borealis/. Accessed 20 April 2022.
(3) National Oceanic and Atmospheric Administration. 2022. Sei Whale. https://www.fisheries.noaa.gov/species/sei-whale. Accessed 20 April 2022.

Range map



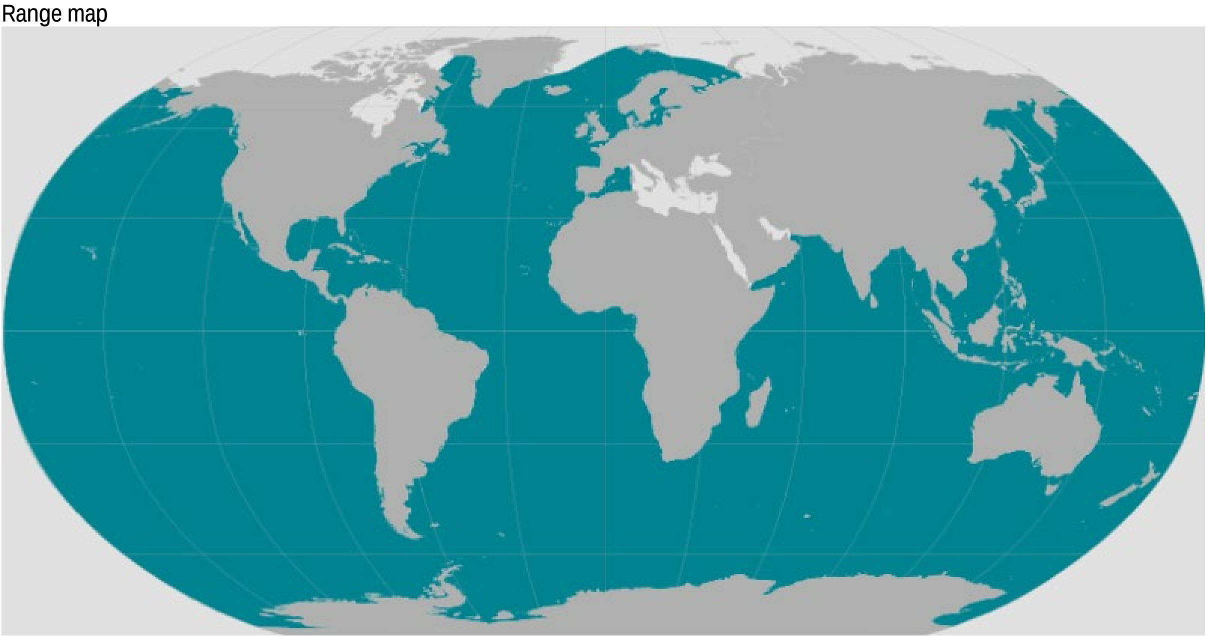
Source: National Oceanic and Atmospheric Administration. 2022. Sei Whale. https://www.fisheries.noaa.gov/species/sei-whale. Accessed 20 April 2022.

Balaenoptera musculus
Blue Whale
(EN)

Sources consulted

(1) MarineBio. Undated. Blue whales, *Balaenoptera musculus.* https://www.marinebio.org/species/blue-whales/balaenoptera-musculus/. Accessed 20 April 2022.
(2) National Oceanic and Atmospheric Administration. 2022. Blue Whale. https://www.fisheries.noaa.gov/species/blue-whale. Accessed 20 April 2022.
(3) Acebes. J.M.V., J.N. Silberg, T.J. Gardner, E.R. Sabater, A.J.C. Tiongson, P. Dumandan, D.M.M. Verdote, C.L. Emata, J. Utzurrum and A.A. Yaptinchay. 2021. First Confirmed Sightings of Blue Whales *Balaenoptera musculus* Linnaeus, 1758 (Mammalia: Cetartiodactyla: Balaenopteridae) in the Philippines Since the 19th Century. Journal of Threatened Taxa 13)3): 17875–17888. doi: 10.11609/jott.6483.13.3.17075–17888.

Range map



Source: National Oceanic and Atmospheric Administration. 2022. Blue Whale. https://www.fisheries.noaa.gov/species/blue-whale. Accessed 20 April 2022.

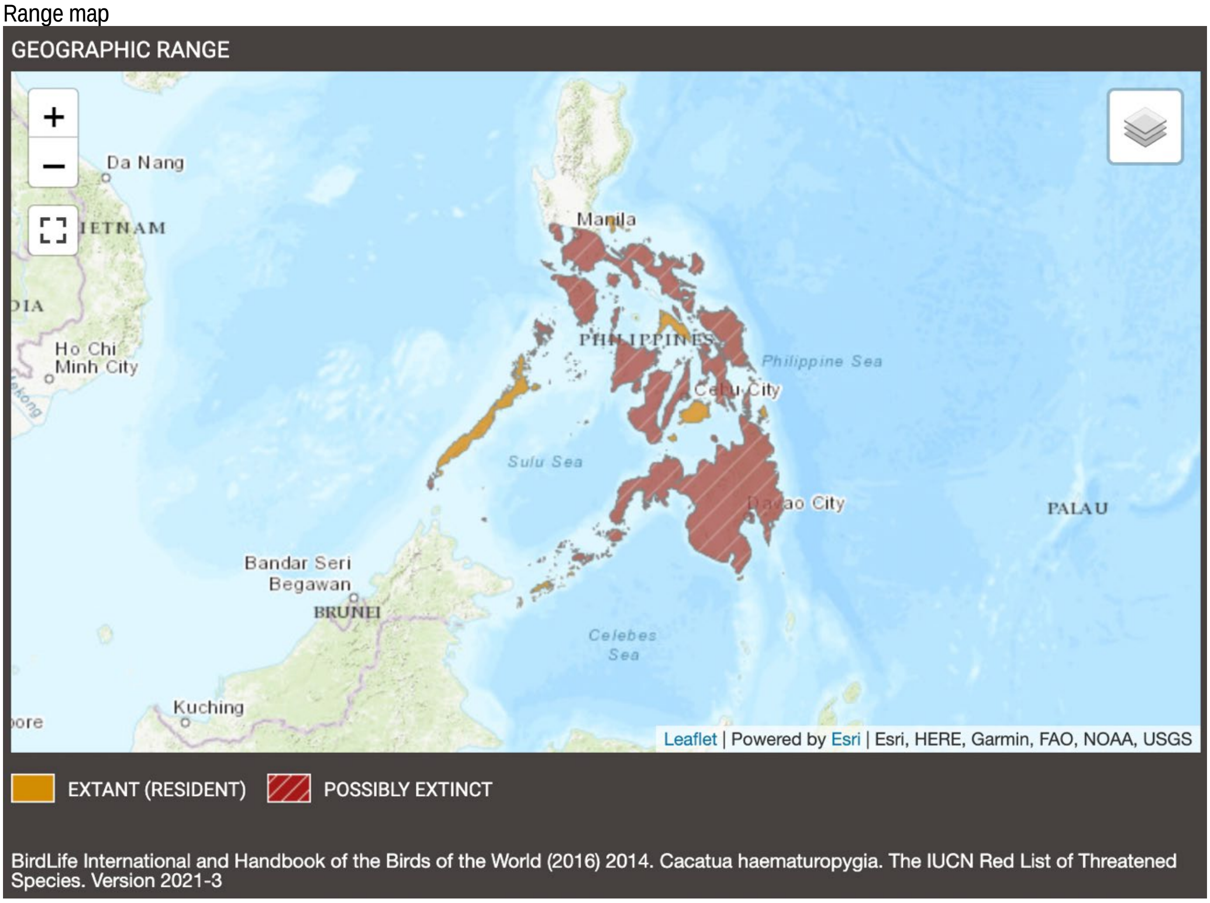
Cacatua haematuropygia
Philippine Cockatoo
(CR)

Sources consulted

(1) BirdLife International. 2017. *Cacatua haematuropygia*. *The IUCN Red List of Threatened Species* 2017: e.T22684795A117578604. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22684795A117578604.en. Accessed on 20 June 2022.

(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map



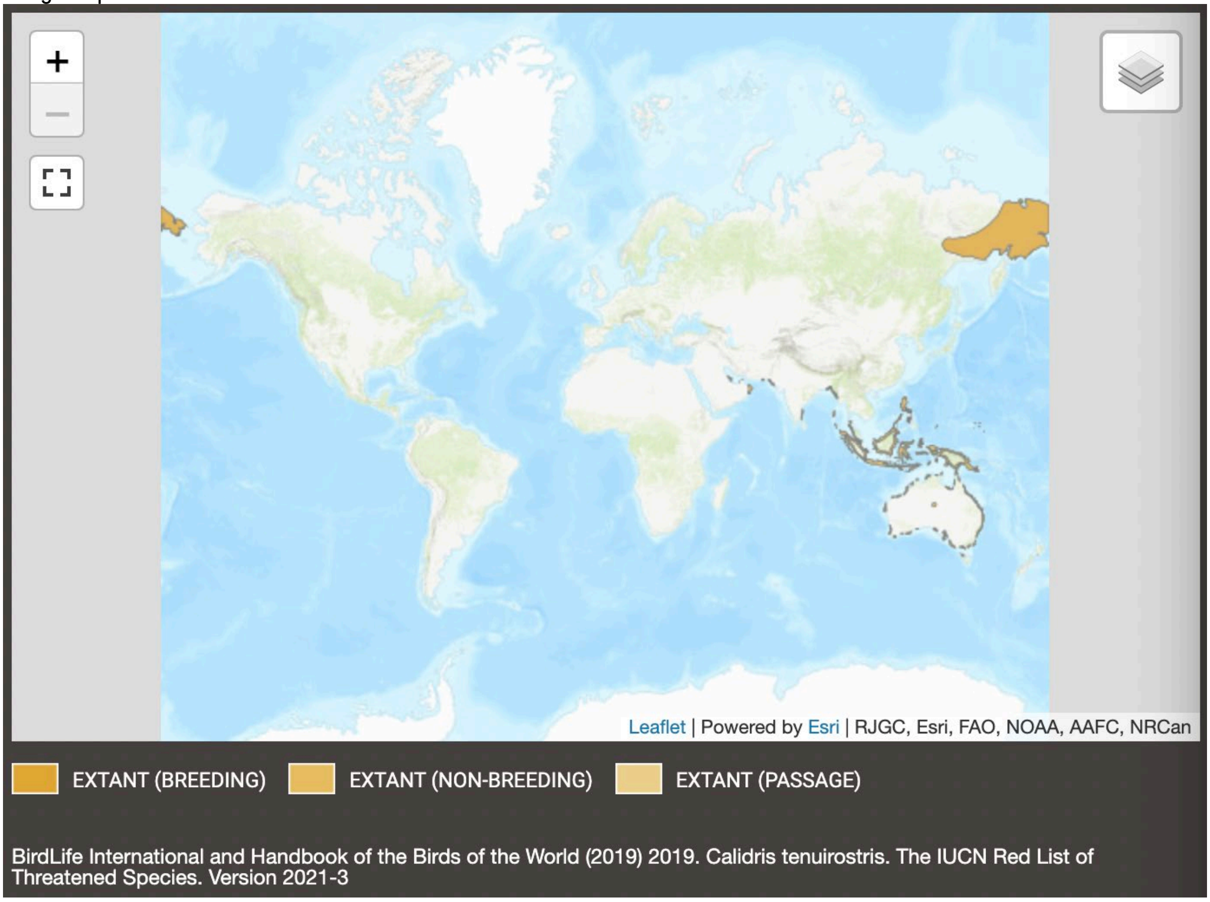
Source: (1) BirdLife International. 2017. *Cacatua haematuropygia*. *The IUCN Red List of Threatened Species* 2017: e.T22684795A117578604. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22684795A117578604.en. Accessed on 20 June 2022.

Calidris tenuirostris
Great Knot
(EN)

Sources consulted

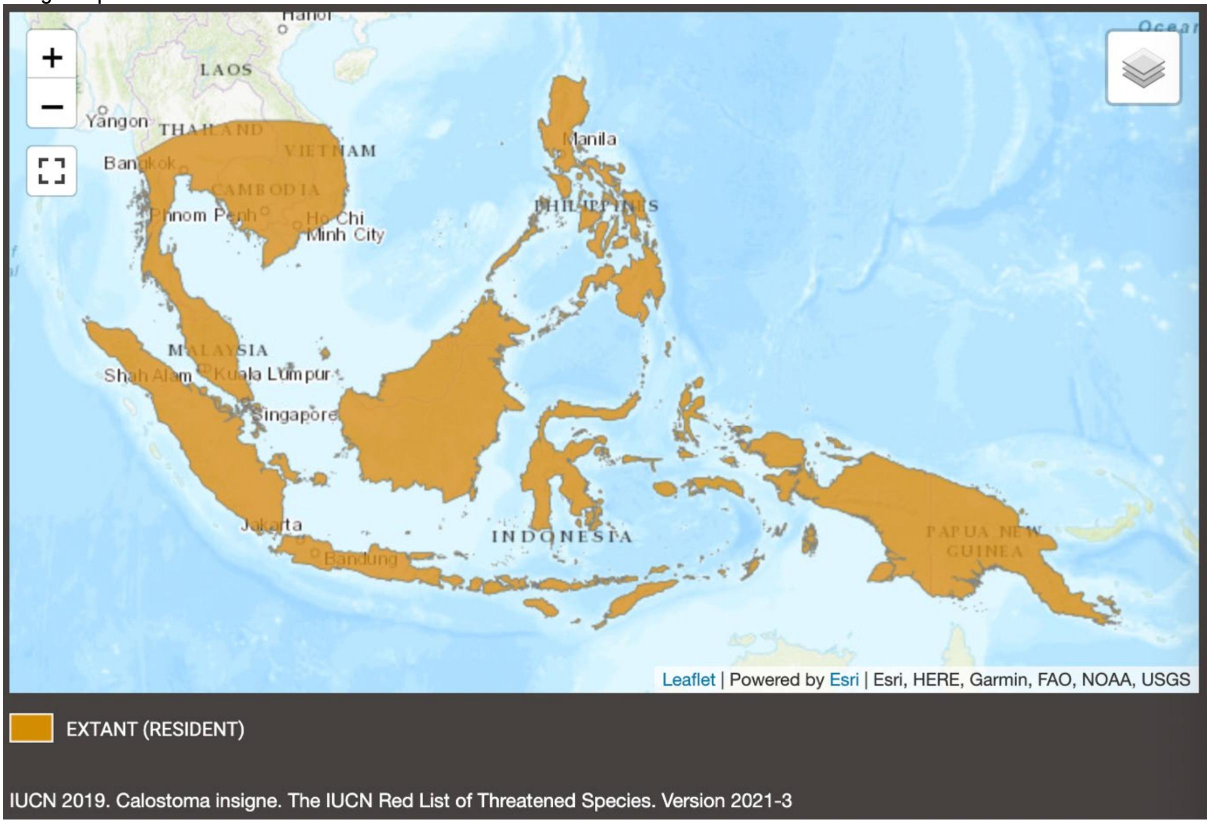
(1) BirdLife International. 2019. *Calidris tenuirostris* (amended version of 2016 assessment). *The IUCN Red List of Threatened Species* 2019: e.T22693359A155482913. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22693359A155482913.en. Accessed on 17 June 2022.
(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph
(3) Jensen, A.E. 2018. Internationally Important Waterbird Sites in Manila Bay, Philippines, October 2018. Technical Report. Wetlands International and IUCN National Committee of the Netherlands

Range map



Source: BirdLife International. 2019. *Calidris tenuirostris* (amended version of 2016 assessment). *The IUCN Red List of Threatened Species* 2019: e.T22693359A155482913. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22693359A155482913.en. Accessed on 17 June 2022.

Calostoma insigne (EN)
Sources consulted
(1) Ngadin, A.A. 2019. *Calostoma insigne*. *The IUCN Red List of Threatened Species* 2019: e.T125434353A125435555. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T125434353A125435555.en. Accessed on 20 June 2022.
Range map



Source: Ngadin, A.A. 2019. *Calostoma insigne*. *The IUCN Red List of Threatened Species* 2019: e.T125434353A125435555. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T125434353A125435555.en. Accessed on 20 June 2022.

Camptostemon philippinense
(EN)

Sources consulted

(1) Duke, N., Kathiresan, K., Salmo III, S.G., Fernando, E.S., Peras, J.R., Sukardjo, S., Miyagi, T., Ellison, J., Koedam, N.E., Wang, Y., Primavera, J., Jin Eong, O., Wan-Hong Yong, J. & Ngoc Nam, V. 2010. *Camptostemon philippinense*. *The IUCN Red List of Threatened Species* 2010: e.T178808A7612909. https://dx.doi.org/10.2305/IUCN.UK.2010-2.RLTS.T178808A7612909.en. Accessed on 20 June 2022.

Range map

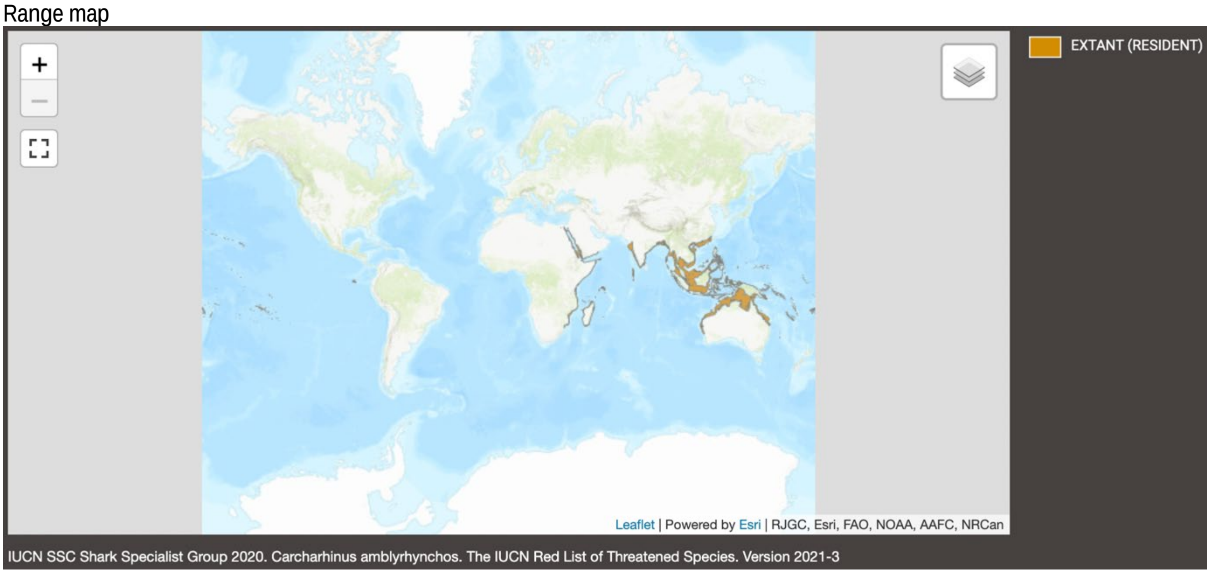
Source: Duke, N., Kathiresan, K., Salmo III, S.G., Fernando, E.S., Peras, J.R., Sukardjo, S., Miyagi, T., Ellison, J., Koedam, N.E., Wang, Y., Primavera, J., Jin Eong, O., Wan-Hong Yong, J. & Ngoc Nam, V. 2010. *Camptostemon philippinense*. *The IUCN Red List of Threatened Species* 2010: e.T178808A7612909. https://dx.doi.org/10.2305/IUCN.UK.2010-2.RLTS.T178808A7612909.en. Accessed on 20 June 2022.

Carcharhinus amblyrhynchos
Grey Reef Shark
(EN)

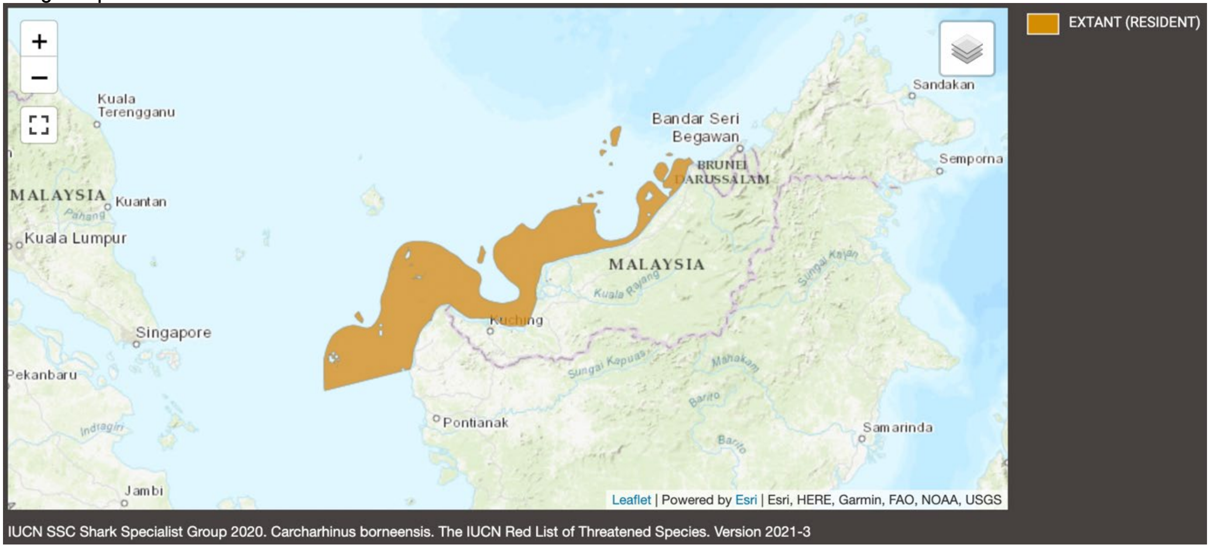
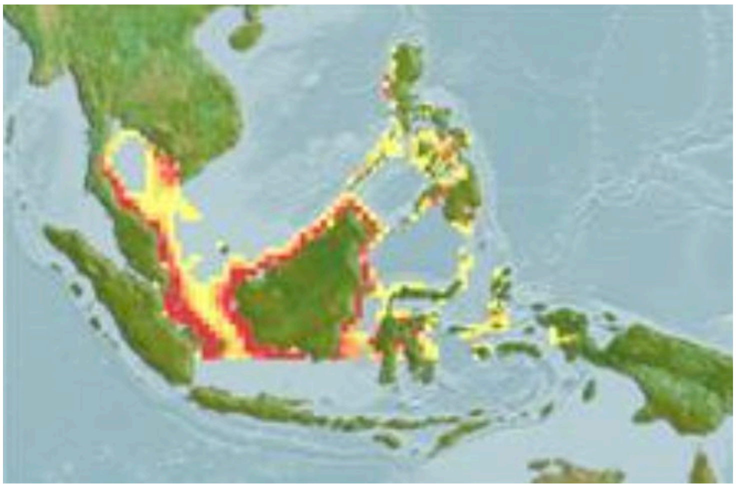
Sources consulted

(1) Simpfendorfer, C., Fahmi, Bin Ali, A., , D., Utzurrum, J.A.T., Seyha, L., Maung, A., Bineesh, K.K., Yuneni, R.R., Sianipar, A., Haque, A.B., Tanay, D., Gautama, D.A. & Vo, V.Q. 2020. *Carcharhinus amblyrhynchos*. *The IUCN Red List of Threatened Species* 2020: e.T39365A173433550. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T39365A173433550.en. Accessed on 17 June 2022.
(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



Source: Simpfendorfer, C., Fahmi, Bin Ali, A., , D., Utzurrum, J.A.T., Seyha, L., Maung, A., Bineesh, K.K., Yuneni, R.R., Sianipar, A., Haque, A.B., Tanay, D., Gautama, D.A. & Vo, V.Q. 2020. *Carcharhinus amblyrhynchos*. *The IUCN Red List of Threatened Species* 2020: e.T39365A173433550. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T39365A173433550.en. Accessed on 17 June 2022.

Carcharhinus borneensis Borneo Shark (CR)
Sources consulted (1) Dulvy, N.K., Bin Ali, A., Derrick, D., Dharmadi & Fahmi. 2021. *Carcharhinus borneensis*. *The IUCN Red List of Threatened Species* 2021: e.T39367A124407121. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T39367A124407121.en. Accessed on 01 July 2022. (2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 1 July 2022. (3) Compagno, L.J.V., 2022. Sharks of the World: Borneo shark (*Carcharhinus borneensis*). http://species-identification.org/species.php?species_group=sharks&id=439. Accessed 30 June 2022.
Range maps  Source: Dulvy, N.K., Bin Ali, A., Derrick, D., Dharmadi & Fahmi. 2021. *Carcharhinus borneensis*. *The IUCN Red List of Threatened Species* 2021: e.T39367A124407121. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T39367A124407121.en. Accessed on 01 July 2022.  Source: Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 1 July 2022.

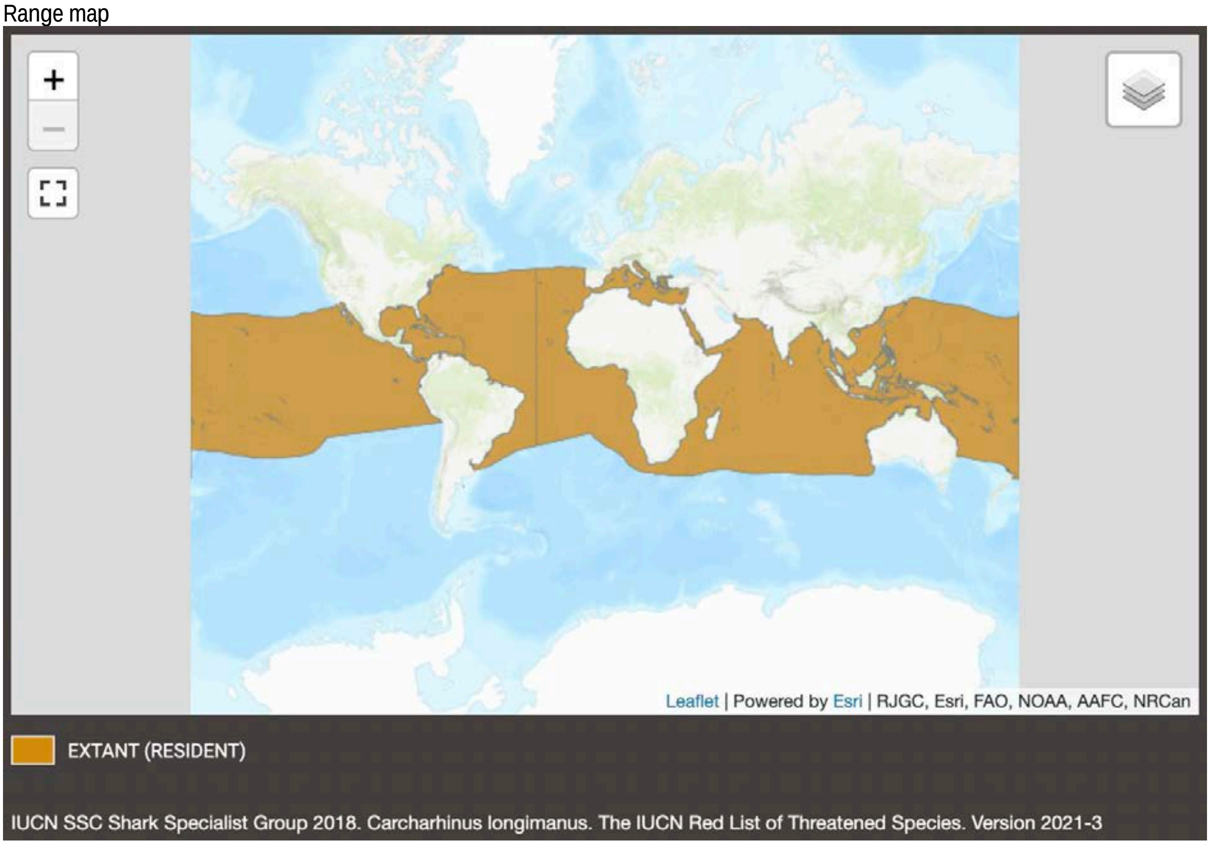
Carcharhinus longimanus
Oceanic whitetip shark
(CR)

Sources consulted

(1) Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. Carcharhinus longimanus. The IUCN Red List of Threatened Species 2019: e.T39374A2911619. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T39374A2911619.en. Accessed on 25 April 2022.

(2) NOAA. Oceanic Whitetip Shark. https://www.fisheries.noaa.gov/species/oceanic-whitetip-shark. Accessed 12 May 2022.

Range map



Source: Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. Carcharhinus longimanus. The IUCN Red List of Threatened Species 2019: e.T39374A2911619. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T39374A2911619.en. Accessed on 25 April 2022.

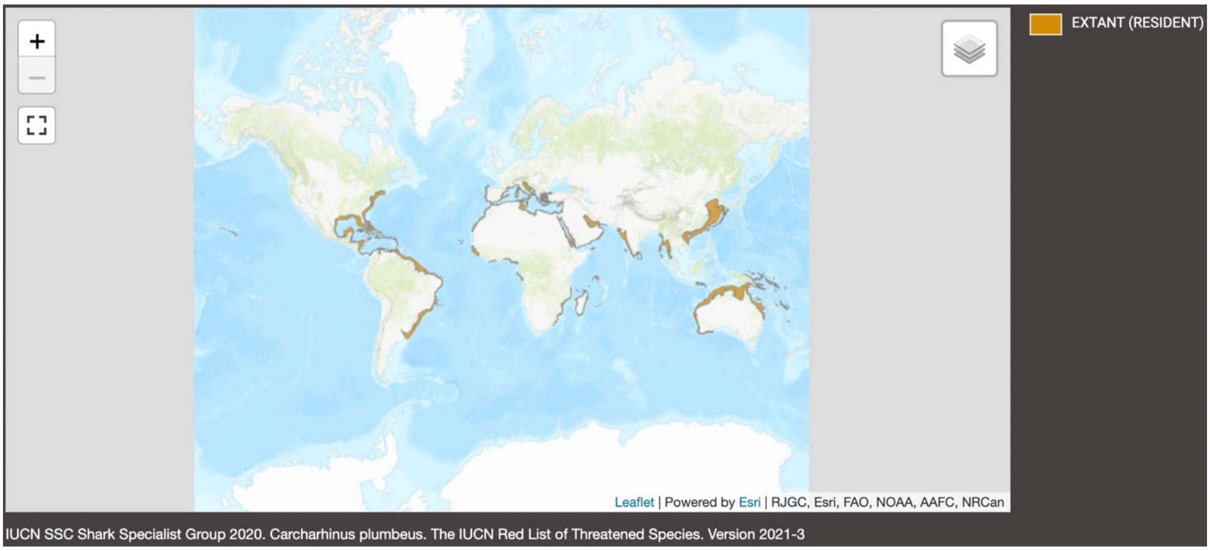
Carcharhinus plumbeus
Sandbar Shark
(EN)

Sources consulted

(1) Rigby, C.L., Derrick, D., Dicken, M., Harry, A.V., Pacoureau, N. & Simpfendorfer, C. 2021. *Carcharhinus plumbeus*. *The IUCN Red List of Threatened Species* 2021: e.T3853A2874370. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T3853A2874370.en. Accessed on 01 July 2022.

(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 1 July 2022.

Range map



Source: Rigby, C.L., Derrick, D., Dicken, M., Harry, A.V., Pacoureau, N. & Simpfendorfer, C. 2021. *Carcharhinus plumbeus*. *The IUCN Red List of Threatened Species* 2021: e.T3853A2874370. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T3853A2874370.en. Accessed on 01 July 2022.

Cephaloscyllium fasciatum
Reticulated Swellshark
(CR)

Sources consulted

(1) Dulvy, N.K., Bineesh, K.K., Cheok, J., Dharmadi, Finucci, B., Rigby, C.L. & Sherman, C.S. 2020. *Cephaloscyllium fasciatum. The IUCN Red List of Threatened Species* 2020: e.T162207827A162870102. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T162207827A162870102.en. Accessed on 17 June 2022.

(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map

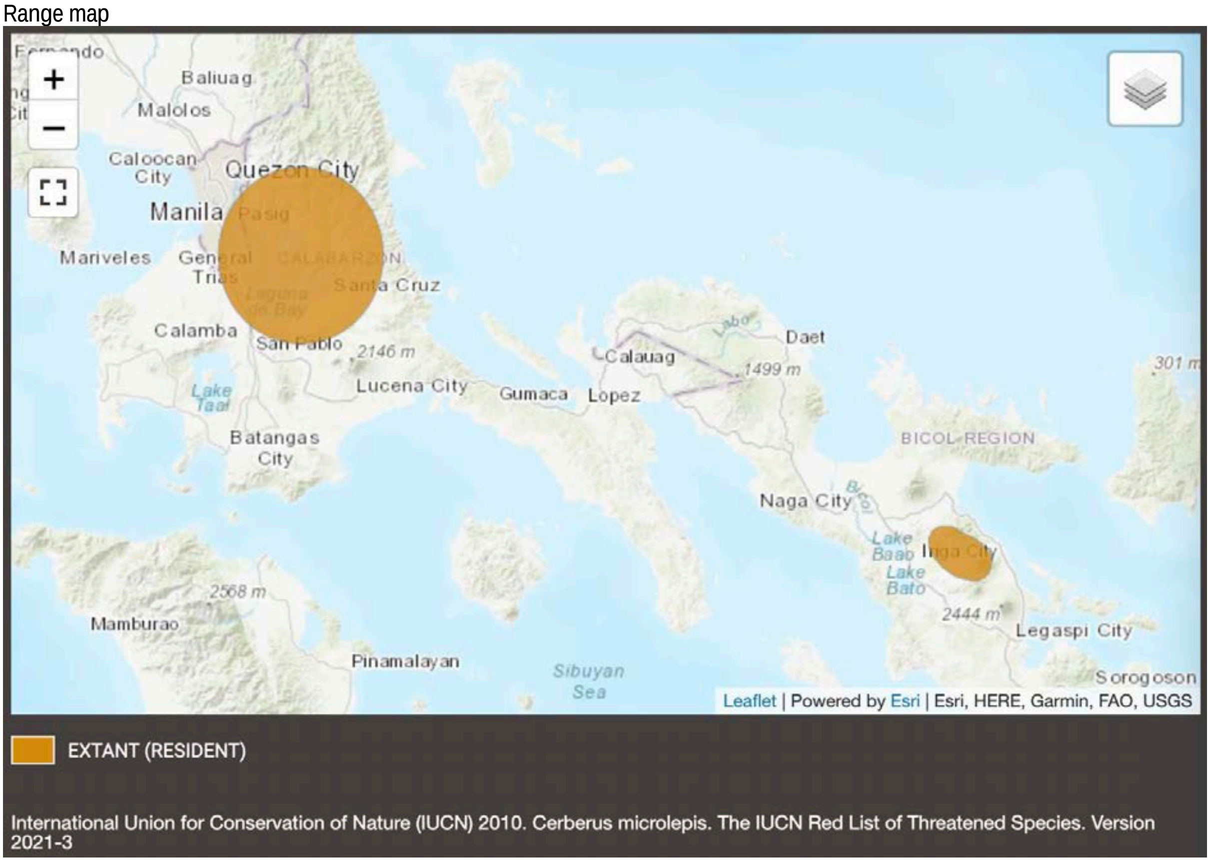
Source: Dulvy, N.K., Bineesh, K.K., Cheok, J., Dharmadi, Finucci, B., Rigby, C.L. & Sherman, C.S. 2020. *Cephaloscyllium fasciatum. The IUCN Red List of Threatened Species* 2020: e.T162207827A162870102. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T162207827A162870102.en. Accessed on 17 June 2022.

Cerberus microlepis
Lake Buhi Bockadam
(EN)

Sources consulted

(1) Ledesma, M., Rico, E., Gonzalez, J.C., Brown, R., Murphy, J., Voris, H. & Karns, D. 2010. *Cerberus microlepis*. *The IUCN Red List of Threatened Species* 2010: e.T169827A6679261. https://dx.doi.org/10.2305/IUCN.UK.2010-4.RLTS.T169827A6679261.en. Accessed on 20 June 2022.

Range map



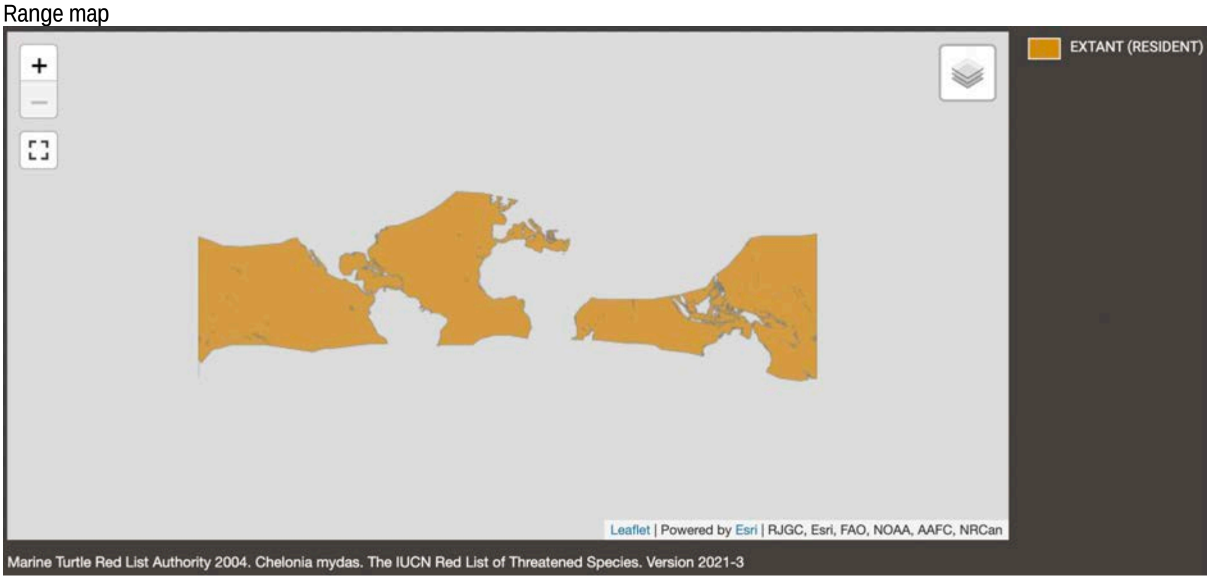
Source: Ledesma, M., Rico, E., Gonzalez, J.C., Brown, R., Murphy, J., Voris, H. & Karns, D. 2010. *Cerberus microlepis*. *The IUCN Red List of Threatened Species* 2010: e.T169827A6679261. https://dx.doi.org/10.2305/IUCN.UK.2010-4.RLTS.T169827A6679261.en. Accessed on 20 June 2022.

Chelonia mydas
Green Turtle
(EN)

Sources consulted

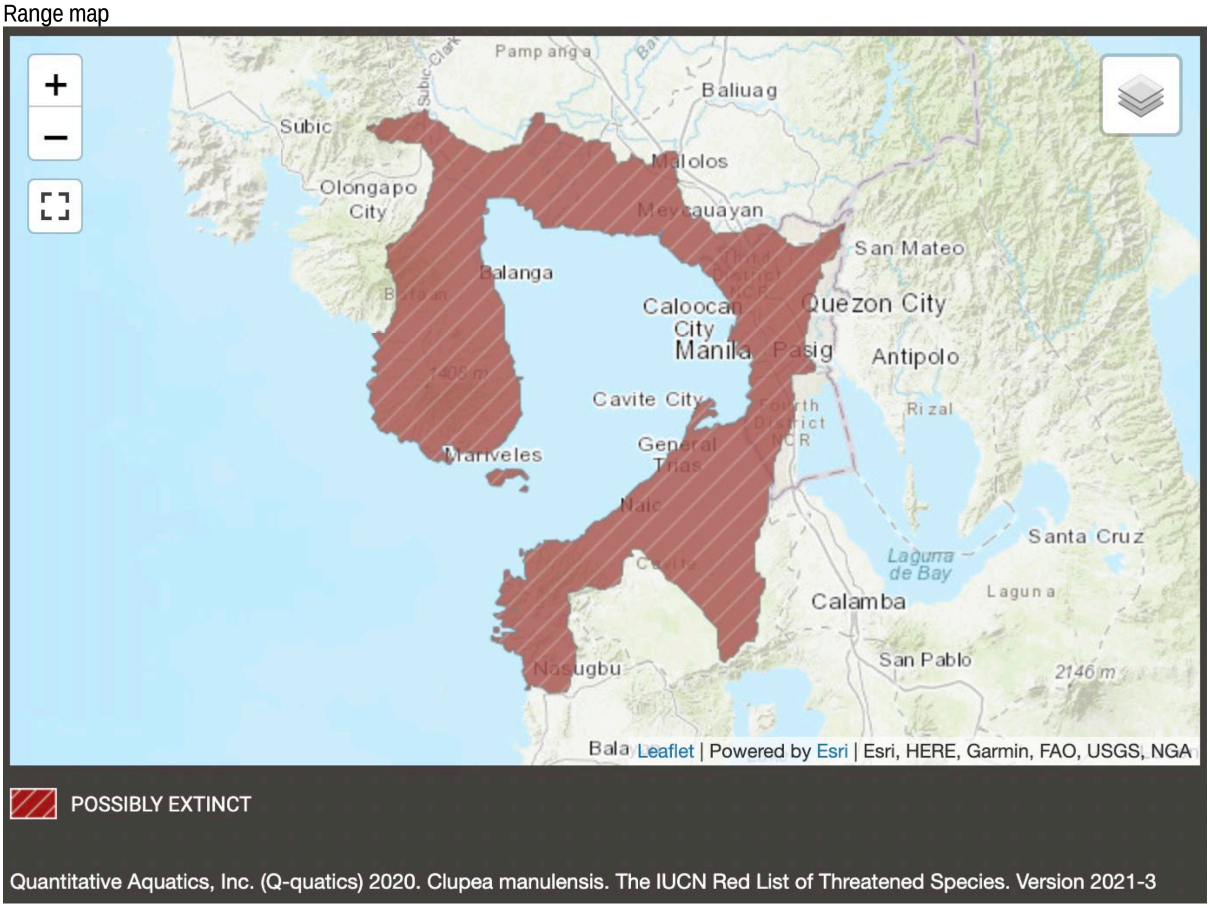
(1) Seminoff, J.A. (Southwest Fisheries Science Center, U.S.). 2004. *Chelonia mydas*. *The IUCN Red List of Threatened Species* 2004: e.T4615A11037468. https://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T4615A11037468.en. Accessed on 17 June 2022.
(2) Sea Turtle Conservancy. Information About Sea Turtles: Green Sea Turtle. https://conserveturtles.org/information-sea-turtles-green-sea-turtle/. Accessed 18 February 2022.

Range map



Source: Seminoff, J.A. (Southwest Fisheries Science Center, U.S.). 2004. *Chelonia mydas*. *The IUCN Red List of Threatened Species* 2004: e.T4615A11037468. https://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T4615A11037468.en. Accessed on 17 June 2022.

Clupea manulensis (CR)
Sources consulted
(1) Torres, A.G., Kesner-Reyes, K. & Capuli, E. 2021. *Clupea manulensis*. *The IUCN Red List of Threatened Species* 2021: e.T162160049A162160065. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T162160049A162160065.en. Accessed on 17 June 2022. (2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.
Range map



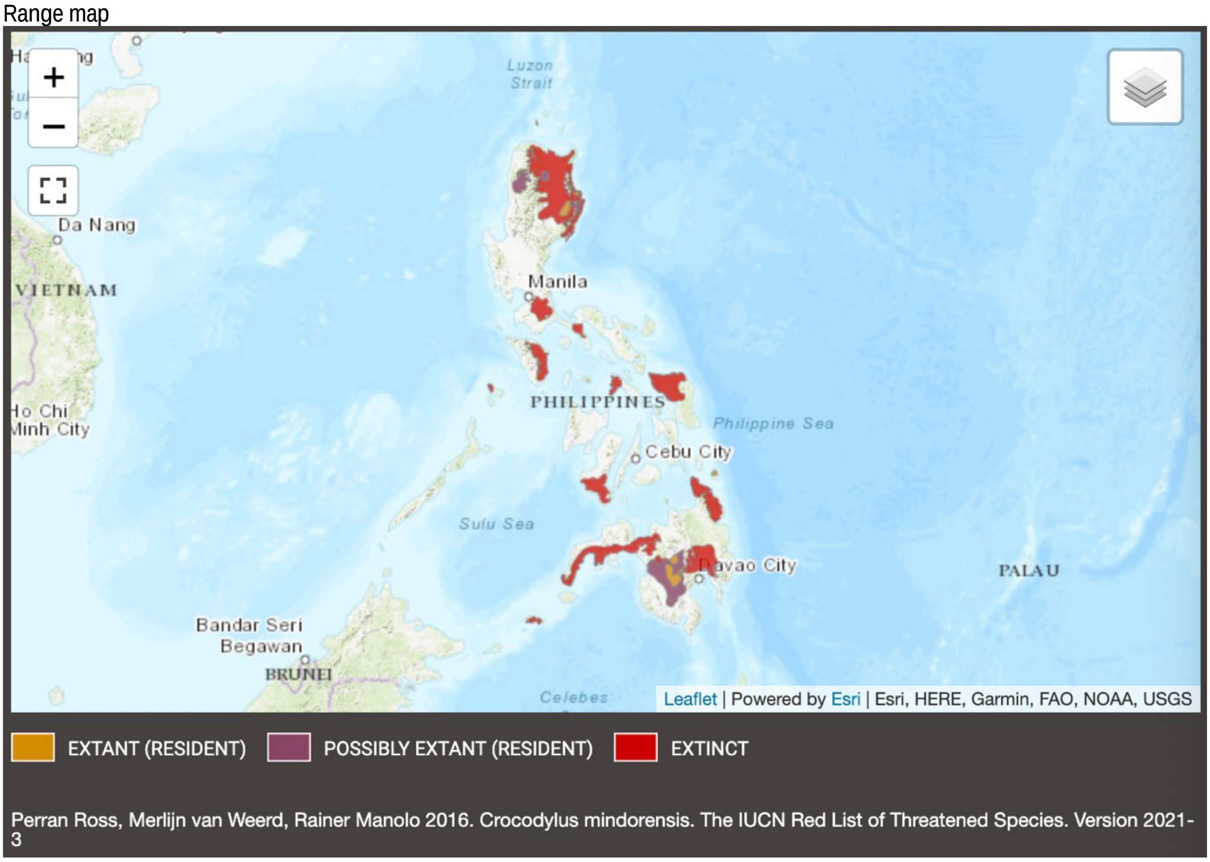
Source: Torres, A.G., Kesner-Reyes, K. & Capuli, E. 2021. *Clupea manulensis*. *The IUCN Red List of Threatened Species* 2021: e.T162160049A162160065. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T162160049A162160065.en. Accessed on 17 June 2022.

Crocodylus mindorensis
Philippine Crocodile
(CR)

Sources consulted

(1) van Weerd, M., C. Pomaro, C., de Leon, J., Antolin, R. & Mercado, V. 2016. *Crocodylus mindorensis*. *The IUCN Red List of Threatened Species* 2016: e.T5672A3048281. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T5672A3048281.en. Accessed on 20 June 2022.

Range map



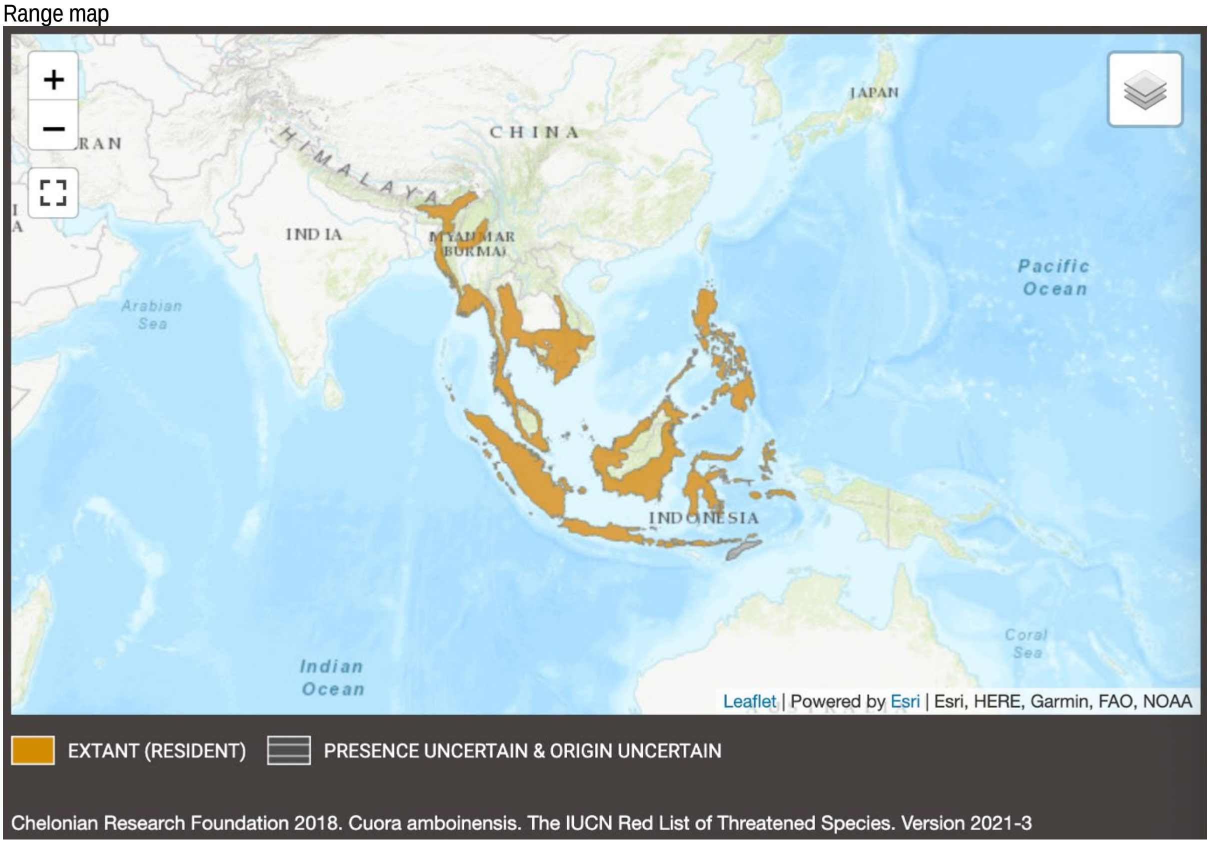
Source: van Weerd, M., C. Pomaro, C., de Leon, J., Antolin, R. & Mercado, V. 2016. *Crocodylus mindorensis*. *The IUCN Red List of Threatened Species* 2016: e.T5672A3048281. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T5672A3048281.en. Accessed on 20 June 2022.

Cuora amboinensis
Southeast Asian Box Turtle
(EN)

Sources consulted

(1) Cota, M., Hoang, H., Horne, B.D., Kusrini, M.D., McCormack, T., Platt, K., Schoppe, S. & Shepherd, C. 2020. *Cuora amboinensis*. *The IUCN Red List of Threatened Species* 2020: e.T5958A3078812. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T5958A3078812.en. Accessed on 20 June 2022.

Range map



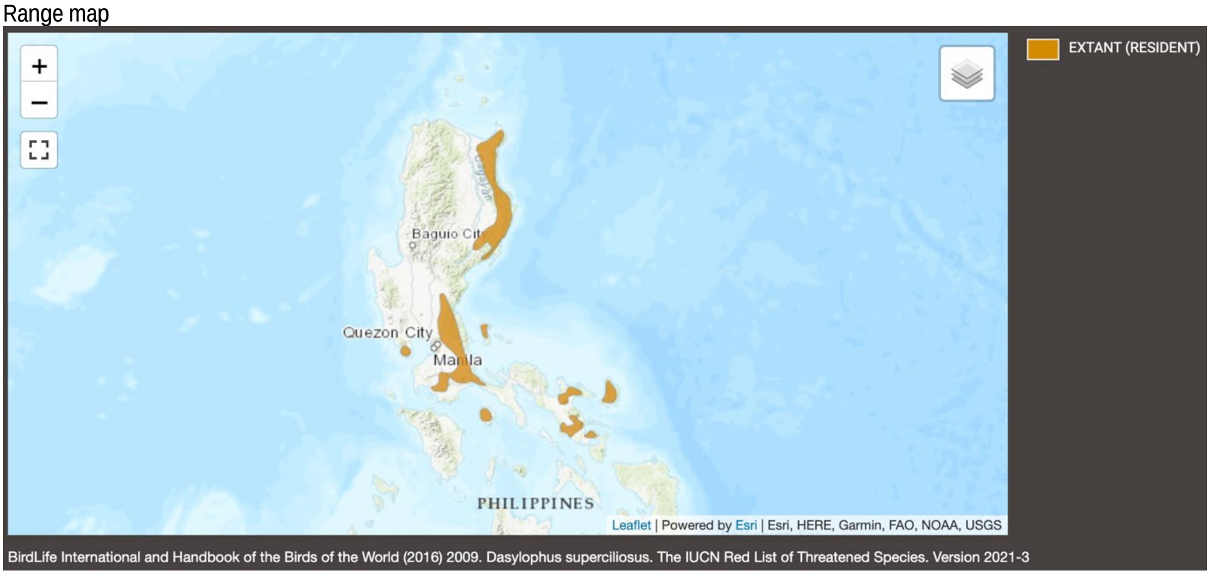
Source: Cota, M., Hoang, H., Horne, B.D., Kusrini, M.D., McCormack, T., Platt, K., Schoppe, S. & Shepherd, C. 2020. *Cuora amboinensis*. *The IUCN Red List of Threatened Species* 2020: e.T5958A3078812. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T5958A3078812.en. Accessed on 20 June 2022.

Dasylophus superciliosus
Red-Crested Malkoha
(LC)

Sources consulted

(1) BirdLife International. 2016. *Dasylophus superciliosus*. *The IUCN Red List of Threatened Species* 2016: e.T22684126A93015650. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22684126A93015650.en. Accessed on 19 June 2022.
(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map



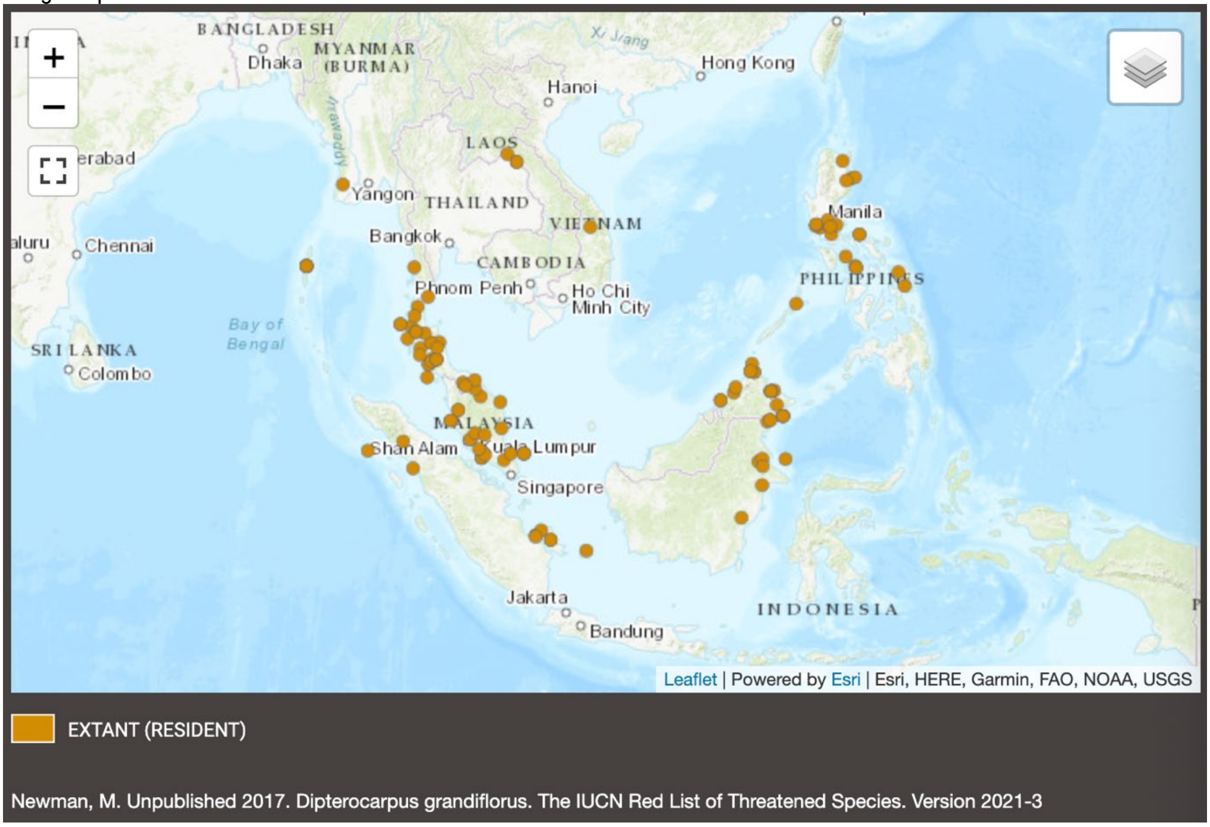
Source: BirdLife International. 2016. *Dasylophus superciliosus*. *The IUCN Red List of Threatened Species* 2016: e.T22684126A93015650. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22684126A93015650.en. Accessed on 19 June 2022.

Dipterocarpus grandiflorus
(EN)

Sources consulted

(1) Ly, V., Nanthavong, K., Pooma, R., Luu, H.T., Vu, V.D., Barstow, M., Nguyen, H.N., Hoang, V.S., Khou, E. & Newman, M.F. 2017. *Dipterocarpus grandiflorus*. *The IUCN Red List of Threatened Species* 2017: e.T33012A2830533. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T33012A2830533.en. Accessed on 20 June 2022.

Range map



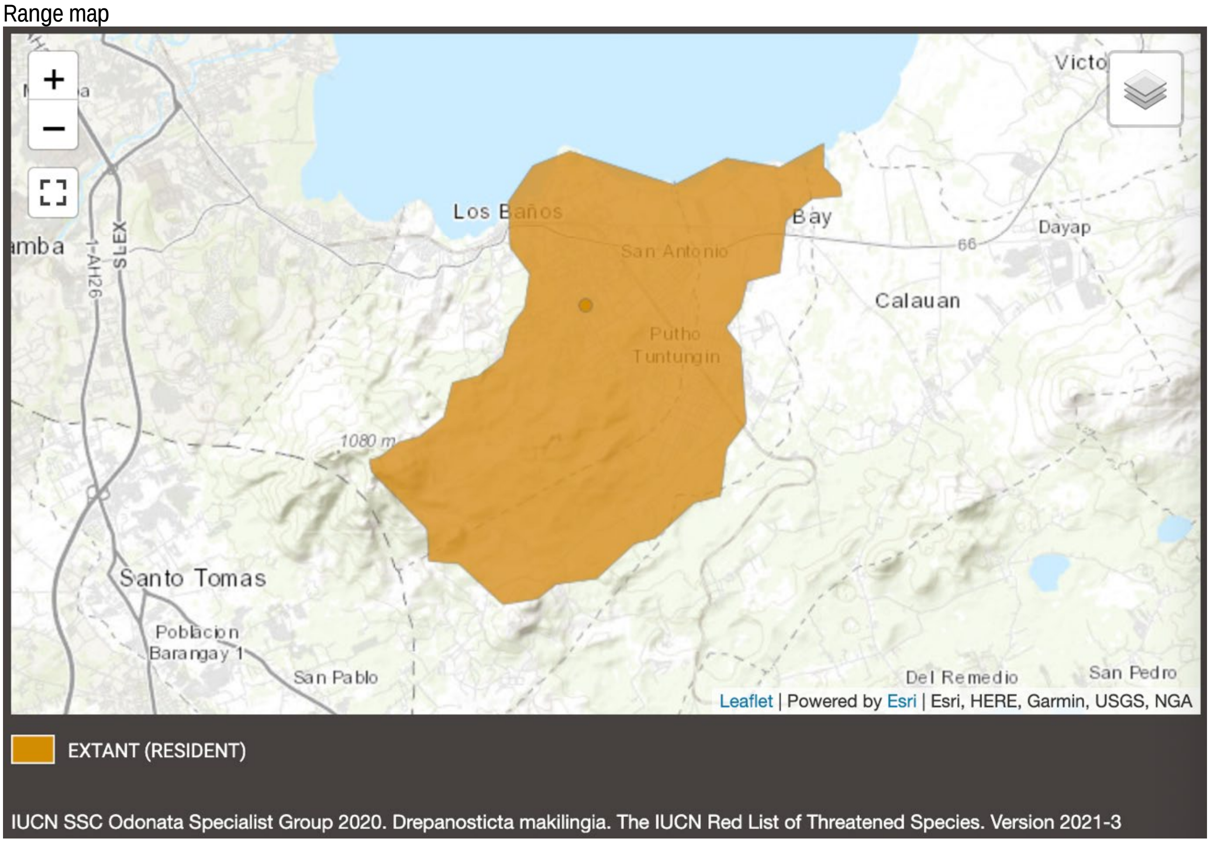
Source: Ly, V., Nanthavong, K., Pooma, R., Luu, H.T., Vu, V.D., Barstow, M., Nguyen, H.N., Hoang, V.S., Khou, E. & Newman, M.F. 2017. *Dipterocarpus grandiflorus*. *The IUCN Red List of Threatened Species* 2017: e.T33012A2830533. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T33012A2830533.en. Accessed on 20 June 2022.

Drepanosticta makilingia
(CR)

Sources consulted

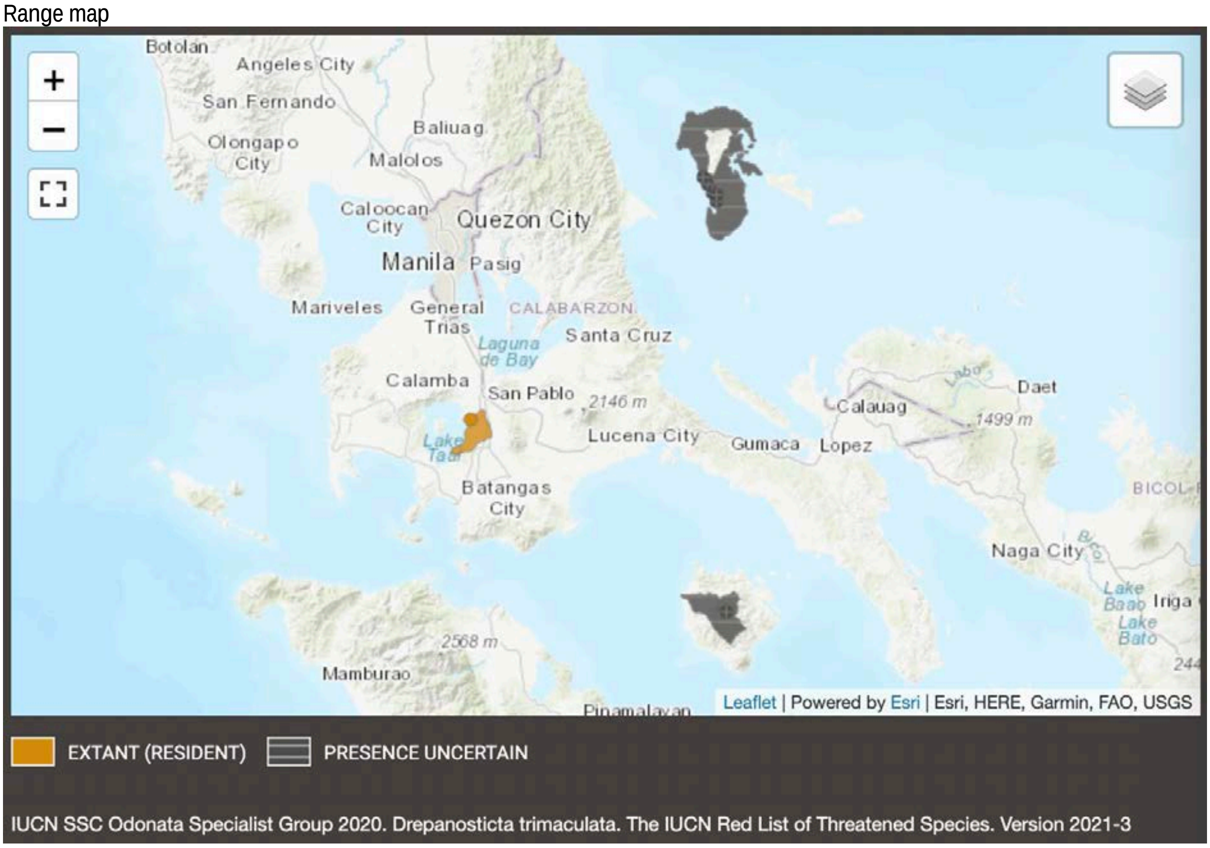
(1) Dow, R.A. 2020. *Drepanosticta makilingia. The IUCN Red List of Threatened Species* 2020: e.T139568018A146602615. https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T139568018A146602615.en. Accessed on 20 June 2022.

Range map



Source: Dow, R.A. 2020. *Drepanosticta makilingia. The IUCN Red List of Threatened Species* 2020: e.T139568018A146602615. https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T139568018A146602615.en. Accessed on 20 June 2022.

Drepanosticta trimaculata (CR)
Sources consulted
(1) Dow, R.A. 2020. *Drepanosticta trimaculata*. *The IUCN Red List of Threatened Species* 2020: e.T139569432A146602680. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T139569432A146602680.en. Accessed on 20 June 2022.
Range map



Source: Dow, R.A. 2020. *Drepanosticta trimaculata*. *The IUCN Red List of Threatened Species* 2020: e.T139569432A146602680. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T139569432A146602680.en. Accessed on 20 June 2022.

Eretmochelys imbricata
Hawksbill Turtle
(CR)

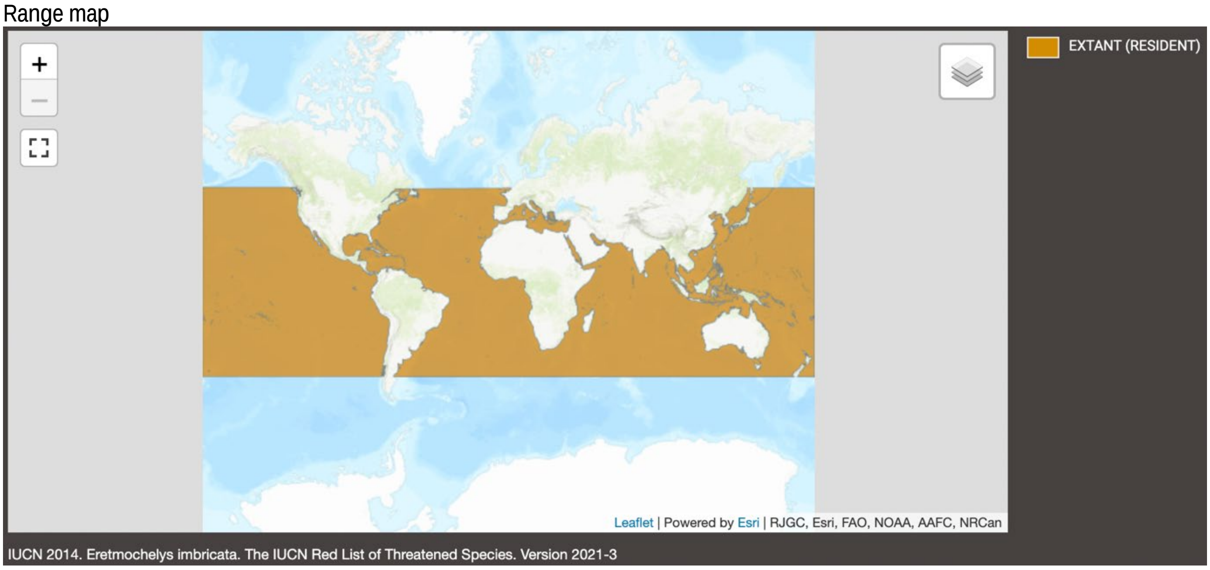
Sources consulted

(1) "Species Fact Sheet: 'FIGIS - Fisheries Global Information System". United Nations. 2006. Retrieved 2009-06-14.
(2) Lutz, P. L.; J. A. Musick (1997). *The Biology of Sea Turtles*. Boca Raton, Florida: CRC Press. ISBN 978-0-8493-8422-6.

(3) FAO 2022. Eretmochelys imbricata Linnaeus,1766. Fisheries and Aquaculture Division [online]. Rome. [Cited Sunday, June 19th 2022]. https://www.fao.org/fishery/en/aqspecies/3606

(4) Mortimer, J.A & Donnelly, M. (IUCN SSC Marine Turtle Specialist Group). 2008. *Eretmochelys imbricata*. *The IUCN Red List of Threatened Species* 2008: e.T8005A12881238. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T8005A12881238.en. Accessed on 19 June 2022.

Range map



Source: Mortimer, J.A & Donnelly, M. (IUCN SSC Marine Turtle Specialist Group). 2008. *Eretmochelys imbricata*. *The IUCN Red List of Threatened Species* 2008: e.T8005A12881238. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T8005A12881238.en. Accessed on 19 June 2022.

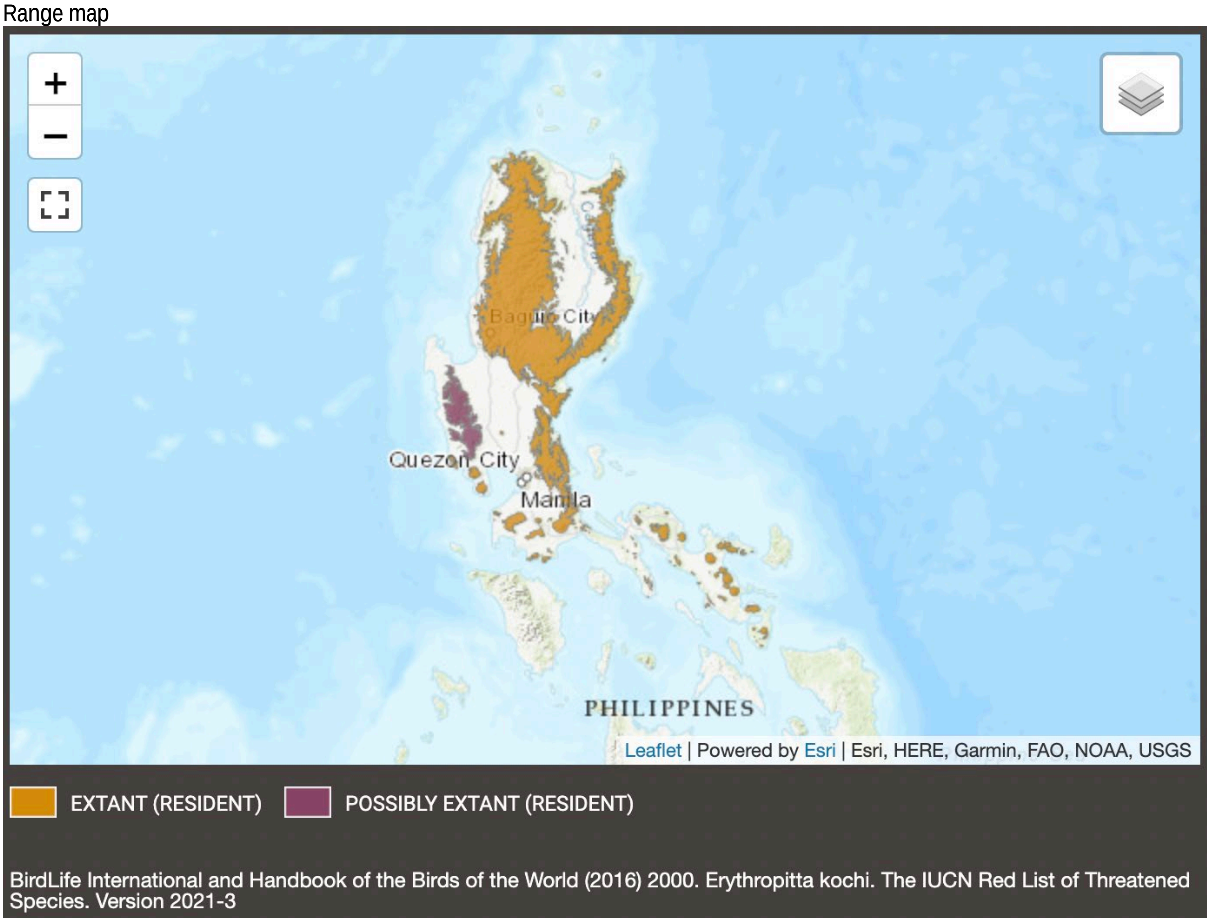
Erythropitta kochi
Whiskered Pitta
(NT)

Sources consulted

(1) BirdLife International. 2016. *Erythropitta kochi*. *The IUCN Red List of Threatened Species* 2016: e.T22698648A93695101. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22698648A93695101.en. Accessed on 17 June 2022.

(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map



Source: BirdLife International. 2016. *Erythropitta kochi*. *The IUCN Red List of Threatened Species* 2016: e.T22698648A93695101. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22698648A93695101.en. Accessed on 17 June 2022.

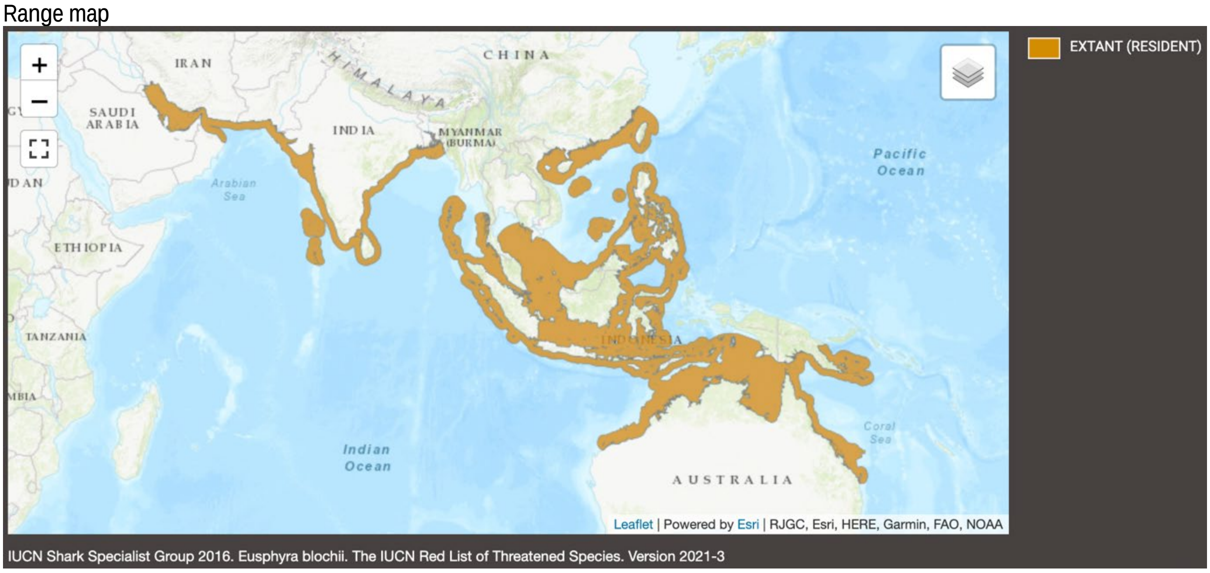
Eusphyra blochii
Winghead Shark
(EN)

Sources consulted

(1) Smart, J.J. & Simpfendorfer, C. 2016. Eusphyra blochii. The IUCN Red List of Threatened Species 2016: e.T41810A68623209. https://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T41810A68623209.en. Accessed on 25 April 2022.

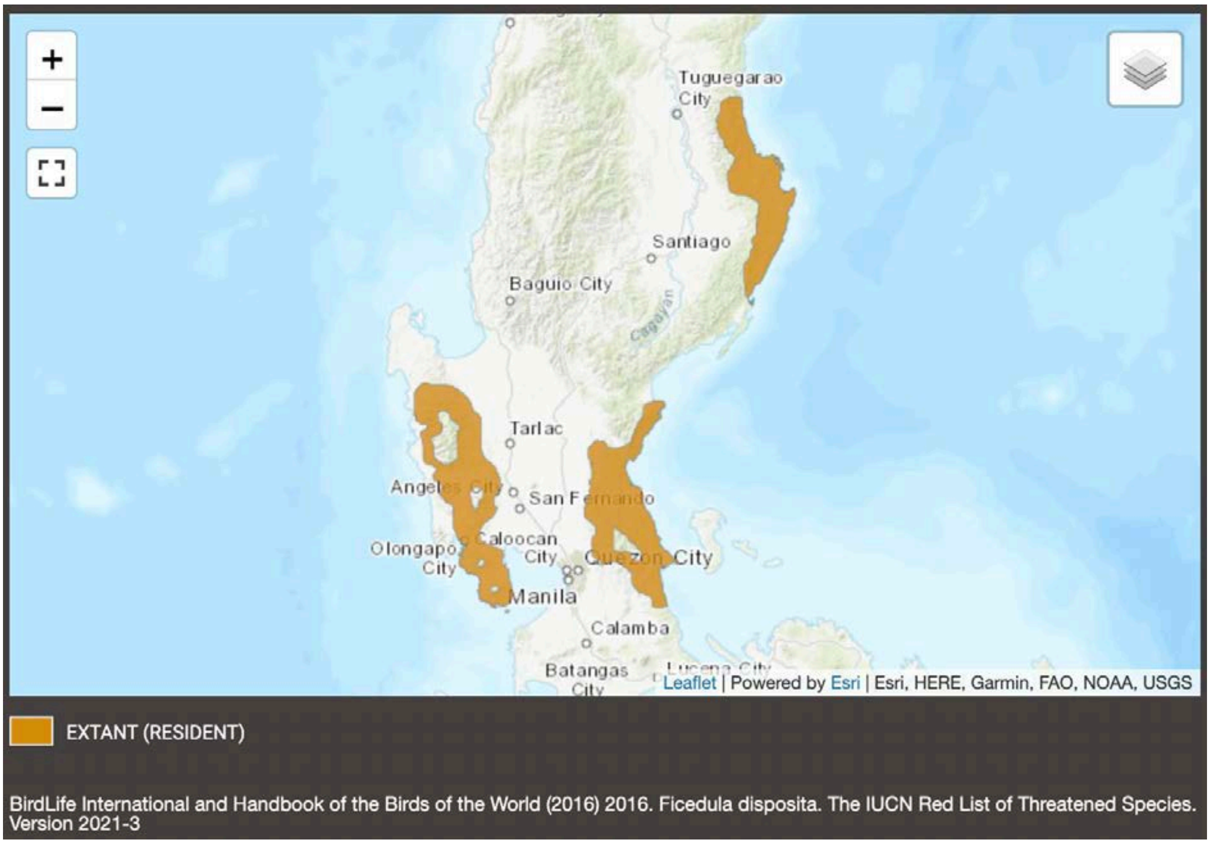
(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



Source: Smart, J.J. & Simpfendorfer, C. 2016. Eusphyra blochii. The IUCN Red List of Threatened Species 2016: e.T41810A68623209. https://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T41810A68623209.en. Accessed on 25 April 2022.

Ficedula disposita Furtive Flycatcher (NT)
Sources consulted
(1) BirdLife International. 2017. *Ficedula disposita* (amended version of 2016 assessment). *The IUCN Red List of Threatened Species* 2017: e.T22709394A111055836. https://dx.doi.org/10.2305/IUCN.UK.2017-1.RLTS.T22709394A111055836.en. Accessed on 17 June 2022.
(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph
Range map



Source: BirdLife International. 2017. *Ficedula disposita* (amended version of 2016 assessment). *The IUCN Red List of Threatened Species* 2017: e.T22709394A111055836. https://dx.doi.org/10.2305/IUCN.UK.2017-1.RLTS.T22709394A111055836.en. Accessed on 17 June 2022.

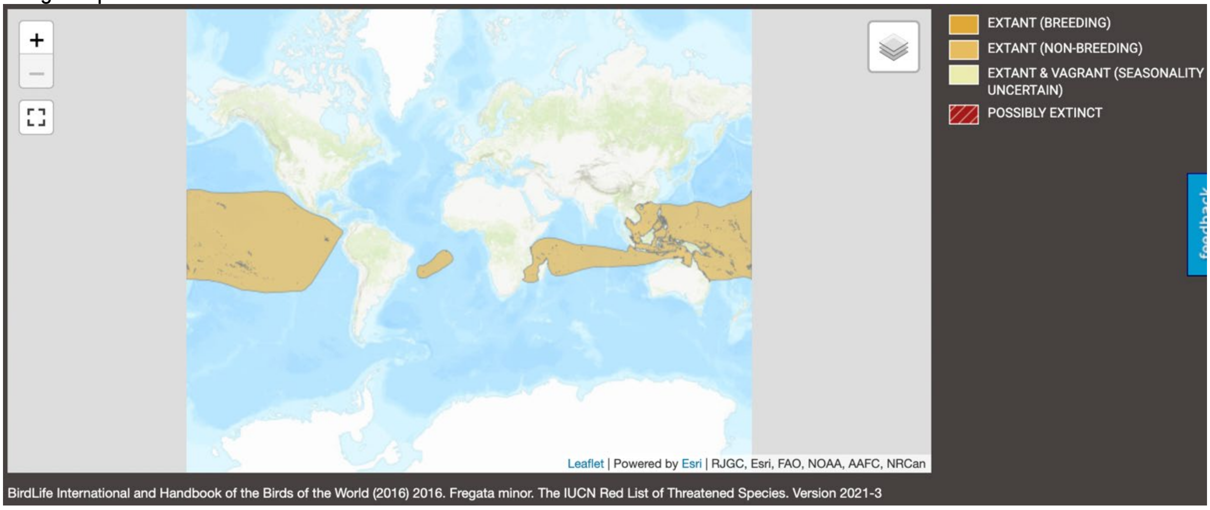
Fregata minor
Great Frigatebird
(LC)

Sources consulted

(1) BirdLife International. 2020. *Fregata minor*. *The IUCN Red List of Threatened Species* 2020: e.T22697733A163770613. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T22697733A163770613.en. Accessed on 19 June 2022.
(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

(3) Dewey, T. 2009. "Fregata minor" (On-line), Animal Diversity Web. Accessed June 19, 2022 at https://animaldiversity.org/accounts/Fregata_minor/

Range map



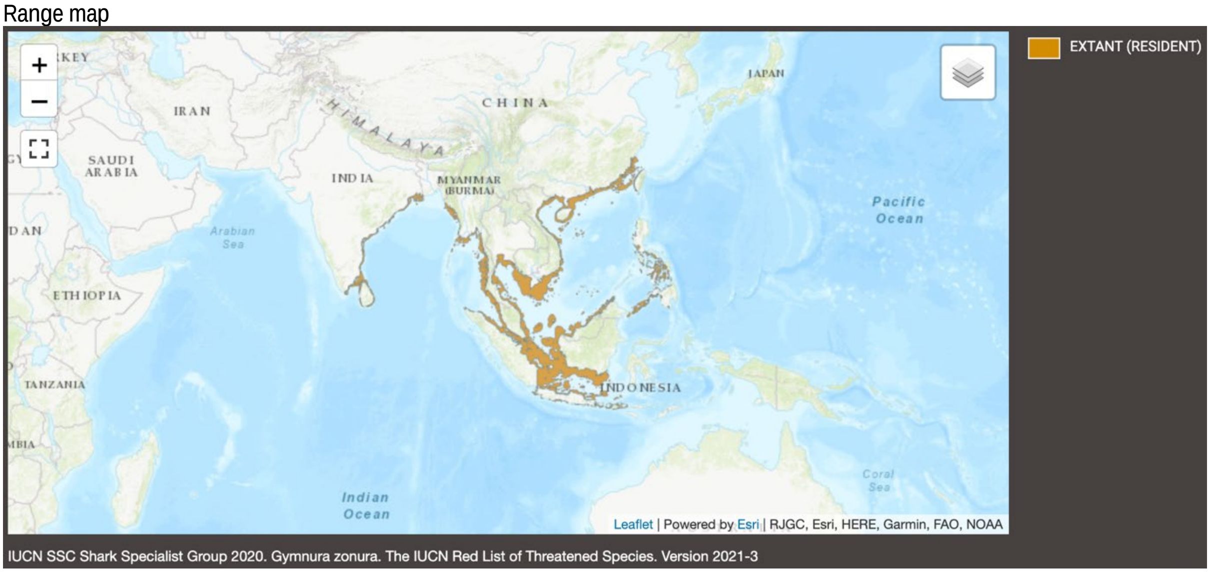
Source; BirdLife International. 2020. *Fregata minor*. *The IUCN Red List of Threatened Species* 2020: e.T22697733A163770613. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T22697733A163770613.en. Accessed on 19 June 2022.

Gymnura zonura
Zonetail Butterfly Ray
(EN)

Sources consulted

(1) Sherman, C.S., Bin Ali, A., Bineesh, K.K., Derrick, D., Dharmadi, Fahmi, Fernando, D., Haque, A.B., Maung, A., Seyha, L., Tanay, D., Utzurrum, J.A.T., Vo, V.Q. & Yuneni, R.R. 2021. *Gymnura zonura*. *The IUCN Red List of Threatened Species* 2021: e.T60113A124439689. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T60113A124439689.en. Accessed on 17 June 2022.
(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



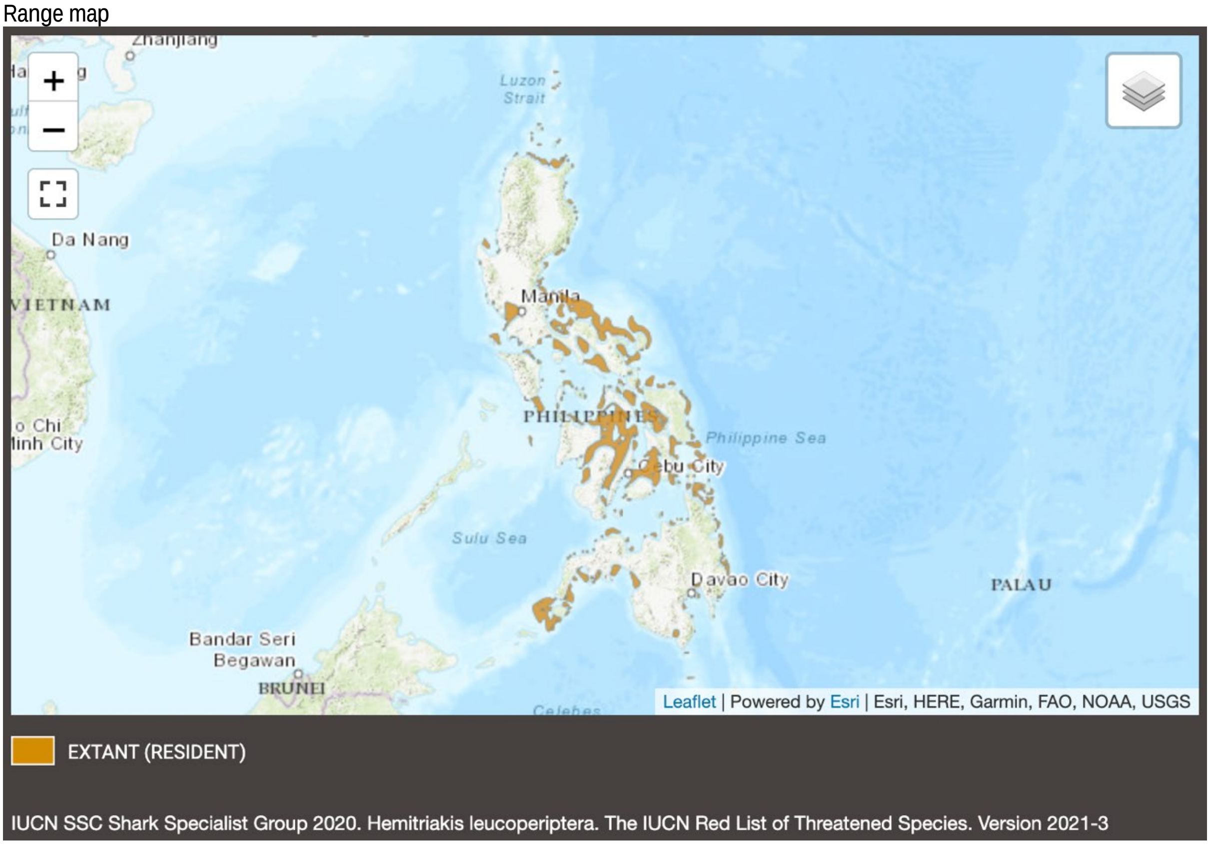
Source: Sherman, C.S., Bin Ali, A., Bineesh, K.K., Derrick, D., Dharmadi, Fahmi, Fernando, D., Haque, A.B., Maung, A., Seyha, L., Tanay, D., Utzurrum, J.A.T., Vo, V.Q. & Yuneni, R.R. 2021. *Gymnura zonura*. *The IUCN Red List of Threatened Species* 2021: e.T60113A124439689. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T60113A124439689.en. Accessed on 17 June 2022.

Hemitriakis leucoperiptera
Whitefin Topeshark
(CR)

Sources consulted

(1) Sherman, C.S., Simpfendorfer, C., Bin Ali, A., Bineesh, K.K., Derrick, D., Dharmadi, Fahmi, Fernando, D., Haque, A.B., Maung, A., Seyha, L., Tanay, D., Utzurrum, J.A.T., Vo, V.Q. & Yuneni, R.R. 2021. Hemitriakis leucoperiptera. The IUCN Red List of Threatened Species 2021: e.T39353A124404742. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T39353A124404742.en. Accessed on 25 April 2022.
(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



Source: Sherman, C.S., Simpfendorfer, C., Bin Ali, A., Bineesh, K.K., Derrick, D., Dharmadi, Fahmi, Fernando, D., Haque, A.B., Maung, A., Seyha, L., Tanay, D., Utzurrum, J.A.T., Vo, V.Q. & Yuneni, R.R. 2021. Hemitriakis leucoperiptera. The IUCN Red List of Threatened Species 2021: e.T39353A124404742. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T39353A124404742.en. Accessed on 25 April 2022.

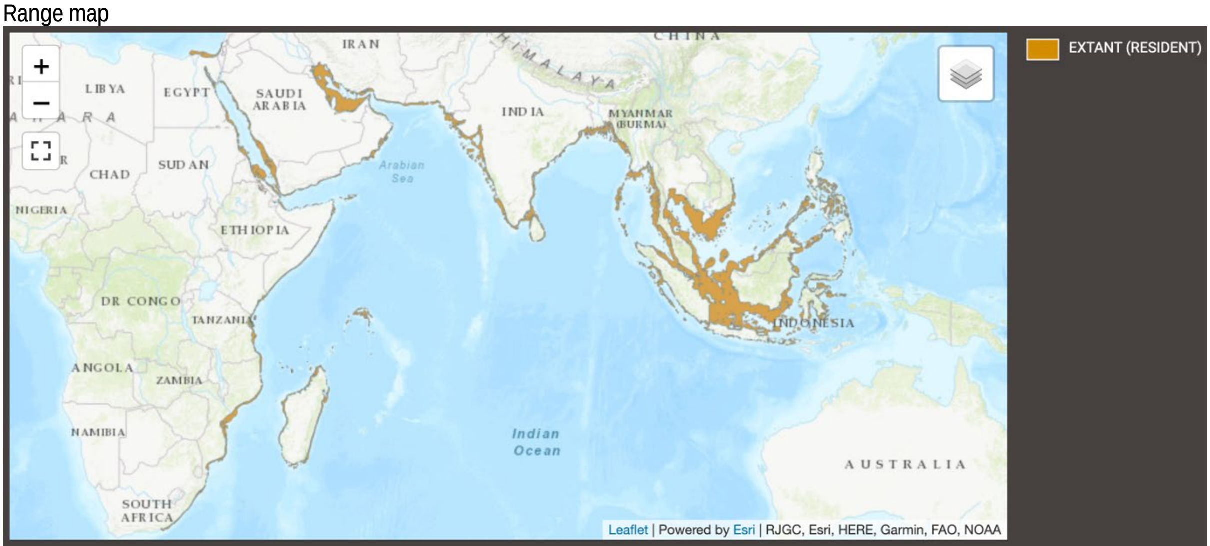
Himantura uarnak
Reticulate Whipray
(EN)

Sources consulted

(1) Sherman, C.S., Bin Ali, A., Bineesh, K.K., Derrick, D., Dharmadi, Fahmi, Fernando, D., Haque, A.B., Maung, A., Seyha, L., Tanay, D., Utzurrum, J.A.T., Vo, V.Q. & Yuneni, R.R. 2021. *Himantura uarnak*. *The IUCN Red List of Threatened Species* 2021: e.T201098826A124528737. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T201098826A124528737.en. Accessed on 01 July 2022.

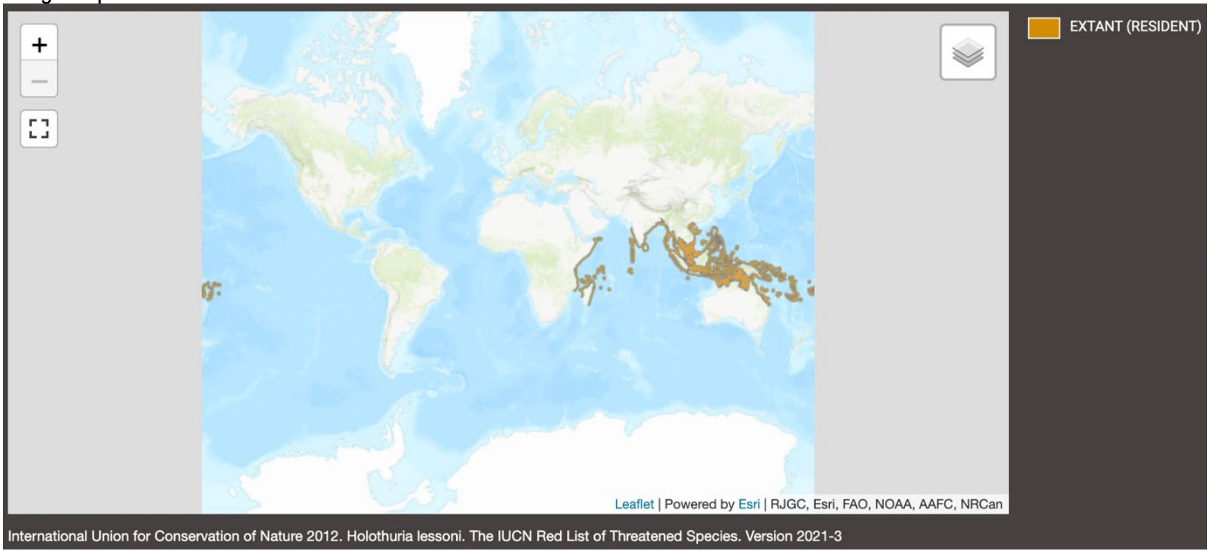
(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 1 July 2022.

Range map



IUCN SSC Shark Specialist Group 2020. Himantura uarnak. The IUCN Red List of Threatened Species. Version 2021-3

Source: Sherman, C.S., Bin Ali, A., Bineesh, K.K., Derrick, D., Dharmadi, Fahmi, Fernando, D., Haque, A.B., Maung, A., Seyha, L., Tanay, D., Utzurrum, J.A.T., Vo, V.Q. & Yuneni, R.R. 2021. *Himantura uarnak*. *The IUCN Red List of Threatened Species* 2021: e.T201098826A124528737. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T201098826A124528737.en. Accessed on 01 July 2022.

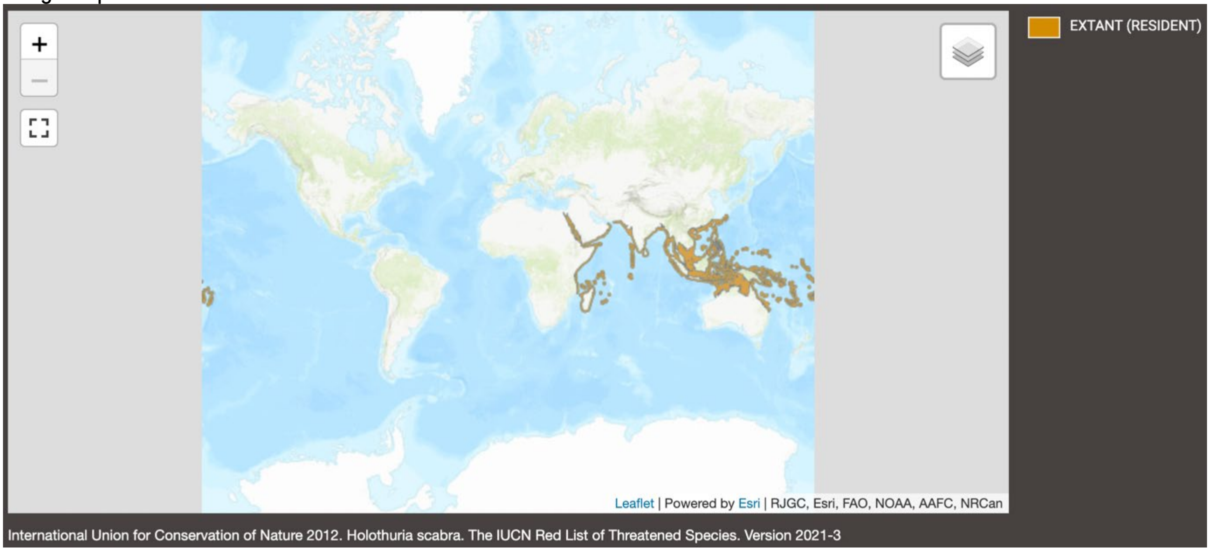
Holothuria lessoni Golden Sandfish (EN)
Sources consulted (1) Conand, C., Purcell, S. & Gamboa, R. 2013. *Holothuria lessoni*. *The IUCN Red List of Threatened Species* 2013: e.T180275A1609567. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180275A1609567.en. Accessed on 17 June 2022. (2) Palomares, M.L.D. and D. Pauly. Editors. 2022. SeaLifeBase. World Wide Web electronic publication. www.sealifebase.org, version (04/2022).
Range map  Source: Conand, C., Purcell, S. & Gamboa, R. 2013. *Holothuria lessoni*. *The IUCN Red List of Threatened Species* 2013: e.T180275A1609567. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180275A1609567.en. Accessed on 17 June 2022.

Holothuria scabra
Golden Sandfish
(EN)

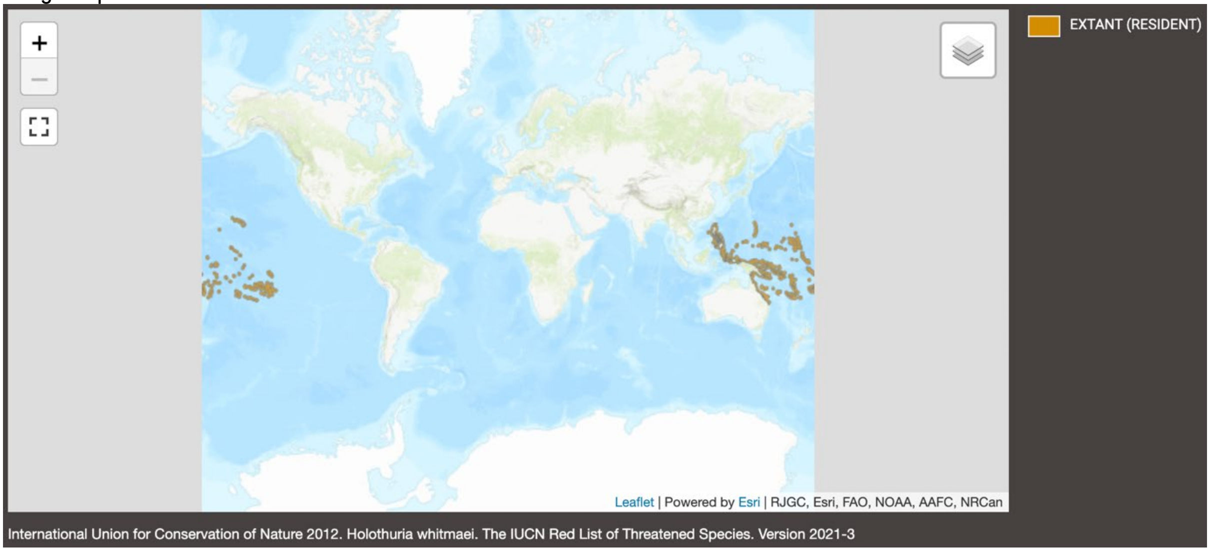
Sources consulted

(1) Hamel, J.-F., Mercier, A., Conand, C., Purcell, S., Toral-Granda, T.-G. & Gamboa, R. 2013. *Holothuria scabra. The IUCN Red List of Threatened Species* 2013: e.T180257A1606648. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180257A1606648.en. Accessed on 17 June 2022.
(2) Palomares, M.L.D. and D. Pauly. Editors. 2022. SeaLifeBase. World Wide Web electronic publication. www.sealifebase.org, version (04/2022).

Range map



Source: Hamel, J.-F., Mercier, A., Conand, C., Purcell, S., Toral-Granda, T.-G. & Gamboa, R. 2013. *Holothuria scabra*. *The IUCN Red List of Threatened Species* 2013: e.T180257A1606648. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180257A1606648.en. Accessed on 17 June 2022.

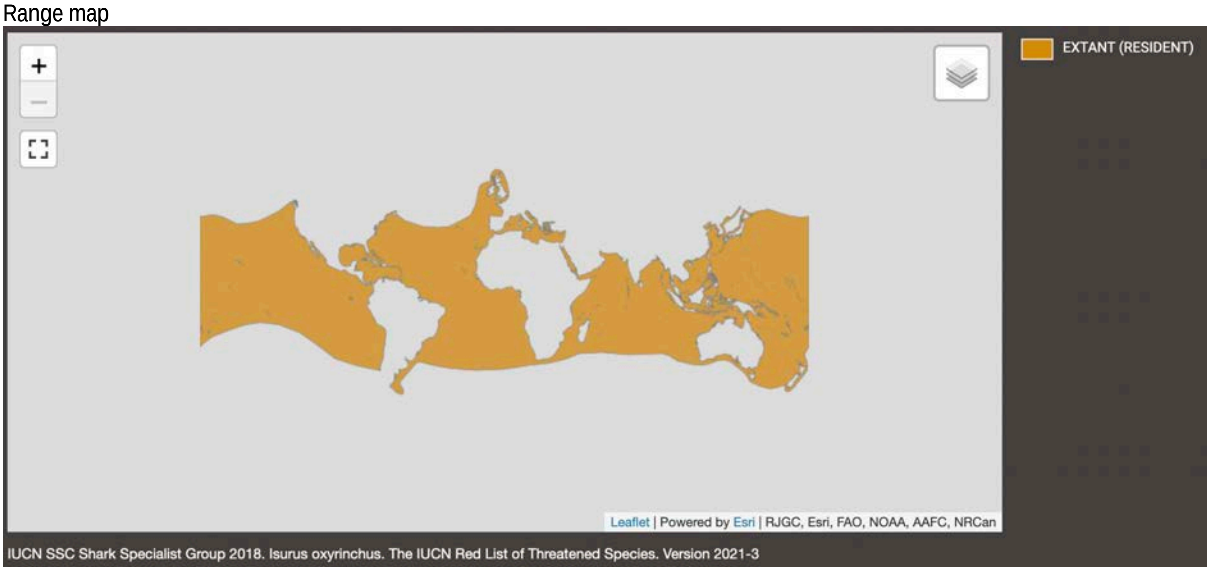
Holothuria whitmaei Black Teatfish (EN)
Sources consulted
(1) Conand, C., Gamboa, R., Purcell, S. & Toral-Granda, T.-G. 2013. *Holothuria whitmaei*. *The IUCN Red List of Threatened Species* 2013: e.T180440A1630988. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180440A1630988.en. Accessed on 17 June 2022. (2) Palomares, M.L.D. and D. Pauly. Editors. 2022. SeaLifeBase. World Wide Web electronic publication. www.sealifebase.org, version (04/2022).
Range map  Source: Conand, C., Gamboa, R., Purcell, S. & Toral-Granda, T.-G. 2013. *Holothuria whitmaei*. *The IUCN Red List of Threatened Species* 2013: e.T180440A1630988. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180440A1630988.en. Accessed on 17 June 2022.

Isurus oxyrinchus
Shortfin Mako
(EN)

Sources consulted

(1) Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. Isurus oxyrinchus. The IUCN Red List of Threatened Species 2019: e.T39341A2903170. https://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T39341A2903170.en. Accessed on 25 April 2022.
(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



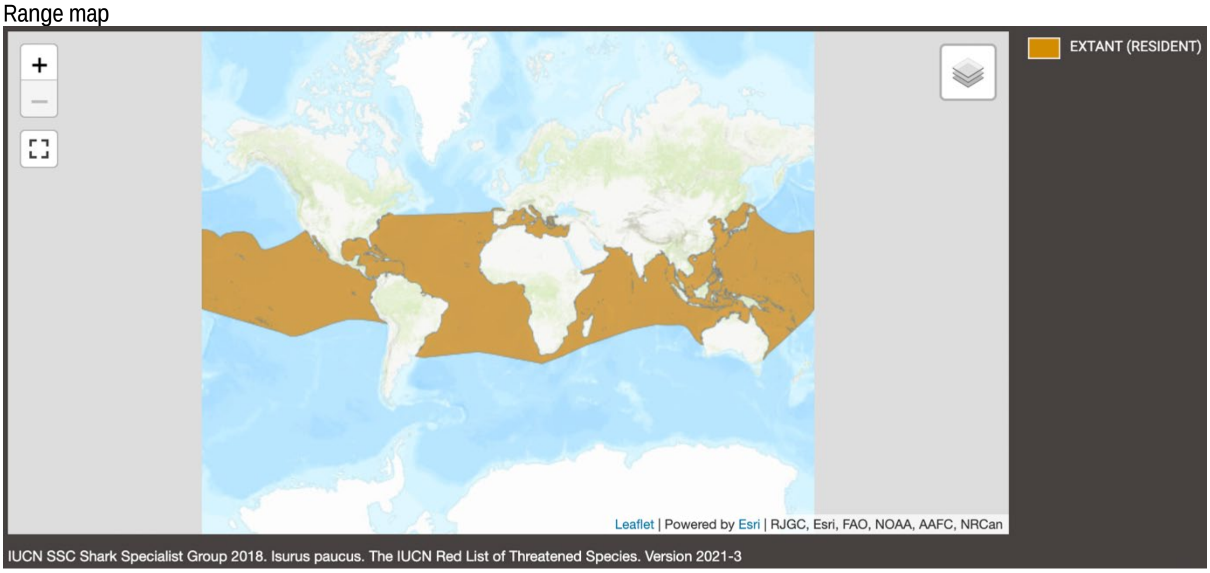
Source: Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. Isurus oxyrinchus. The IUCN Red List of Threatened Species 2019: e.T39341A2903170. https://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T39341A2903170.en. Accessed on 25 April 2022.

Isurus paucas
Longfin Mako
(EN)

Sources consulted

(1) Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. Isurus paucus. The IUCN Red List of Threatened Species 2019: e.T60225A3095898. https://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T60225A3095898.en. Accessed on 25 April 2022.
(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



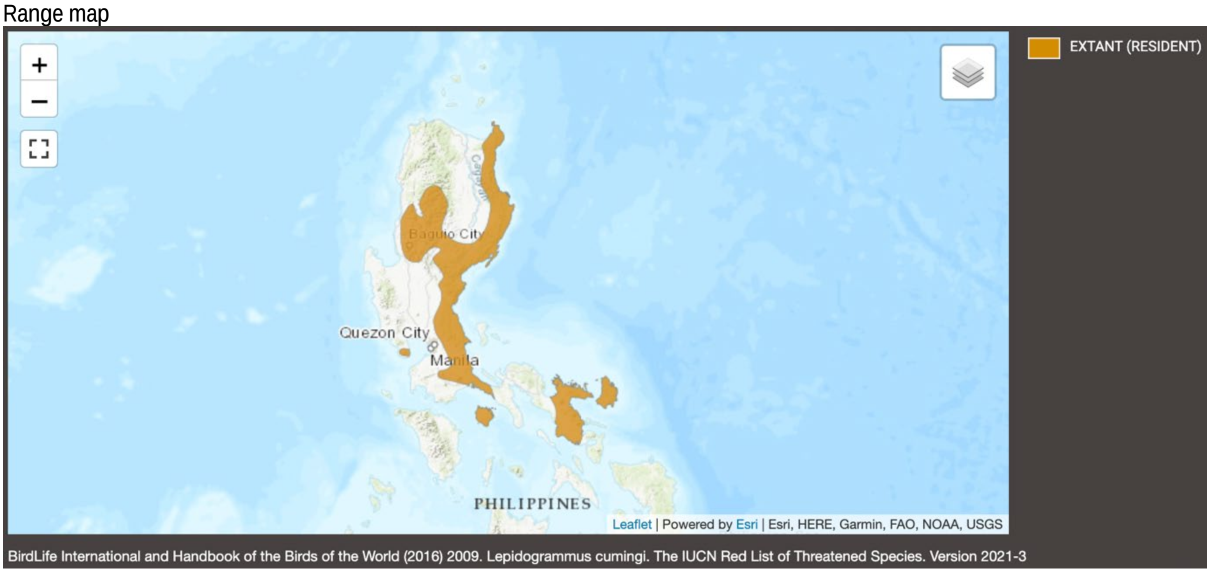
Source: Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. Isurus paucus. The IUCN Red List of Threatened Species 2019: e.T60225A3095898. https://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T60225A3095898.en. Accessed on 25 April 2022.

Lepidogrammus cumingi
Scale-Feathered Malkoha
(LC)

Sources consulted

(1) BirdLife International. 2016. *Lepidogrammus cumingi*. *The IUCN Red List of Threatened Species* 2016: e.T22684129A93015822. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22684129A93015822.en. Accessed on 17 June 2022.
(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map



Source: BirdLife International. 2016. *Lepidogrammus cumingi*. *The IUCN Red List of Threatened Species* 2016: e.T22684129A93015822. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22684129A93015822.en. Accessed on 17 June 2022..

Lobophyllia serratus
(EN)

Sources consulted

(1) Turak, E., Sheppard, C. & Wood, E. 2008. *Lobophyllia serratus*. *The IUCN Red List of Threatened Species* 2008: e.T133226A3641250. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T133226A3641250.en. Accessed on 17 June 2022.
(2) Corals of the World. http://www.coralsoftheworld.org/species_factsheets/species_factsheet_summary/lobophyllia-serratus/. Accessed 15 May 2022.
(3) Coral Trait Database. 2022. *Lobophyllia serrata*. https://coraltraits.org/species/934?search=lobophyllia+serratus. Accessed 28 June 2022.

Range map

Source: Turak, E., Sheppard, C. & Wood, E. 2008. *Lobophyllia serratus*. *The IUCN Red List of Threatened Species* 2008: e.T133226A3641250. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T133226A3641250.en. Accessed on 17 June 2022.

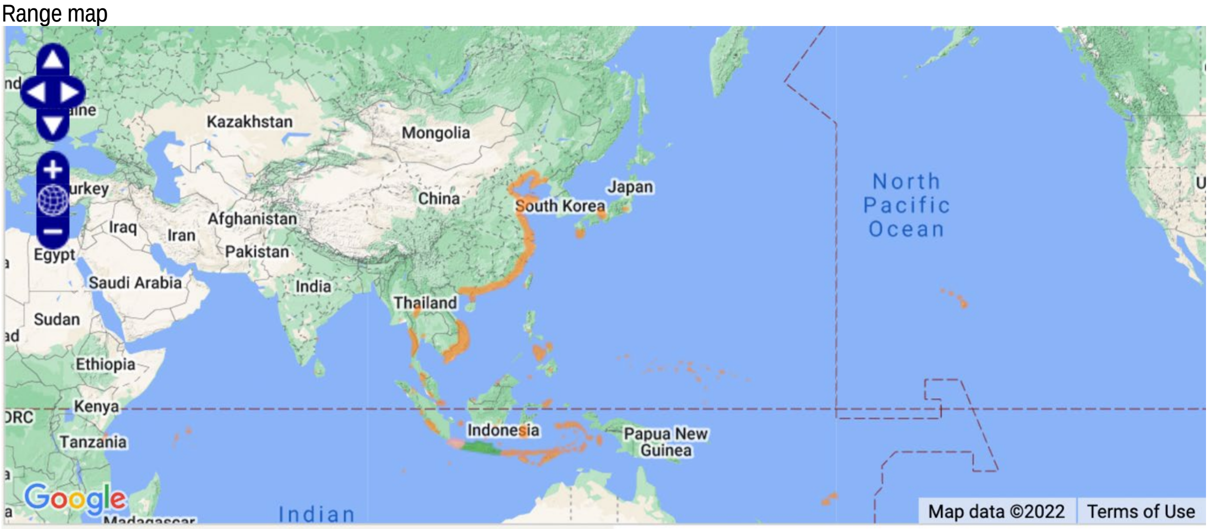
Lonchura oryzivora
Java Sparrow
(EN)

Sources consulted

(1) BirdLife International. 2021. *Lonchura oryzivora*. *The IUCN Red List of Threatened Species* 2021: e.T22719912A183133210. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T22719912A183133210.en. Accessed on 20 June 2022.

(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map



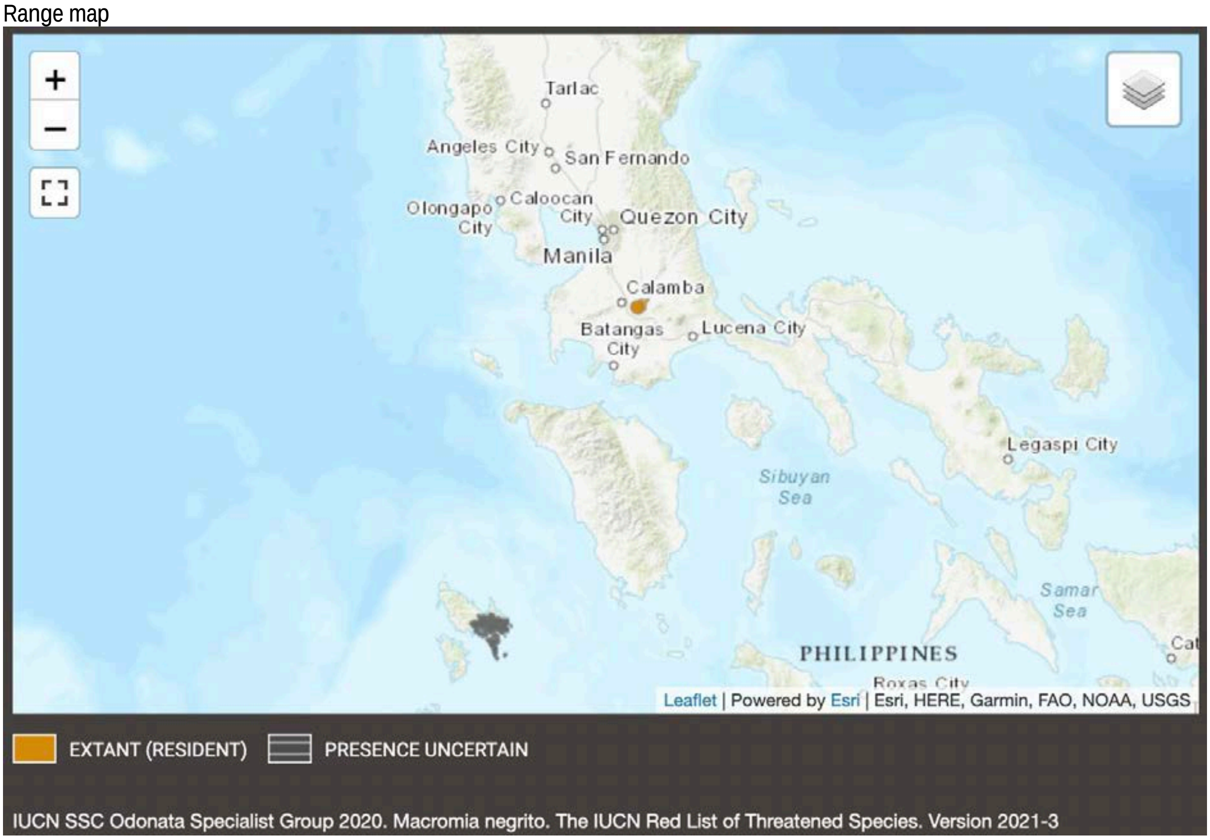
Source (both maps): BirdLife International (2022) Species factsheet: *Lonchura oryzivora*. Downloaded from http://www.birdlife.org on 20/06/2022.

Macromia negrito
(EN)

Sources consulted

(1) Dow, R.A. 2020. *Macromia negrito*. *The IUCN Red List of Threatened Species* 2020: e.T139549193A146602320. https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T139549193A146602320.en. Accessed on 20 June 2022.

Range map



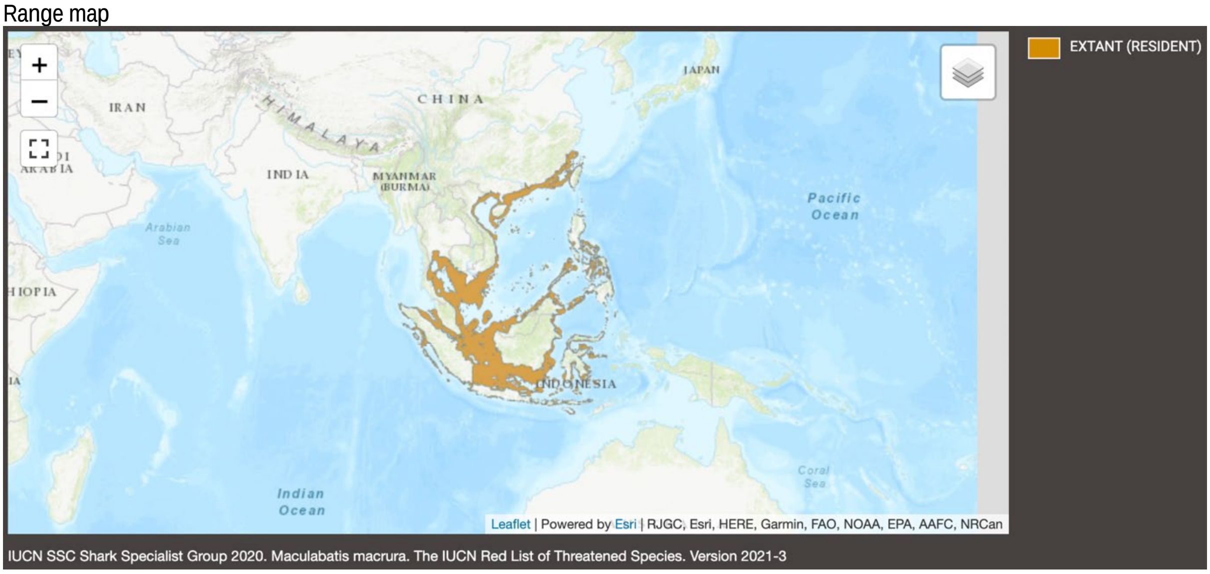
Source: Dow, R.A. 2020. *Macromia negrito*. *The IUCN Red List of Threatened Species* 2020: e.T139549193A146602320. https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T139549193A146602320.en. Accessed on 20 June 2022.

Maculabatis macrura
Sharpnose Whipray
(EN)

Sources consulted

(1) Sherman, C.S., Bin Ali, A., Bineesh, K.K., Derrick, D., Dharmadi, Fahmi, Fernando, D., Haque, A.B., Maung, A., Seyha, L., Tanay, D., Utzurrum, J.A.T., Vo, V.Q. & Yuneni, R.R. 2020. Maculabatis macrura. The IUCN Red List of Threatened Species 2020: e.T104188627A104189052. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T104188627A104189052.en. Accessed on 25 April 2022.

Range map



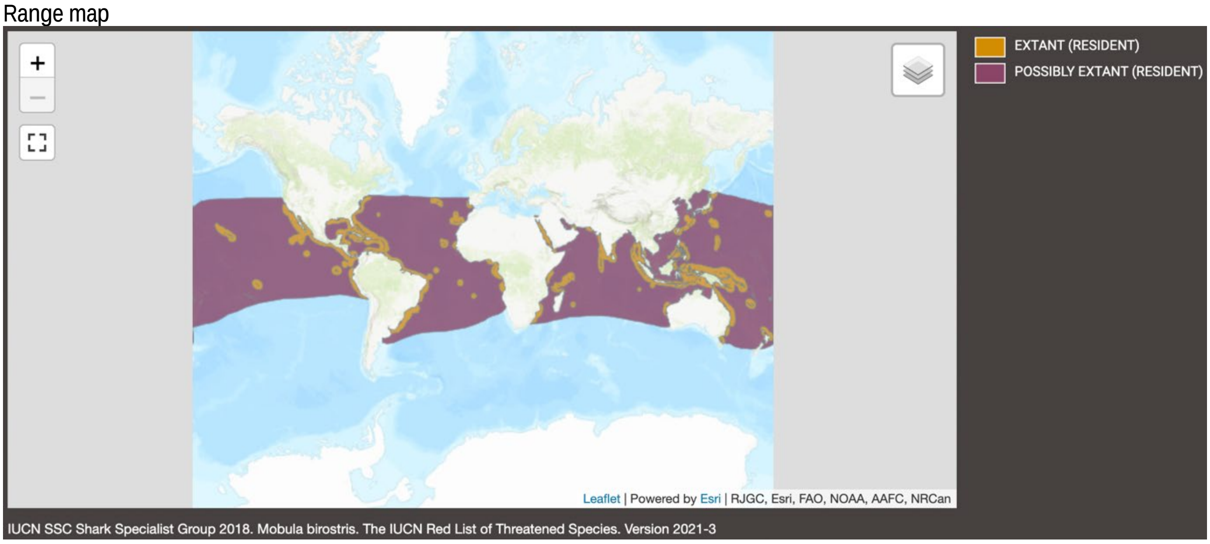
Source: Sherman, C.S., Bin Ali, A., Bineesh, K.K., Derrick, D., Dharmadi, Fahmi, Fernando, D., Haque, A.B., Maung, A., Seyha, L., Tanay, D., Utzurrum, J.A.T., Vo, V.Q. & Yuneni, R.R. 2020. Maculabatis macrura. The IUCN Red List of Threatened Species 2020: e.T104188627A104189052. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T104188627A104189052.en. Accessed on 25 April 2022.

Mobula birostris
Giant Manta Ray
(EN)

Sources consulted

(1) Marshall, A., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Derrick, D., Herman, K., Jabado, R.W., Liu, K.M., Rigby, C.L. & Romanov, E. 2020. Mobula birostris. The IUCN Red List of Threatened Species 2020: e.T198921A68632946. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T198921A68632946.en. Accessed on 25 April 2022.
(2) NOAA. Giant Manta Ray. https://www.fisheries.noaa.gov/species/giant-manta-ray. Accessed 25 April 2022.

Range map



Source: Marshall, A., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Derrick, D., Herman, K., Jabado, R.W., Liu, K.M., Rigby, C.L. & Romanov, E. 2020. Mobula birostris. The IUCN Red List of Threatened Species 2020: e.T198921A68632946. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T198921A68632946.en. Accessed on 25 April 2022.

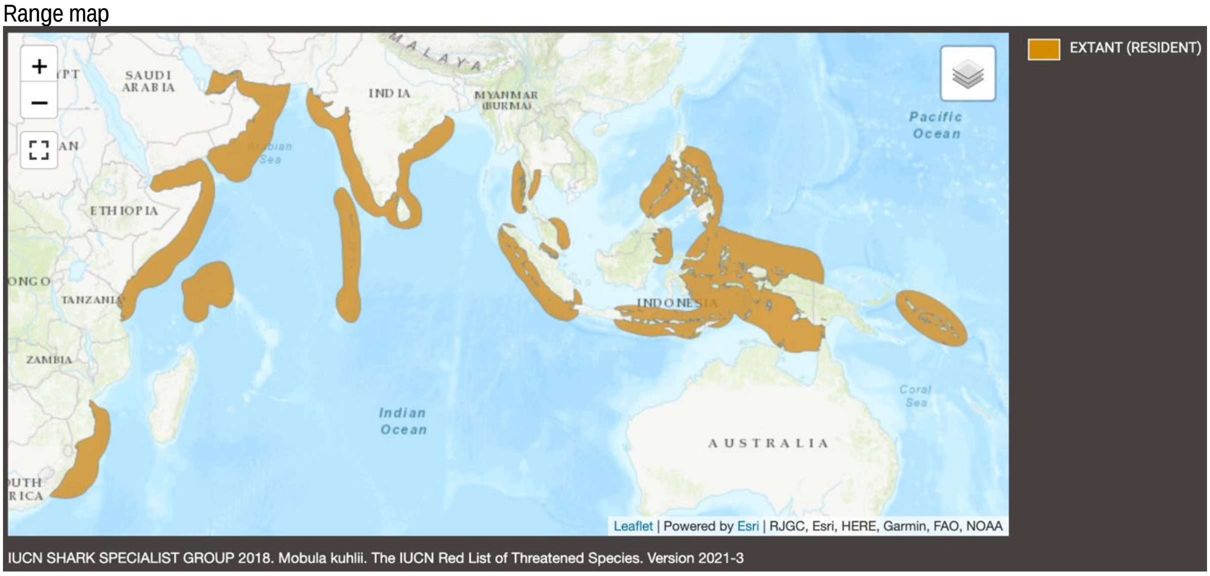
Mobula kuhlii
Shortfin Devilray
(EN)

Sources consulted

(1) Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Jabado, R.W., Liu, K.M., Marshall, A. & Romanov, E. 2020. Mobula kuhlii. The IUCN Red List of Threatened Species 2020: e.T161439A124485584. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T161439A124485584.en. Accessed on 25 April 2022.

(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



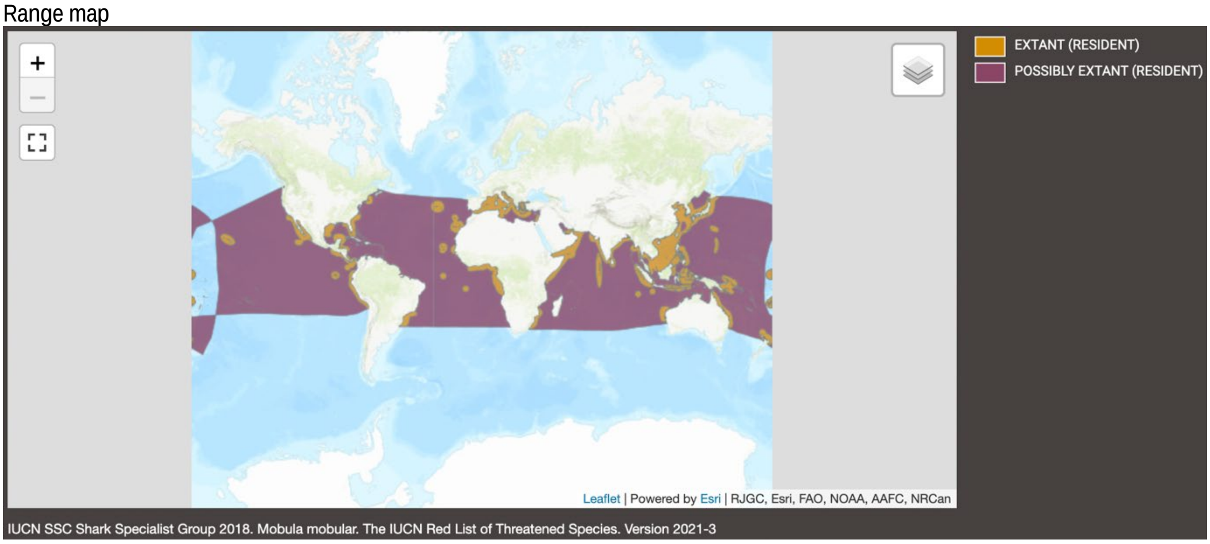
Source: Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Jabado, R.W., Liu, K.M., Marshall, A. & Romanov, E. 2020. Mobula kuhlii. The IUCN Red List of Threatened Species 2020: e.T161439A124485584. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T161439A124485584.en. Accessed on 25 April 2022.

Mobula mobular
Spinetail Devilray
(EN)

Sources consulted

(1) Marshall, A., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Rigby, C.L. & Romanov, E. 2020. Mobula mobular (amended version of 2019 assessment). The IUCN Red List of Threatened Species 2020: e.T110847130A176550858. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T110847130A176550858.en
(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



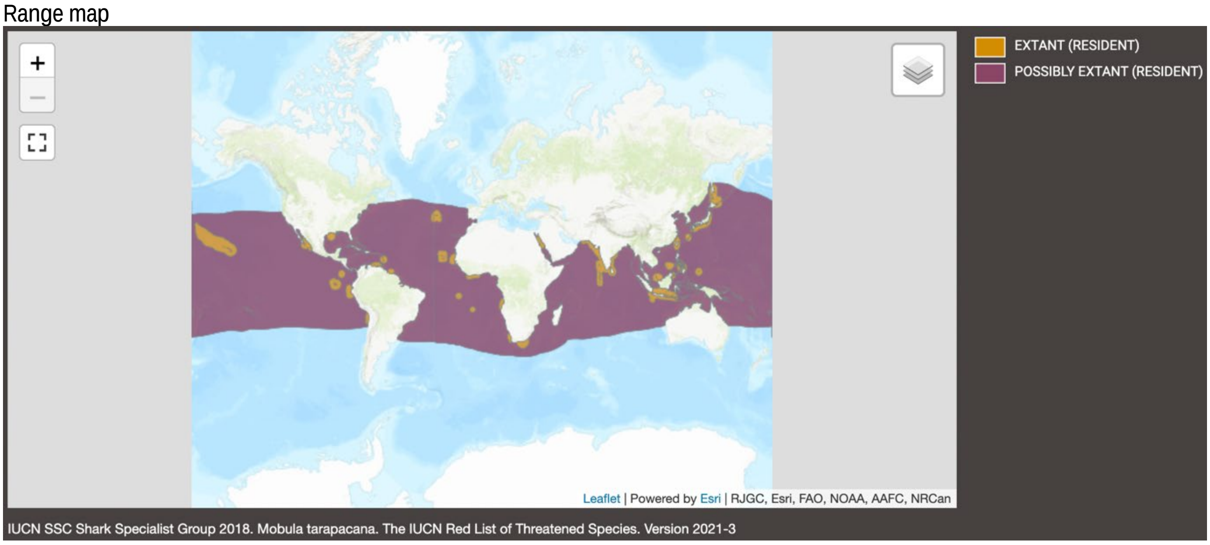
Source: Marshall, A., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Rigby, C.L. & Romanov, E. 2020. Mobula mobular (amended version of 2019 assessment). The IUCN Red List of Threatened Species 2020: e.T110847130A176550858. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T110847130A176550858.en

Mobula tarapacana
Sicklefin Devilray
(EN)

Sources consulted

(1) Marshall, A. et al. 2019. Mobula tarapacana. The IUCN Red List of Threatened Species 2019: e.T60199A124451161. http://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T60199A124451161.en
(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



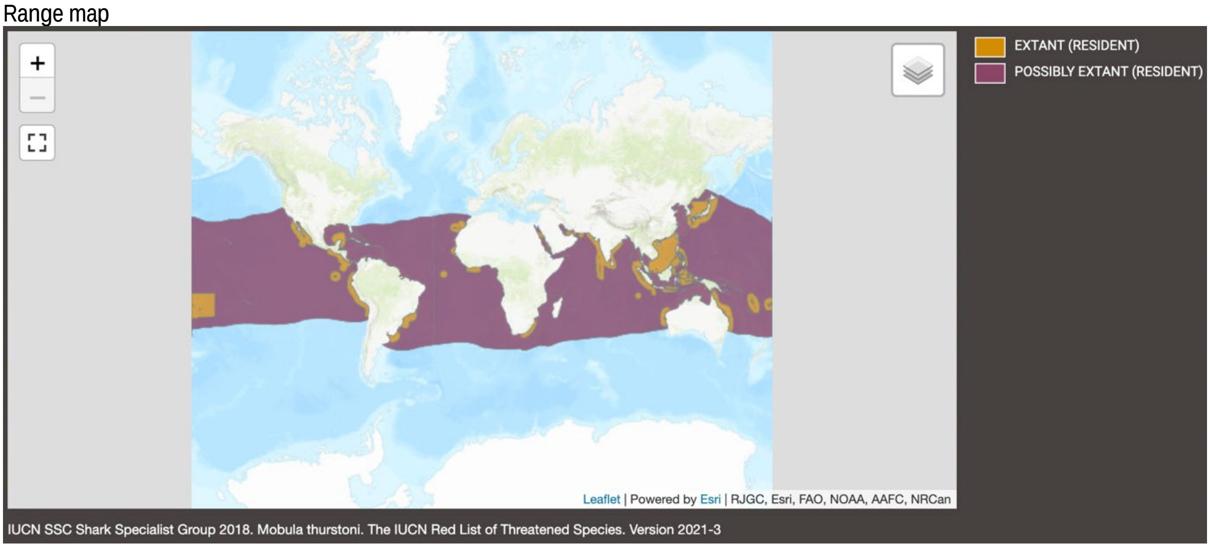
Source: Marshall, A. et al. 2019. Mobula tarapacana. The IUCN Red List of Threatened Species 2019: e.T60199A124451161. http://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T60199A124451161.en

Mobula thurstoni
Bentfin Devilray
(EN)

Sources consulted

(1) Marshall, A., Barreto, R., Bigman, J.S., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Pardo, S.A., Rigby, C.L., Romanov, E., Smith, W.D. & Walls, R.H.L. 2019. Mobula thurstoni. The IUCN Red List of Threatened Species 2019: e.T60200A124451622. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T60200A124451622.en. Accessed on 25 April 2022.
(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



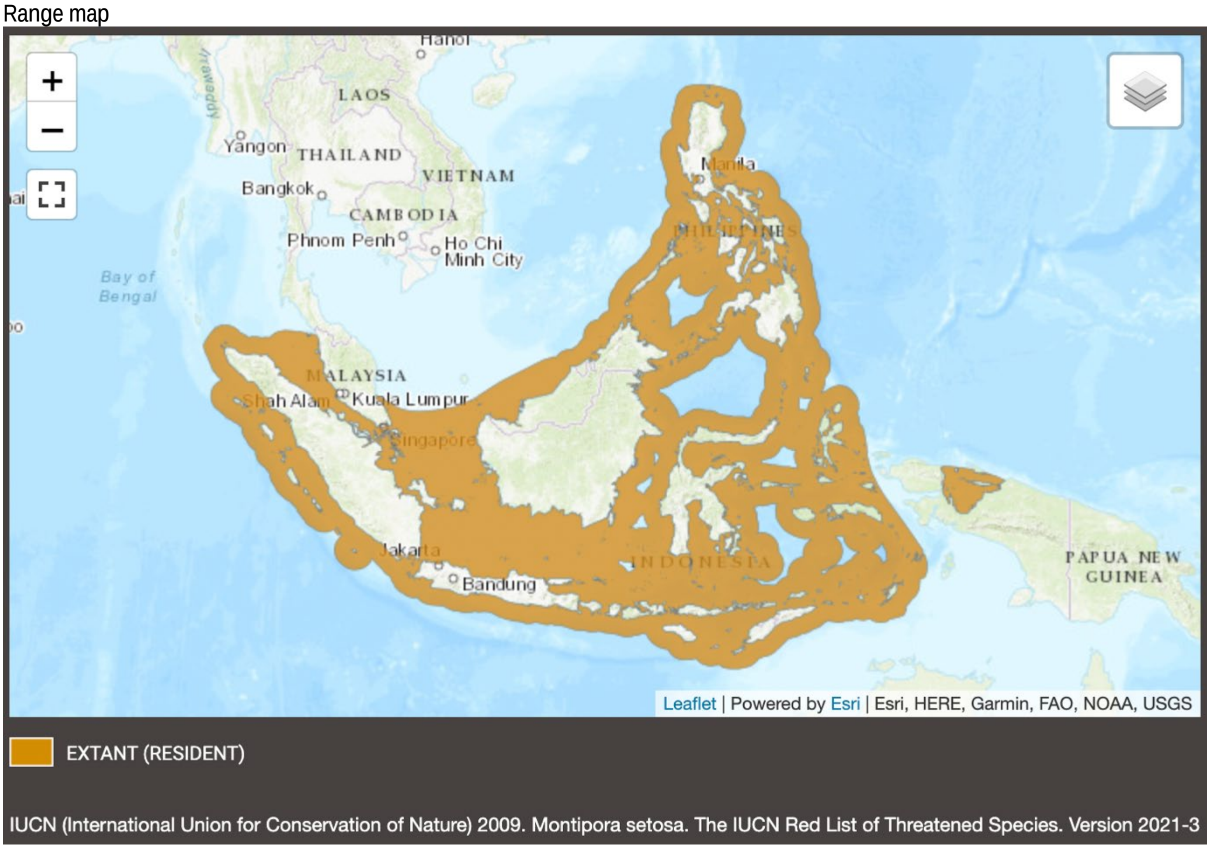
Source: Marshall, A., Barreto, R., Bigman, J.S., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Pardo, S.A., Rigby, C.L., Romanov, E., Smith, W.D. & Walls, R.H.L. 2019. Mobula thurstoni. The IUCN Red List of Threatened Species 2019: e.T60200A124451622. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T60200A124451622.en. Accessed on 25 April 2022.

Montipora setosa
(EN)

Sources consulted

(1) DeVantier, L., Hodgson, G., Huang, D., Johan, O., Licuanan, A., Obura, D., Sheppard, C., Syahrir, M. & Turak, E. 2008. *Montipora setosa*. *The IUCN Red List of Threatened Species* 2008: e.T133361A3707592. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T133361A3707592.en. Accessed on 17 June 2022.
(2) Corals of the World. http://www.coralsoftheworld.org/species_factsheets/species_factsheet_summary/monitpora-setosa/. Accessed 15 May 2022.
(3) Coral Trait Database. 2022. *Montipora setosa*. https://coraltraits.org/species/1045?search=montipora+setosa. Accessed 28 June 2022.

Range map



Source: DeVantier, L., Hodgson, G., Huang, D., Johan, O., Licuanan, A., Obura, D., Sheppard, C., Syahrir, M. & Turak, E. 2008. *Montipora setosa*. *The IUCN Red List of Threatened Species* 2008: e.T133361A3707592. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T133361A3707592.en. Accessed on 17 June 2022.

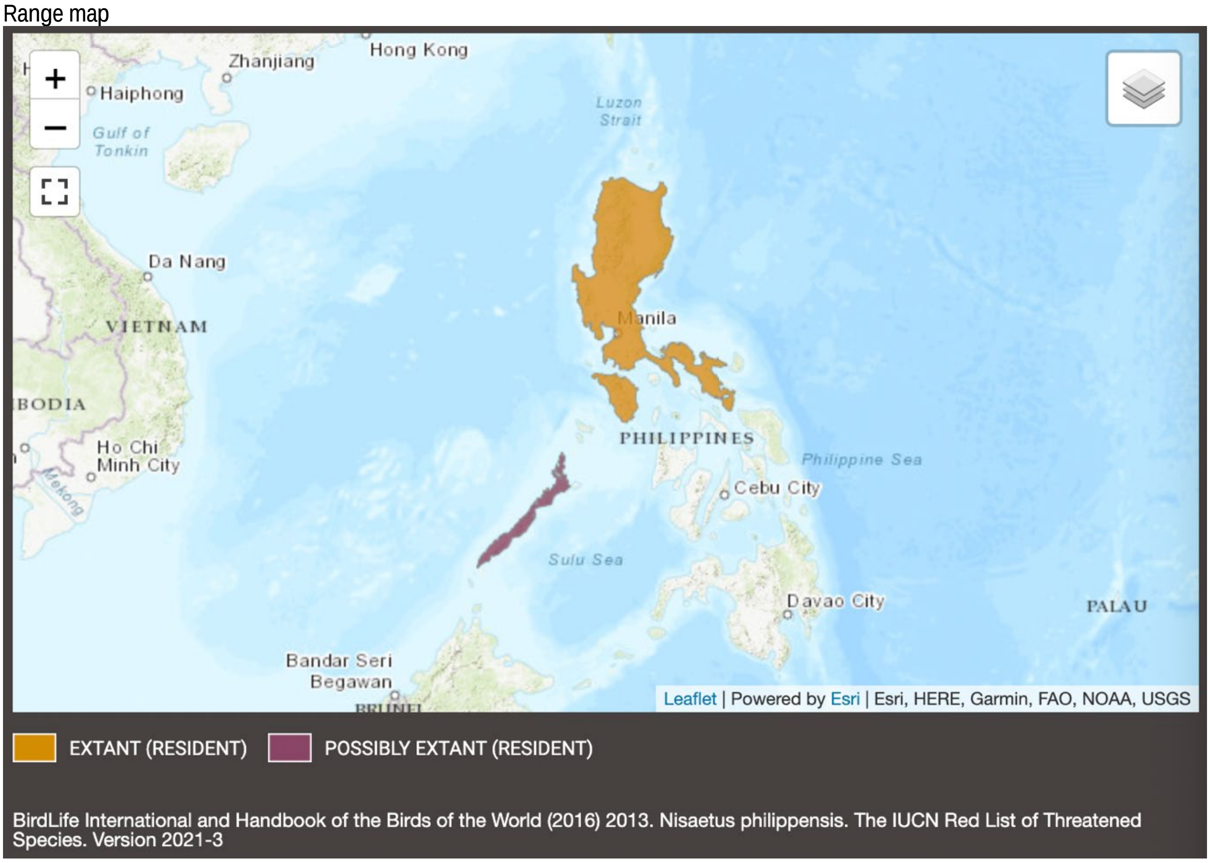
Nisaetus philippensis
North Philippine Hawk-Eagle
(EN)

Sources consulted

(1) BirdLife International. 2016. *Nisaetus philippensis*. *The IUCN Red List of Threatened Species* 2016: e.T45015567A95139313. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T45015567A95139313.en. Accessed on 20 June 2022.

(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map



Source: BirdLife International. 2016. *Nisaetus philippensis*. *The IUCN Red List of Threatened Species* 2016: e.T45015567A95139313. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T45015567A95139313.en. Accessed on 20 June 2022.

Numenius madagascariensis
Far Eastern Curlew
(EN)

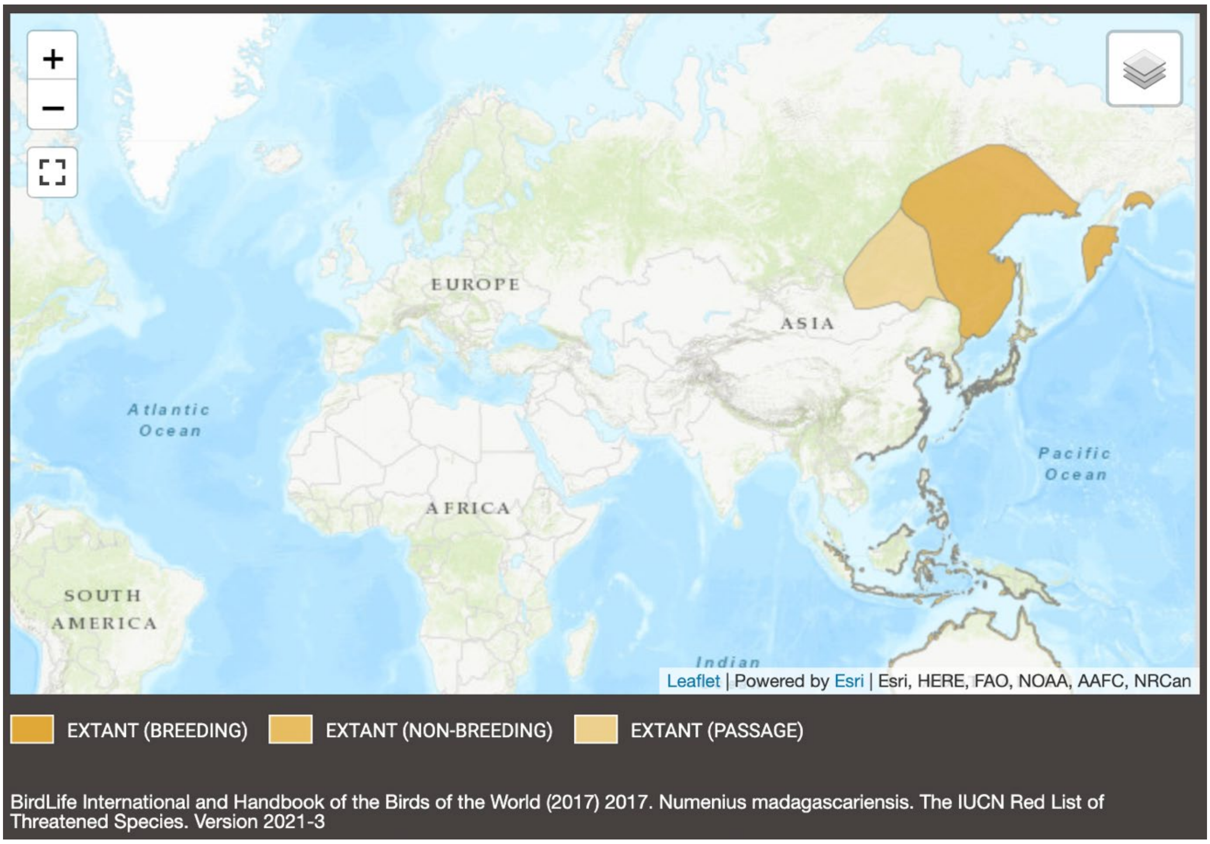
Sources consulted

(1) BirdLife International. 2017. *Numenius madagascariensis* (amended version of 2016 assessment). *The IUCN Red List of Threatened Species* 2017: e.T22693199A118601473. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22693199A118601473.en. Accessed on 17 June 2022.

(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

(3) Jensen, A.E. 2018. Internationally Important Waterbird Sites in Manila Bay, Philippines, October 2018. Technical Report. Wetlands International and IUCN National Committee of the Netherlands

Range map



Source: BirdLife International. 2017. *Numenius madagascariensis* (amended version of 2016 assessment). *The IUCN Red List of Threatened Species* 2017: e.T22693199A118601473. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22693199A118601473.en. Accessed on 17 June 2022.

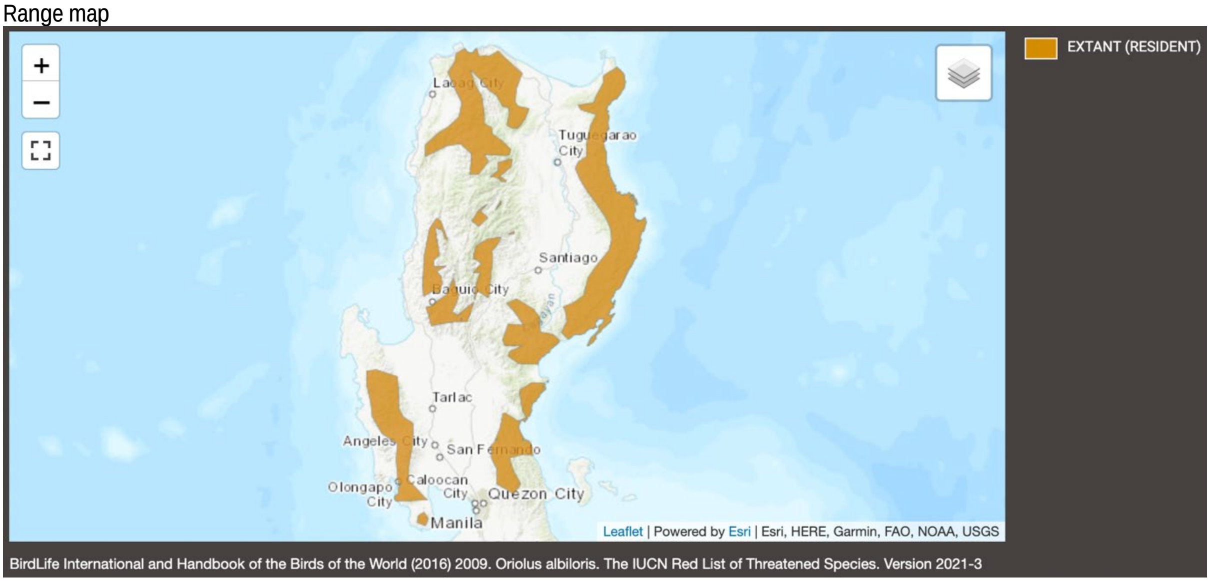
Oriolus albiloris
White-Lored Oriole
(LC)

Sources consulted

(1) BirdLife International. 2018. *Oriolus albiloris*. *The IUCN Red List of Threatened Species* 2018: e.T22706375A130375552. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22706375A130375552.en. Accessed on 17 June 2022.

(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map



Source: BirdLife International. 2018. *Oriolus albiloris*. *The IUCN Red List of Threatened Species* 2018: e.T22706375A130375552. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22706375A130375552.en. Accessed on 17 June 2022.

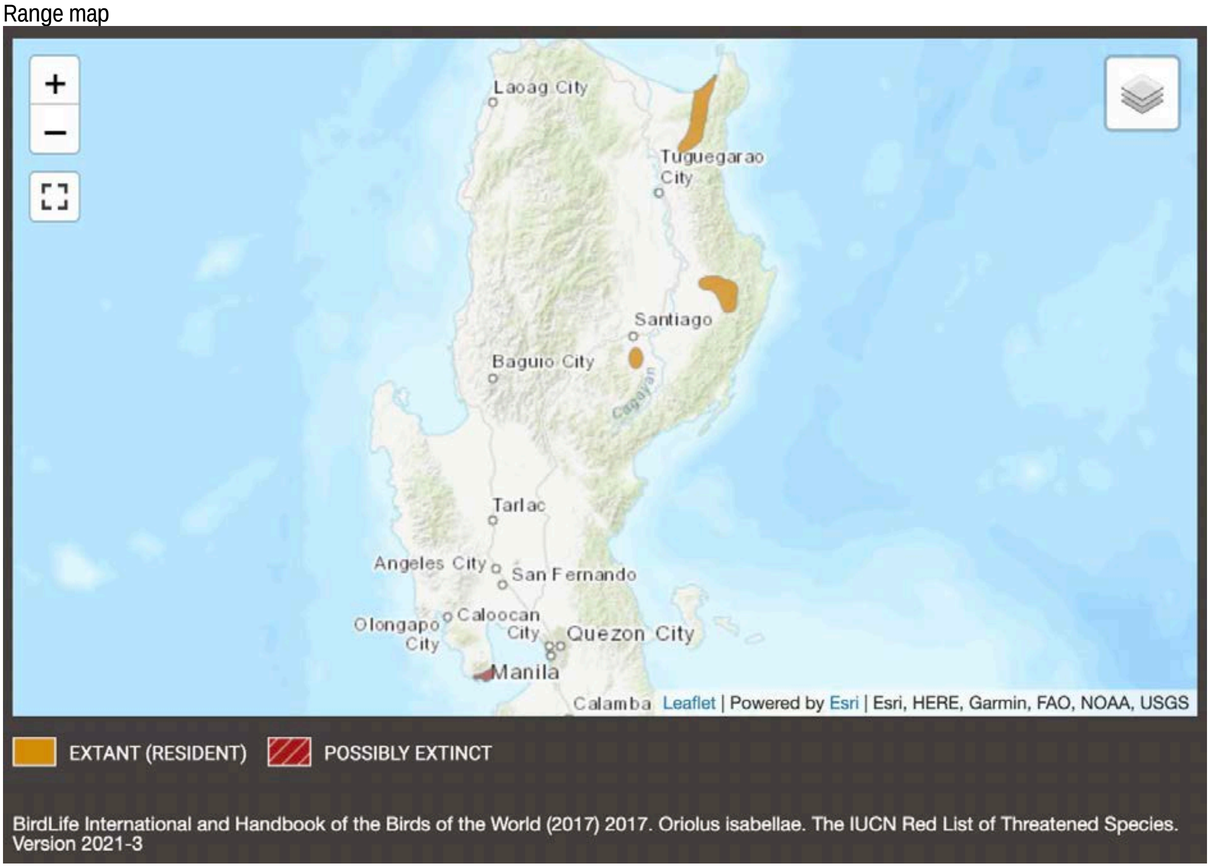
Oriolus isabellae
Isabela Oriole
(CR)

Sources consulted

(1) BirdLife International. 2018. *Oriolus isabellae*. *The IUCN Red List of Threatened Species* 2018: e.T22706378A134213171. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22706378A134213171.en. Accessed on 17 June 2022.

(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map



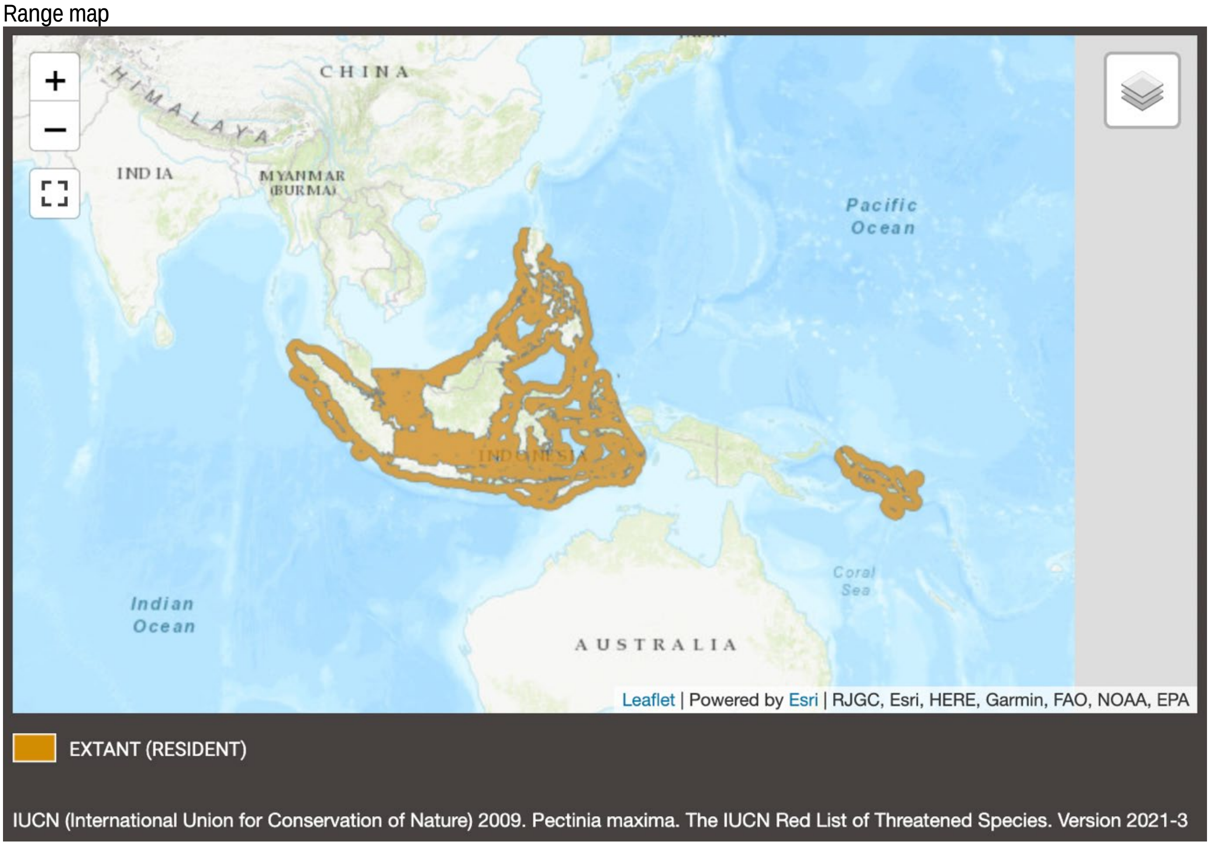
Source: BirdLife International. 2018. *Oriolus isabellae*. *The IUCN Red List of Threatened Species* 2018: e.T22706378A134213171. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22706378A134213171.en. Accessed on 17 June 2022.

Pectinia maxima
(EN)

Sources consulted

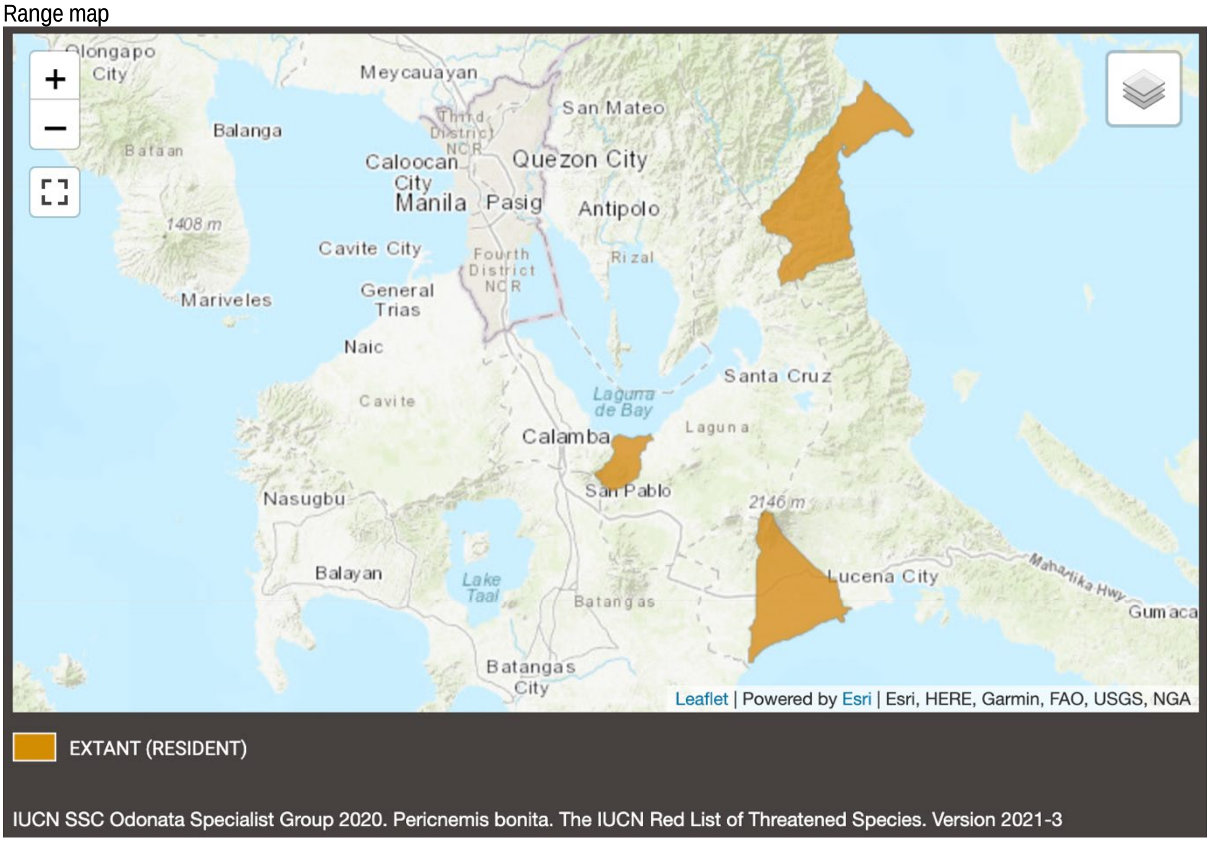
(1) Sheppard, A., Fenner, D., Edwards, A., Abrar, M. & Ochavillo, D. 2008. *Pectinia maxima. The IUCN Red List of Threatened Species* 2008: e.T133683A3863409. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T133683A3863409.en. Accessed on 17 June 2022.
(2) Corals of the World. http://www.coralsoftheworld.org/species_factsheets/species_factsheet_summary/pectinis-maxima/. Accessed 15 May 2022.
(3) Coral Trait Database. 2022. *Echinophyllia maxima*. https://coraltraits.org/species/598. Accessed 28 June 2022.

Range map



Source: Sheppard, A., Fenner, D., Edwards, A., Abrar, M. & Ochavillo, D. 2008. *Pectinia maxima. The IUCN Red List of Threatened Species* 2008: e.T133683A3863409. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T133683A3863409.en. Accessed on 17 June 2022.

Pericnemis bonita (EN)
Sources consulted
(1) Dow, R.A. 2020. *Pericnemis bonita*. *The IUCN Red List of Threatened Species* 2020: e.T139346566A146602070. https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T139346566A146602070.en. Accessed on 20 June 2022.
Range map



Source: Dow, R.A. 2020. *Pericnemis bonita*. *The IUCN Red List of Threatened Species* 2020: e.T139346566A146602070. https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T139346566A146602070.en. Accessed on 20 June 2022.

Pericnemis incallida
(EN)

Sources consulted

(1) Dow, R.A. 2020. *Pericnemis incallida. The IUCN Red List of Threatened Species* 2020: e.T139346947A146602080. https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T139346947A146602080.en. Accessed on 20 June 2022.

Range map

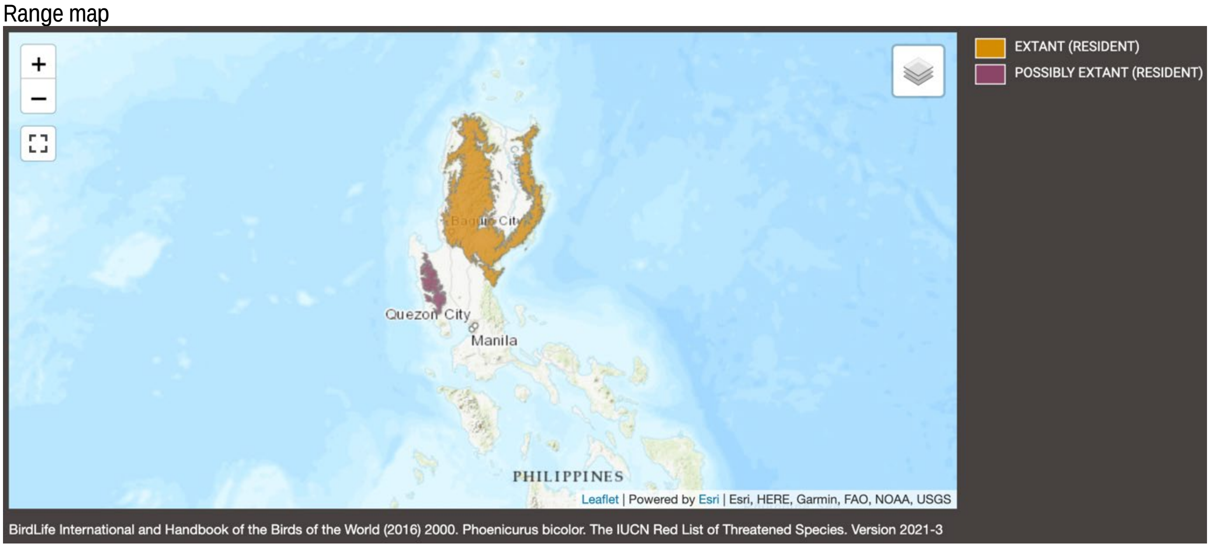
Source: Dow, R.A. 2020. *Pericnemis incallida. The IUCN Red List of Threatened Species* 2020: e.T139346947A146602080. https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T139346947A146602080.en. Accessed on 20 June 2022.

Phoenicurus bicolor
Luzon Water-Redstart
(NT)

Sources consulted

(1) BirdLife International. 2020. *Phoenicurus bicolor*. *The IUCN Red List of Threatened Species* 2020: e.T22710101A117236655. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T22710101A117236655.en. Accessed on 17 June 2022.
(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map



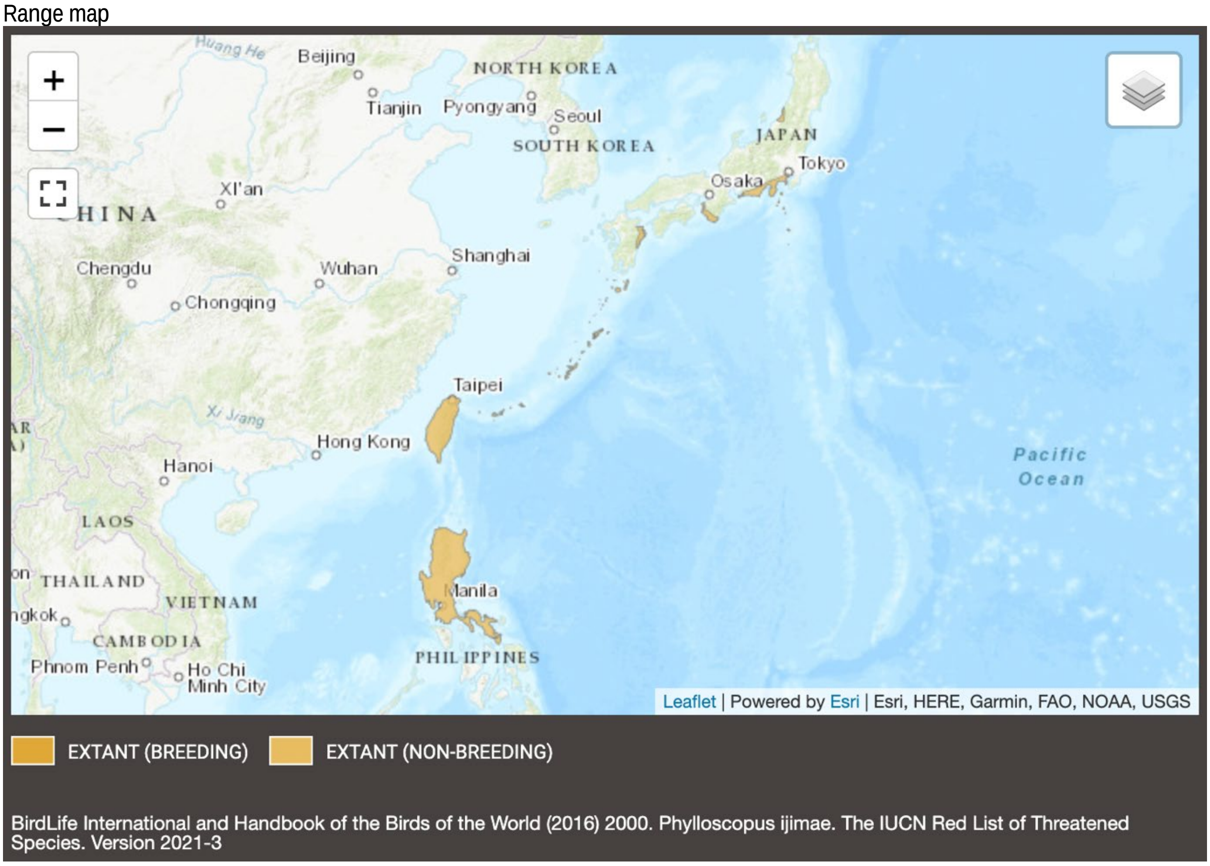
Source: BirdLife International. 2020. *Phoenicurus bicolor*. *The IUCN Red List of Threatened Species* 2020: e.T22710101A117236655. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T22710101A117236655.en. Accessed on 17 June 2022.

Phylloscopus ijimae
Ijima's Leaf-Warbler
(VU)

Sources consulted

(1) BirdLife International. 2016. *Phylloscopus ijimae. The IUCN Red List of Threatened Species* 2016: e.T22715353A94449596. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22715353A94449596.en. Accessed on 17 June 2022.
(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map



Source: BirdLife International. 2016. *Phylloscopus ijimae*. *The IUCN Red List of Threatened Species* 2016: e.T22715353A94449596. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22715353A94449596.en. Accessed on 17 June 2022.

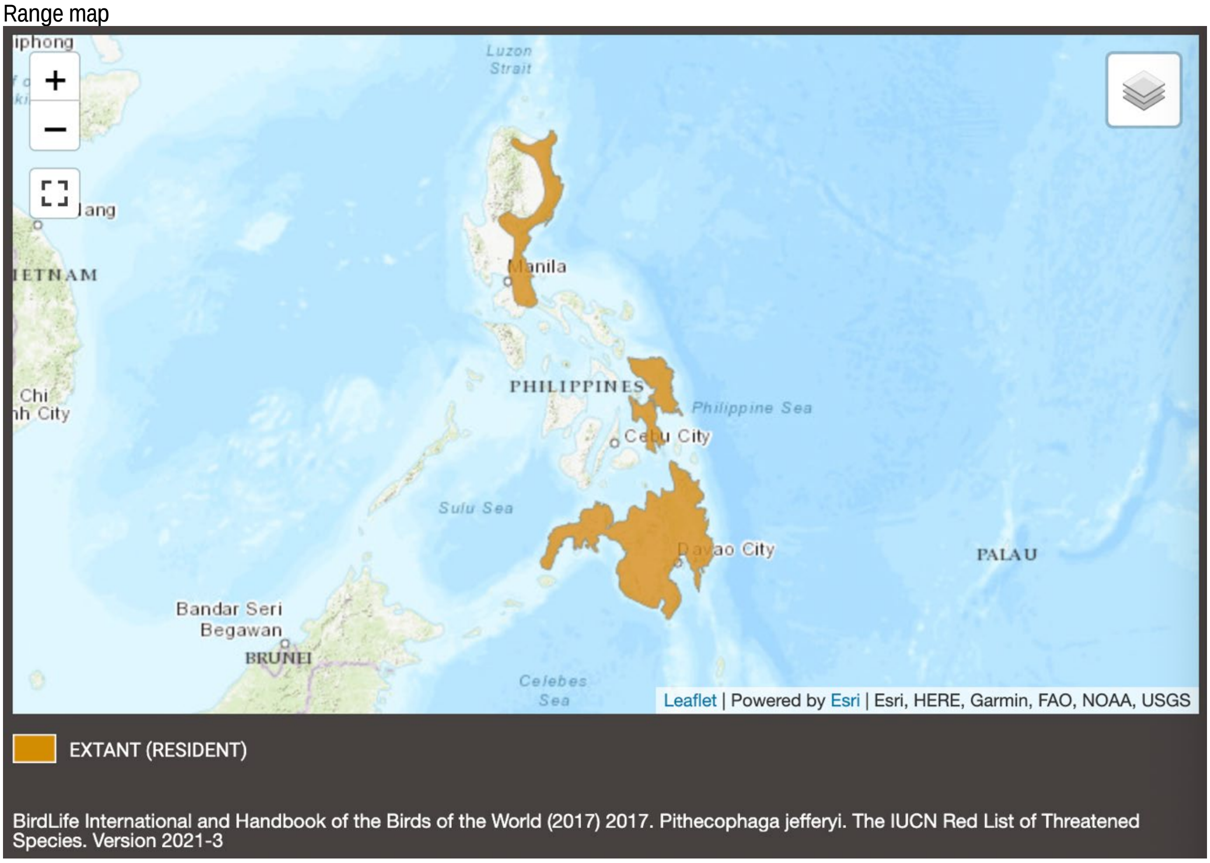
Pithecophaga jefferyi
Philippine Eagle
(CR)

Sources consulted

(1) BirdLife International. 2018. *Pithecophaga jefferyi* (amended version of 2017 assessment). *The IUCN Red List of Threatened Species* 2018: e.T22696012A129595746. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22696012A129595746.en. Accessed on 20 June 2022.

(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map



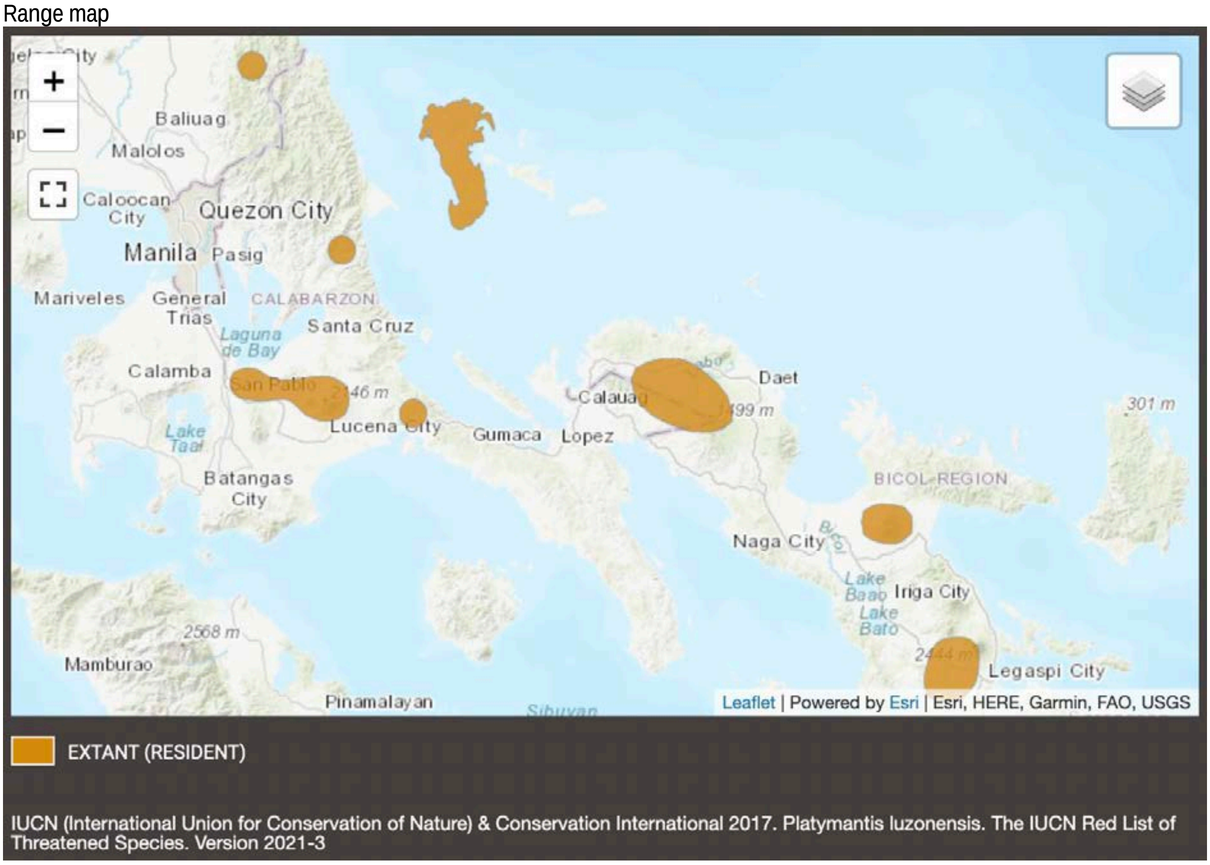
Source: BirdLife International. 2018. *Pithecophaga jefferyi* (amended version of 2017 assessment). *The IUCN Red List of Threatened Species* 2018: e.T22696012A129595746. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22696012A129595746.en. Accessed on 20 June 2022.

Platymantis luzonensis
(NT)

Sources consulted

(1) IUCN SSC Amphibian Specialist Group. 2018. *Platymantis luzonensis*. *The IUCN Red List of Threatened Species* 2018: e.T58464A58480349. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T58464A58480349.en. Accessed on 17 June 2022.

Range map



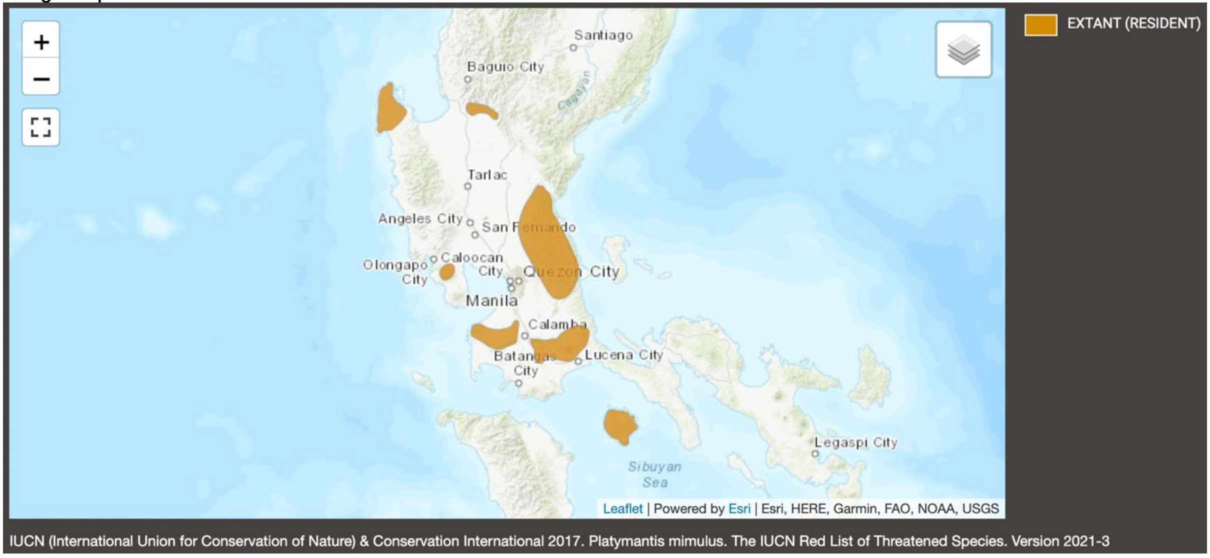
Source: IUCN SSC Amphibian Specialist Group. 2018. *Platymantis luzonensis*. *The IUCN Red List of Threatened Species* 2018: e.T58464A58480349. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T58464A58480349.en. Accessed on 17 June 2022.

Platymantis mimulus
Diminutive Forest Frog
(LC)

Sources consulted

(1) IUCN SSC Amphibian Specialist Group. 2018. *Platymantis mimulus*. *The IUCN Red List of Threatened Species* 2018: e.T58469A58480489. https://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T58469A58480489.en. Accessed on 17 June 2022.
(2) Brown, W. C., A. C. Alcala, and A. C. Diesmos. 1997. A new species of the genus Platymantis (Amphibia: Ranidae) from Luzon Island, Philippines. Proceedings of the Biological Society of Washington 110: 18–23.

Range map



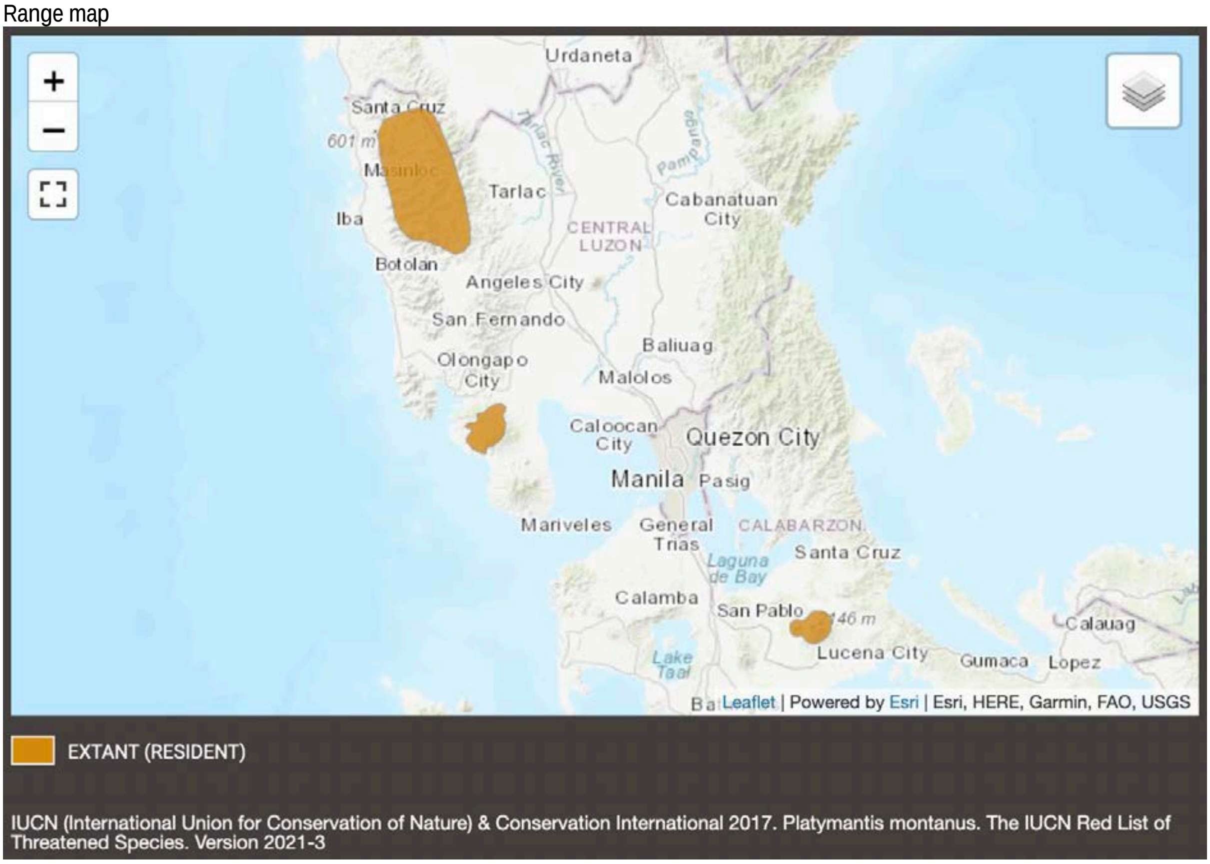
Source: IUCN SSC Amphibian Specialist Group. 2018. *Platymantis mimulus*. *The IUCN Red List of Threatened Species* 2018: e.T58469A58480489. https://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T58469A58480489.en. Accessed on 17 June 2022.

Platymantis montanus
(VU)

Sources consulted

(1) IUCN SSC Amphibian Specialist Group. 2018. *Platymantis montanus*. *The IUCN Red List of Threatened Species* 2018: e.T58470A58480584. https://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T58470A58480584.en. Accessed on 17 June 2022.

Range map



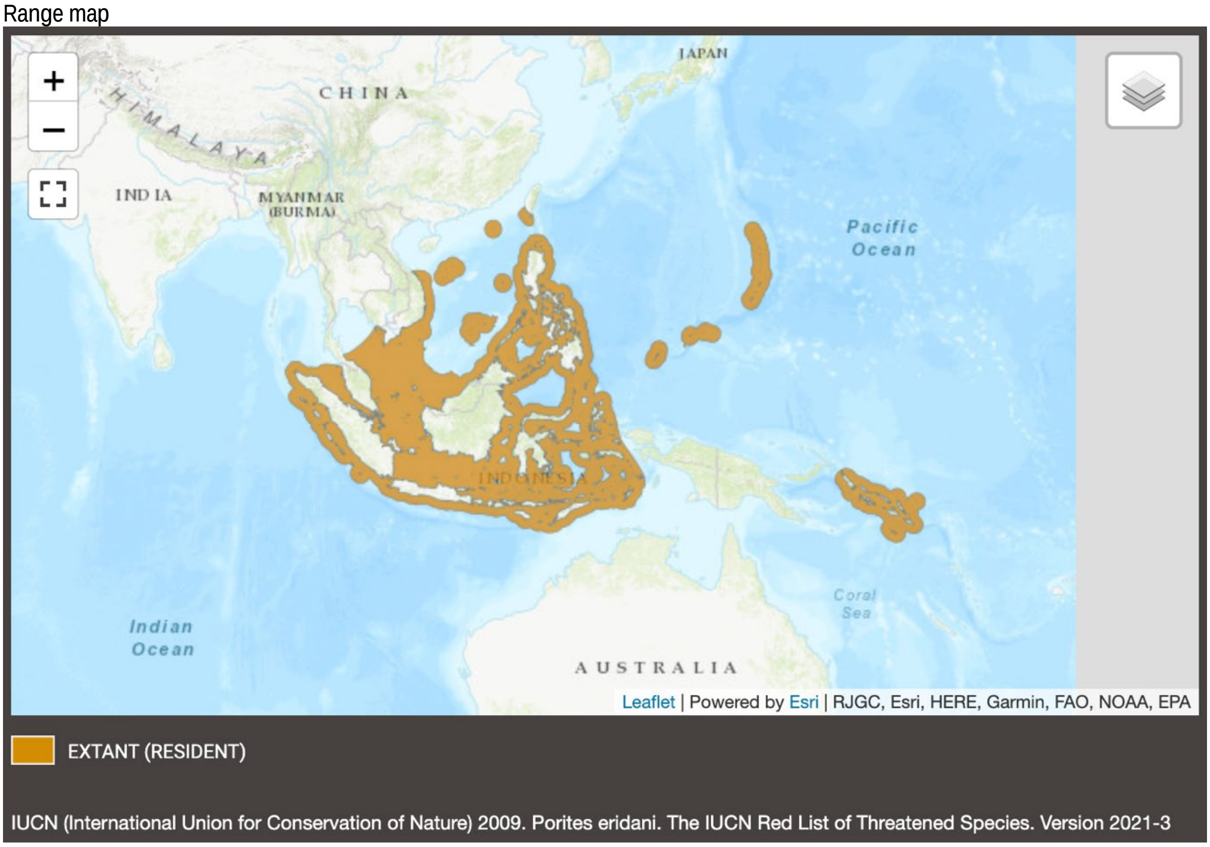
Source: IUCN SSC Amphibian Specialist Group. 2018. *Platymantis montanus*. *The IUCN Red List of Threatened Species* 2018: e.T58470A58480584. https://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T58470A58480584.en. Accessed on 17 June 2022.

Porites eridani
(EN)

Sources consulted

(1) Sheppard, A., Fenner, D., Edwards, A., Abrar, M. & Ochavillo, D. 2014. *Porites eridani*. *The IUCN Red List of Threatened Species* 2014: e.T132897A54157360. https://dx.doi.org/10.2305/IUCN.UK.2014-1.RLTS.T132897A54157360.en. Accessed on 17 June 2022.
(2) Corals of the World. http://www.coralsoftheworld.org/species_factsheets/species_factsheet_summary/porites-eridani/. Accessed 15 May 2022.
(3) Coral Trait Database. 2022. *Porites eridani*. https://coraltraits.org/species/1290?search=porites+eridani. Accessed 28 June 2022.

Range map



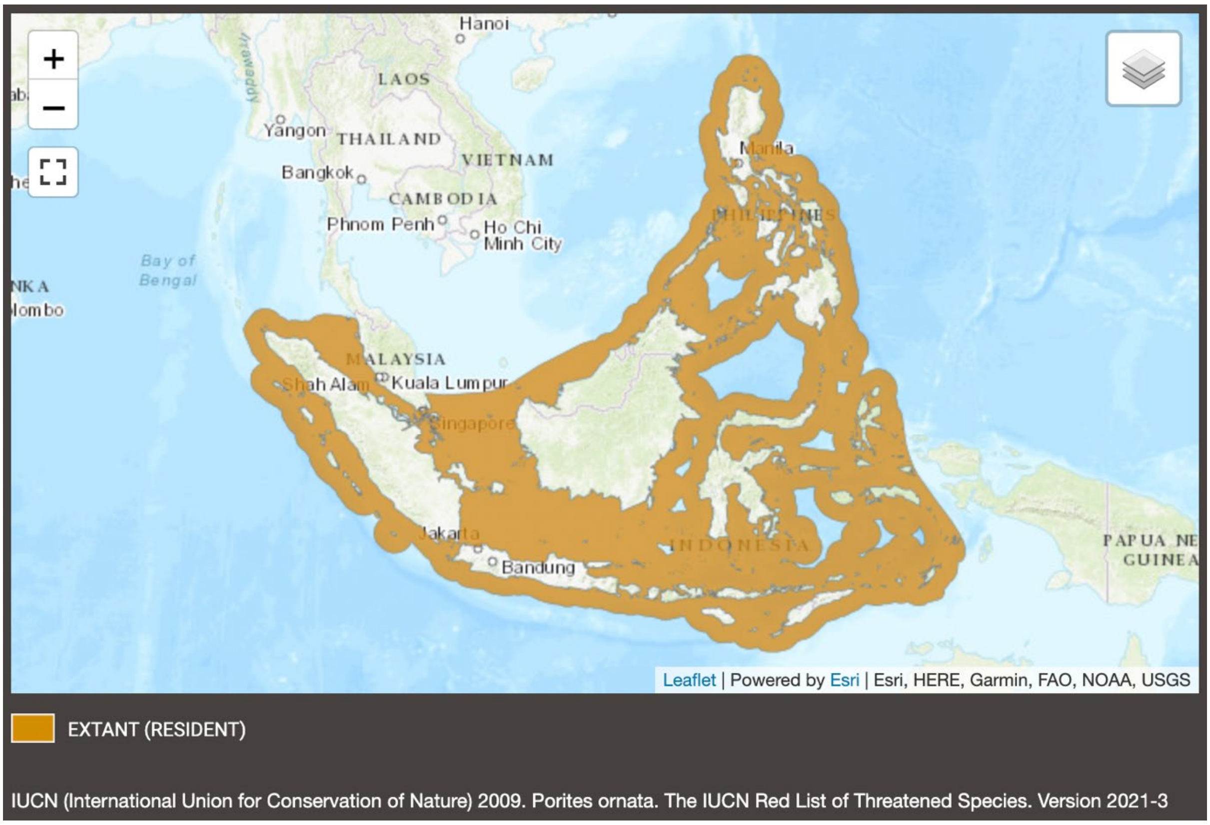
Source: Sheppard, A., Fenner, D., Edwards, A., Abrar, M. & Ochavillo, D. 2014. *Porites eridani*. *The IUCN Red List of Threatened Species* 2014: e.T132897A54157360. https://dx.doi.org/10.2305/IUCN.UK.2014-1.RLTS.T132897A54157360.en. Accessed on 17 June 2022.

Porites ornata
(EN)

Sources consulted

(1) Sheppard, A., Fenner, D., Edwards, A., Abrar, M. & Ochavillo, D. 2008. *Porites ornata. The IUCN Red List of Threatened Species* 2008: e.T133301A3678479. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T133301A3678479.en. Accessed on 17 June 2022.
(2) Corals of the World. http://www.coralsoftheworld.org/species_factsheets/species_factsheet_summary/porites-ornata/. Accessed 15 May 2022.
(3) Coral Trait Database. 2022. *Porites ornata*. https://coraltraits.org/species/1314?search=porites+ornata. Accessed 28 June 2022.

Range map



Source: Sheppard, A., Fenner, D., Edwards, A., Abrar, M. & Ochavillo, D. 2008. *Porites ornata. The IUCN Red List of Threatened Species* 2008: e.T133301A3678479. https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T133301A3678479.en. Accessed on 17 June 2022.

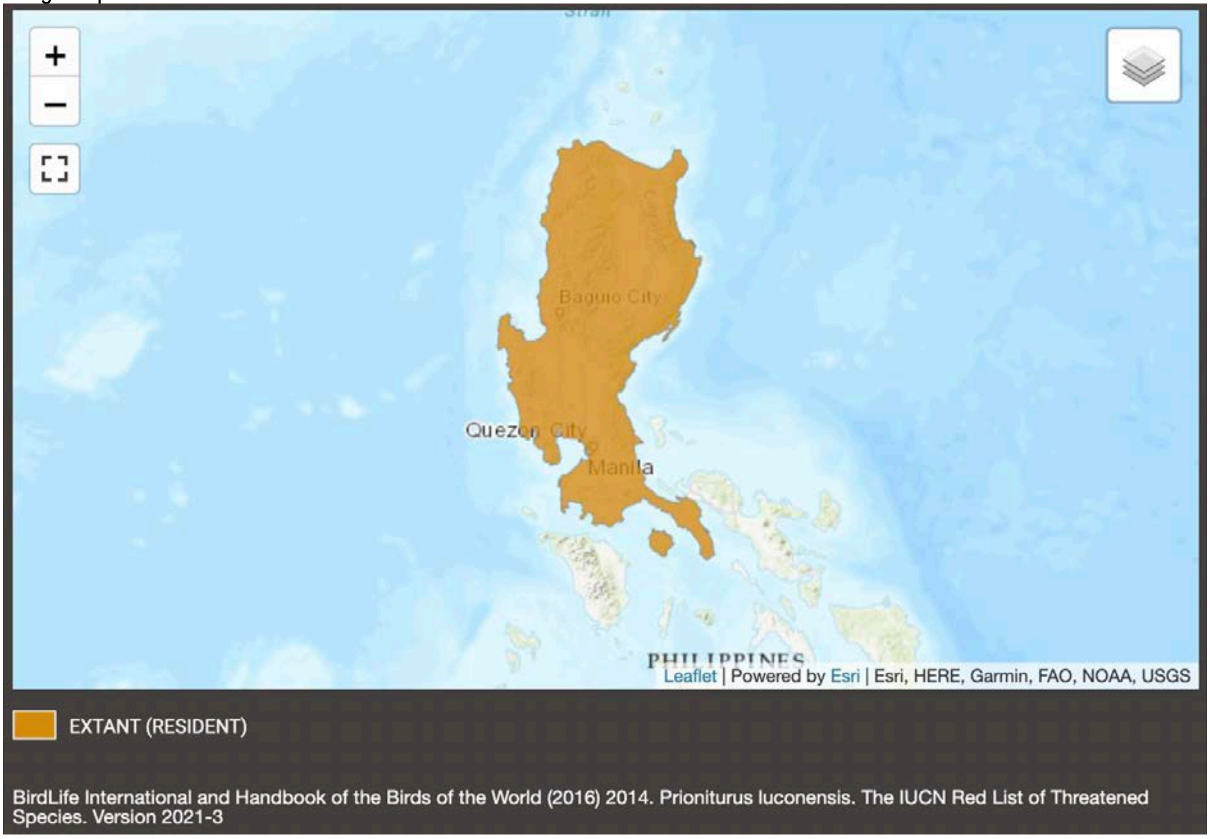
Prioniturus luconensis
Green Racquet-Tail
(EN)

Sources consulted

(1) BirdLife International. 2017. *Prioniturus luconensis* (amended version of 2016 assessment). *The IUCN Red List of Threatened Species* 2017: e.T22684969A110147782. https://dx.doi.org/10.2305/IUCN.UK.2017-1.RLTS.T22684969A110147782.en. Accessed on 20 June 2022.

(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map



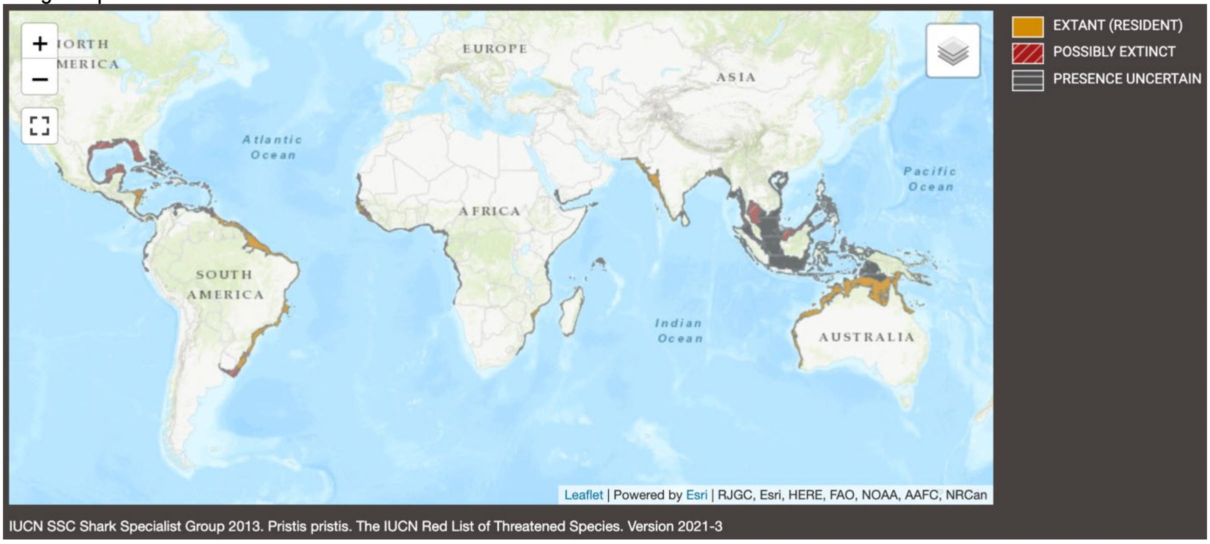
Source: BirdLife International. 2017. *Prioniturus luconensis* (amended version of 2016 assessment). *The IUCN Red List of Threatened Species* 2017: e.T22684969A110147782. https://dx.doi.org/10.2305/IUCN.UK.2017-1.RLTS.T22684969A110147782.en. Accessed on 20 June 2022.

Pristis pristis
Largetooth Sawfish
(CR)

Sources consulted

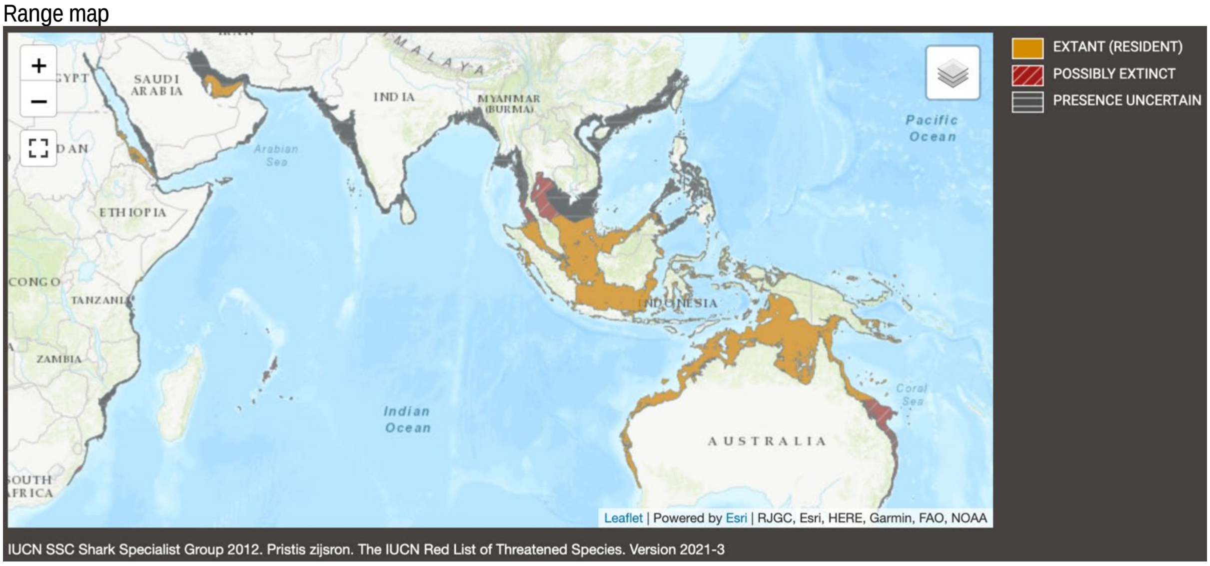
(1) Kyne, P.M., Carlson, J. & Smith, K. 2013. Pristis pristis (errata version published in 2019). The IUCN Red List of Threatened Species 2013: e.T18584848A141788242. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T18584848A141788242.en. Accessed on 25 April 2022.
(2) NOAA. Largetooth Sawfish. https://www.fisheries.noaa.gov/species/largetooth-sawfish. Accessed 17 May 2022.
(3) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



Source: Kyne, P.M., Carlson, J. & Smith, K. 2013. Pristis pristis (errata version published in 2019). The IUCN Red List of Threatened Species 2013: e.T18584848A141788242. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T18584848A141788242.en. Accessed on 25 April 2022.

Pristis zijsron Green Sawfish (CR)
Sources consulted
(1) Simpfendorfer, C. 2013. Pristis zijsron (errata version published in 2019). The IUCN Red List of Threatened Species 2013: e.T39393A141792003. http://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T39393A141792003.en (2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.
Range map



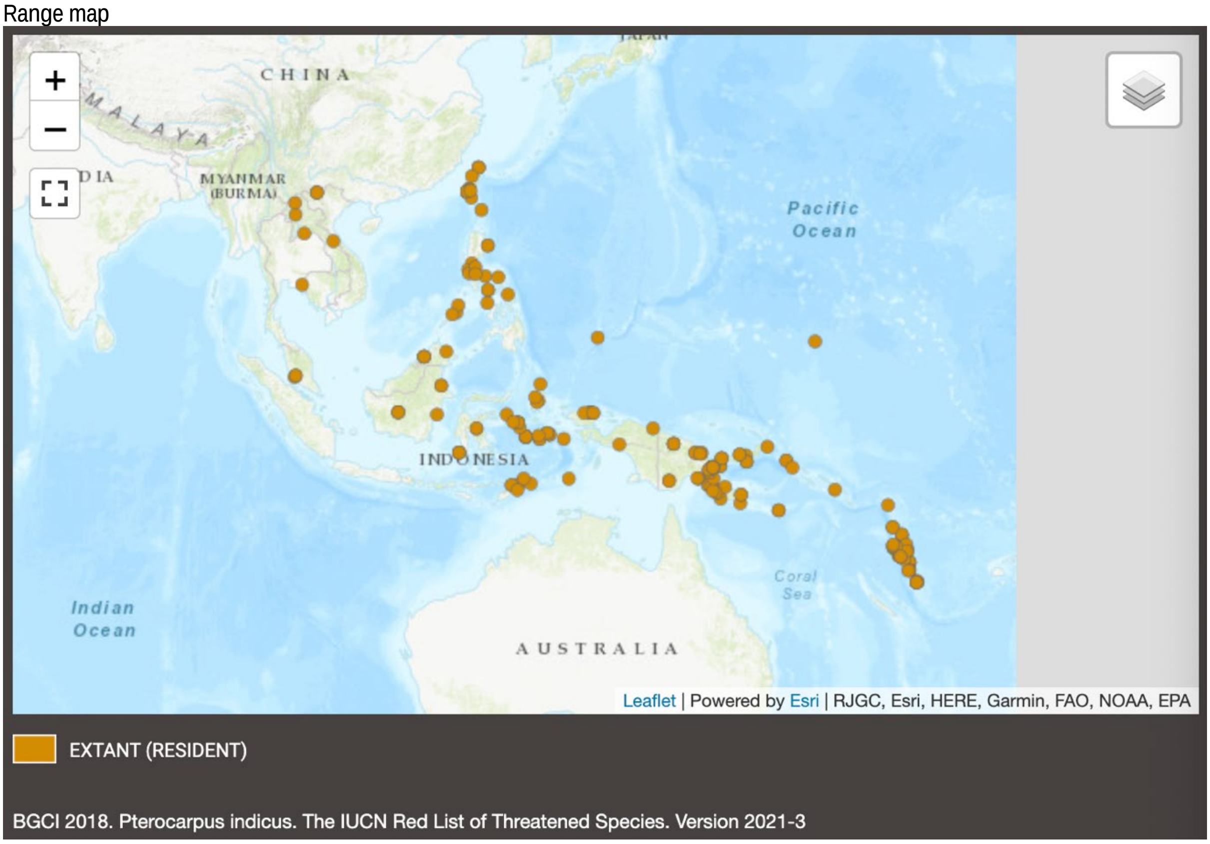
Source: Simpfendorfer, C. 2013. Pristis zijsron (errata version published in 2019). The IUCN Red List of Threatened Species 2013: e.T39393A141792003. http://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T39393A141792003.en

Pterocarpus indicus
Burmese Rosewood
(EN)

Sources consulted

(1) Barstow, M. 2018. *Pterocarpus indicus*. *The IUCN Red List of Threatened Species* 2018: e.T33241A2835450. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T33241A2835450.en. Accessed on 20 June 2022.

Range map



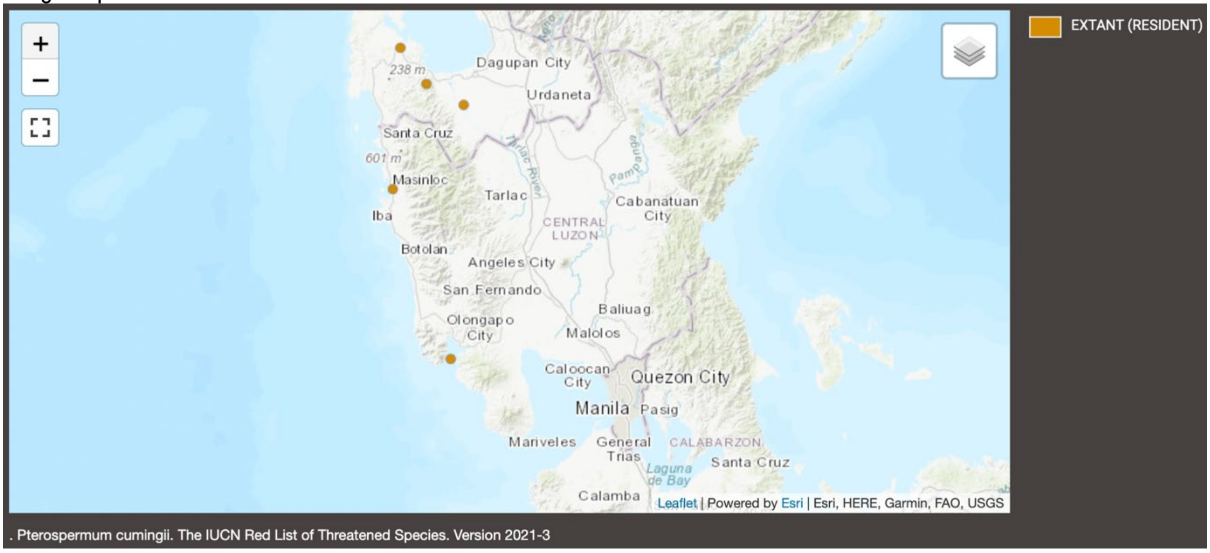
Source: Barstow, M. 2018. *Pterocarpus indicus*. *The IUCN Red List of Threatened Species* 2018: e.T33241A2835450. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T33241A2835450.en. Accessed on 20 June 2022.

Pterospermum cumingii
(EN)

Sources consulted

(1) Ganesan, S.K. 2017. *Pterospermum cumingii*. *The IUCN Red List of Threatened Species* 2017: e.T113756520A113756522. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T113756520A113756522.en. Accessed on 20 June 2022.

Range map



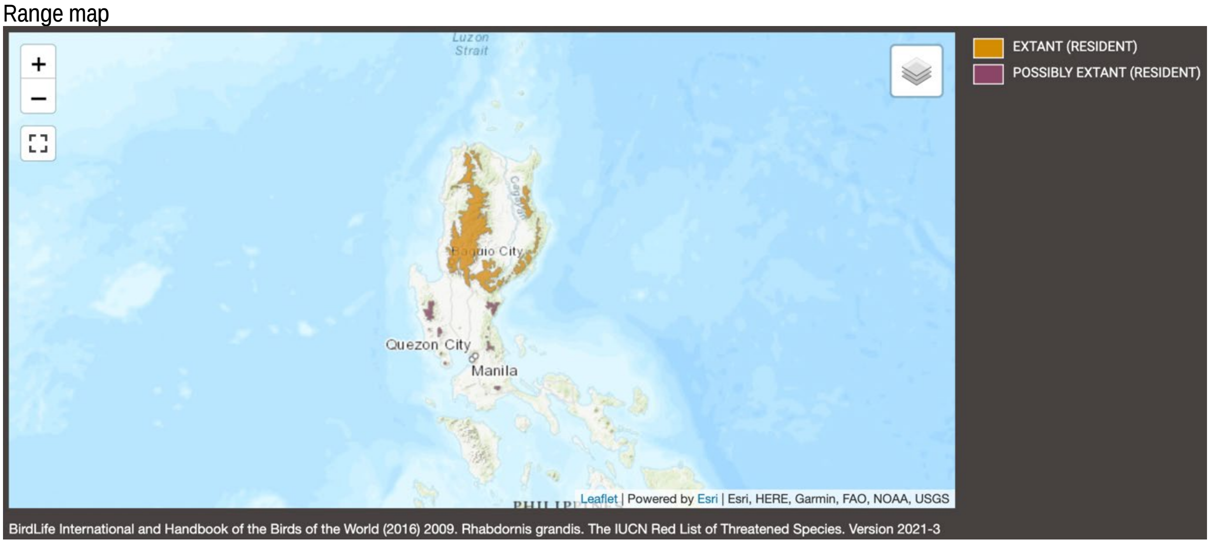
Source: Ganesan, S.K. 2017. *Pterospermum cumingii*. *The IUCN Red List of Threatened Species* 2017: e.T113756520A113756522. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T113756520A113756522.en. Accessed on 20 June 2022.

Rhabdornis grandis
Grand Rhabdornis
(LC)

Sources consulted

(1) BirdLife International. 2016. *Rhabdornis grandis*. *The IUCN Red List of Threatened Species* 2016: e.T22716853A94514558. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22716853A94514558.en. Accessed on 17 June 2022.
(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map



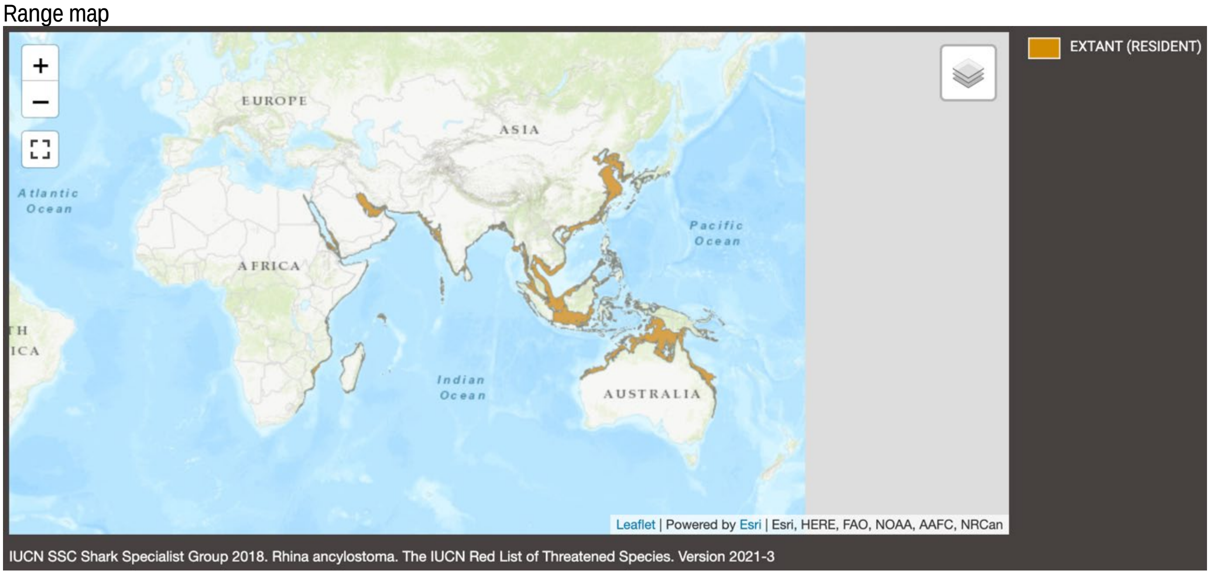
Source: BirdLife International. 2016. *Rhabdornis grandis*. *The IUCN Red List of Threatened Species* 2016: e.T22716853A94514558. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22716853A94514558.en. Accessed on 17 June 2022.

Rhina ancylostoma
Bowmouth Guitarfish
(CR)

Sources consulted

(1) Kyne, P.M., Rigby, C.L., Dharmadi & Jabado, R.W. 2019. Rhina ancylostoma. The IUCN Red List of Threatened Species 2019: e.T41848A124421912. https://dx.doi.org/10.2305/IUCN.UK.2019-2.RLTS.T41848A124421912.en. Accessed on 25 April 2022.
(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



Source: Kyne, P.M., Rigby, C.L., Dharmadi & Jabado, R.W. 2019. Rhina ancylostoma. The IUCN Red List of Threatened Species 2019: e.T41848A124421912. https://dx.doi.org/10.2305/IUCN.UK.2019-2.RLTS.T41848A124421912.en. Accessed on 25 April 2022.

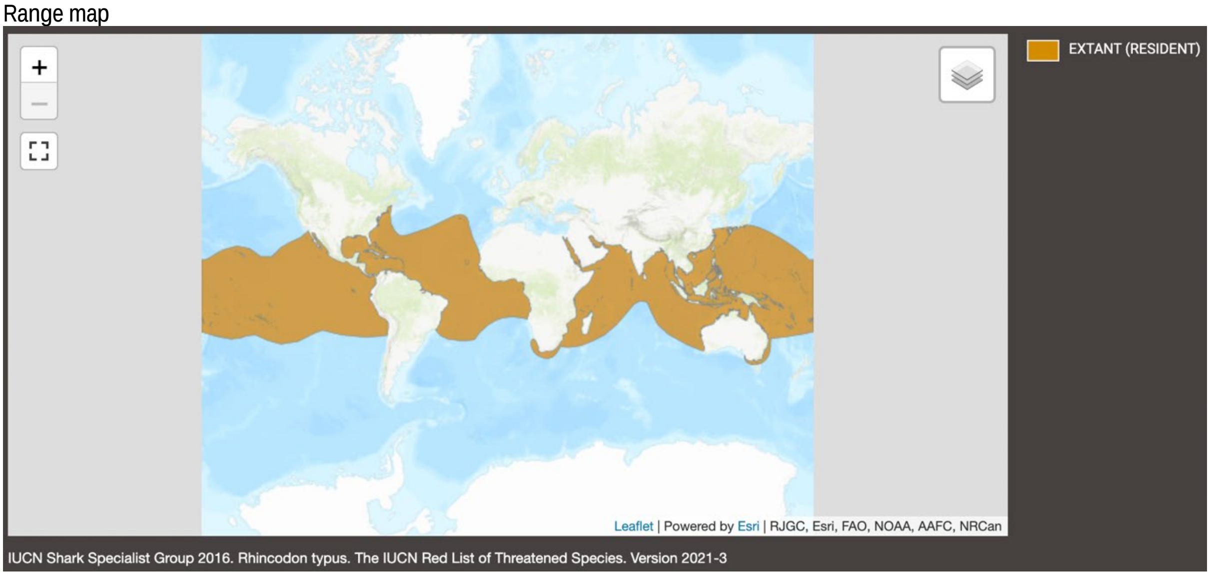
Rhincodon typus
Whale Shark
(EN)

Sources consulted

(1) Pierce, S.J. & Norman, B. 2016. *Rhincodon typus*. *The IUCN Red List of Threatened Species* 2016: e.T19488A2365291. https://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T19488A2365291.en. Accessed on 19 June 2022.

(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



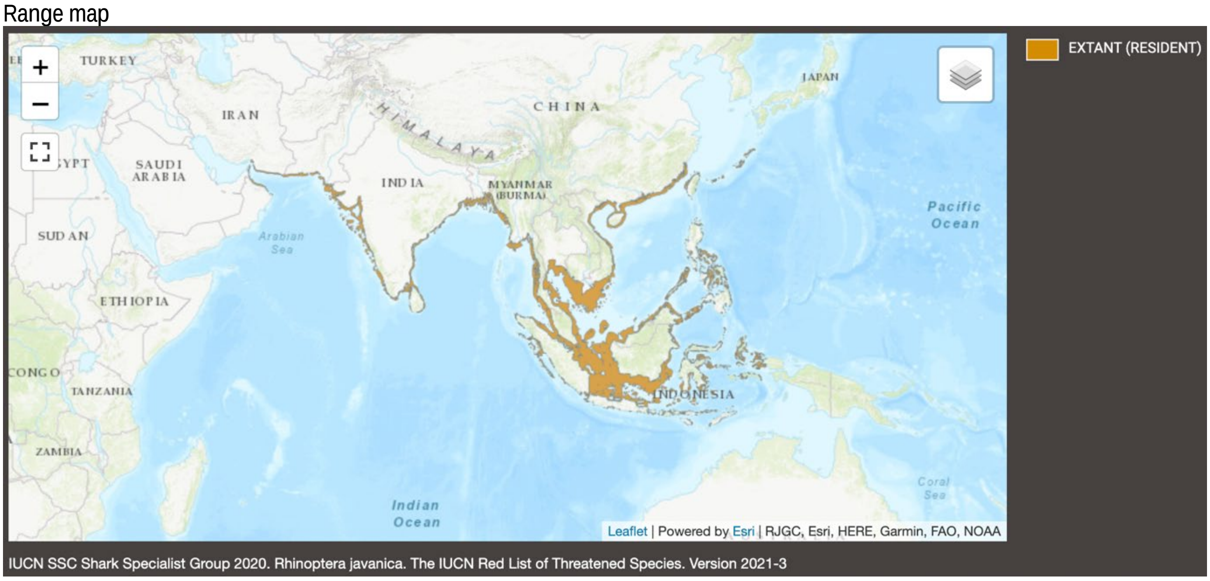
Source: Pierce, S.J. & Norman, B. 2016. *Rhincodon typus*. *The IUCN Red List of Threatened Species* 2016: e.T19488A2365291. https://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T19488A2365291.en. Accessed on 17 June 2022.

Rhinoptera javanica
Javanese Cownose Ray
(EN)

Sources consulted

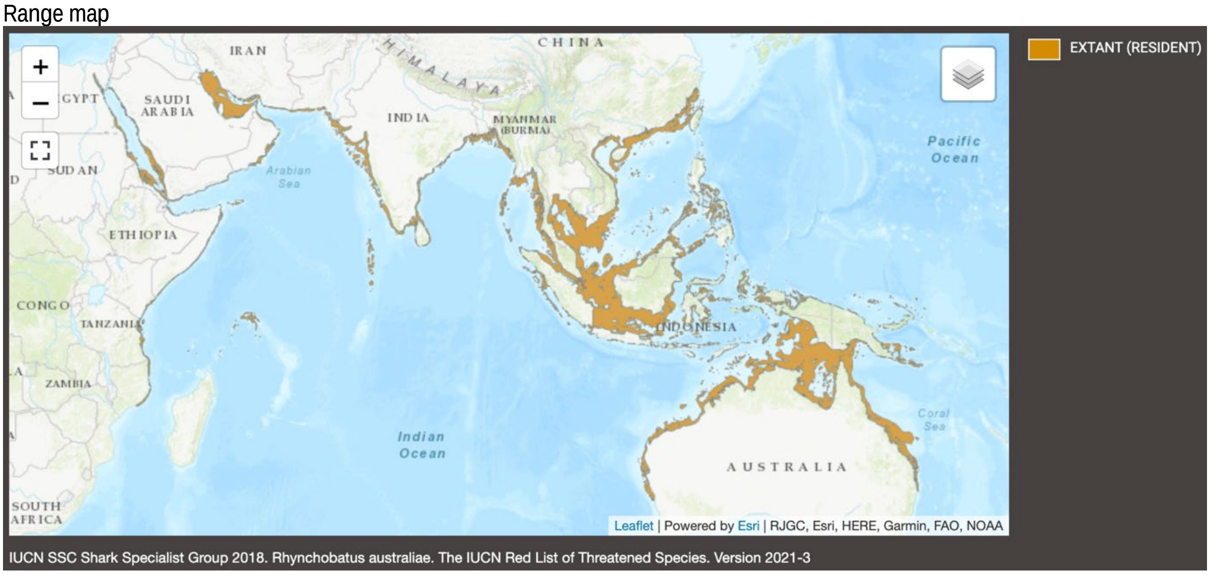
(1) Sherman, C.S., Bin Ali, A., Bineesh, K.K., Derrick, D., Dharmadi, Fahmi, Fernando, D., Haque, A.B., Maung, A., Seyha, L., Tanay, D., Utzurrum, J.A.T., Vo, V.Q. & Yuneni, R.R. 2021. Rhinoptera javanica. The IUCN Red List of Threatened Species 2021: e.T60129A124442197. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T60129A124442197.en. Accessed on 25 April 2022.
(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



Source: Sherman, C.S., Bin Ali, A., Bineesh, K.K., Derrick, D., Dharmadi, Fahmi, Fernando, D., Haque, A.B., Maung, A., Seyha, L., Tanay, D., Utzurrum, J.A.T., Vo, V.Q. & Yuneni, R.R. 2021. Rhinoptera javanica. The IUCN Red List of Threatened Species 2021: e.T60129A124442197. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T60129A124442197.en. Accessed on 25 April 2022.

Rhynchobatus australiae Bottlenose wedgefish (CR)
Sources consulted
(1) Kyne, P.M., Rigby, C.L., Dharmadi & Jabado, R.W. 2019. Rhynchobatus australiae. The IUCN Red List of Threatened Species 2019: e.T41853A68643043. https://dx.doi.org/10.2305/IUCN.UK.2019-2.RLTS.T41853A68643043.en. Accessed on 25 April 2022. (2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.
Range map



Source: Kyne, P.M., Rigby, C.L., Dharmadi & Jabado, R.W. 2019. Rhynchobatus australiae. The IUCN Red List of Threatened Species 2019: e.T41853A68643043. https://dx.doi.org/10.2305/IUCN.UK.2019-2.RLTS.T41853A68643043.en. Accessed on 25 April 2022.

Rhynchobatus springeri
Broadnose wedgefish
(CR)

Sources consulted

(1) Kyne, P.M. 2019. Rhynchobatus springeri. The IUCN Red List of Threatened Species 2019: e.T60182A124448942. https://dx.doi.org/10.2305/IUCN.UK.2019-2.RLTS.T60182A124448942.en. Accessed on 25 April 2022.
(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map

Source: Kyne, P.M. 2019. Rhynchobatus springeri. The IUCN Red List of Threatened Species 2019: e.T60182A124448942. https://dx.doi.org/10.2305/IUCN.UK.2019-2.RLTS.T60182A124448942.en. Accessed on 25 April 2022.

Robsonius sorsogonensis
Bicol Ground-Warbler
(NT)

Sources consulted

(1) BirdLife International. 2019. *Robsonius sorsogonensis*. *The IUCN Red List of Threatened Species* 2019: e.T22735664A156385693. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T22735664A156385693.en. Accessed on 17 June 2022.
(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

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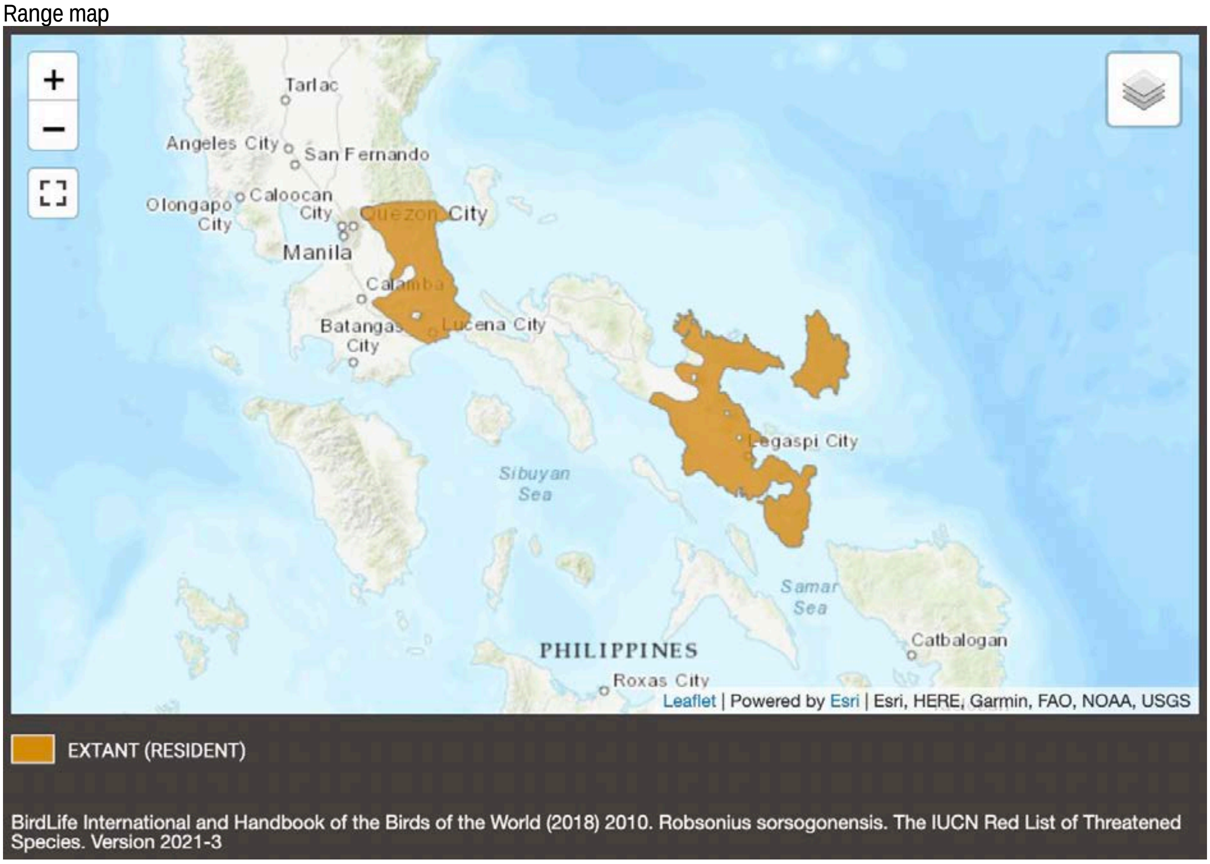


Source: BirdLife International. 2019. *Robsonius sorsogonensis*. *The IUCN Red List of Threatened Species* 2019: e.T22735664A156385693. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T22735664A156385693.en. Accessed on 17 June 2022.

Scolopax bukidnonensis Bukidnon Woodcock (LC)
Sources consulted (1) BirdLife International. 2016. *Scolopax bukidnonensis*. *The IUCN Red List of Threatened Species* 2016: e.T22729854A95022201. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22729854A95022201.en. Accessed on 17 June 2022. (2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map

Source: BirdLife International. 2016. *Scolopax bukidnonensis*. *The IUCN Red List of Threatened Species* 2016: e.T22729854A95022201. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22729854A95022201.en. Accessed on 17 June 2022.

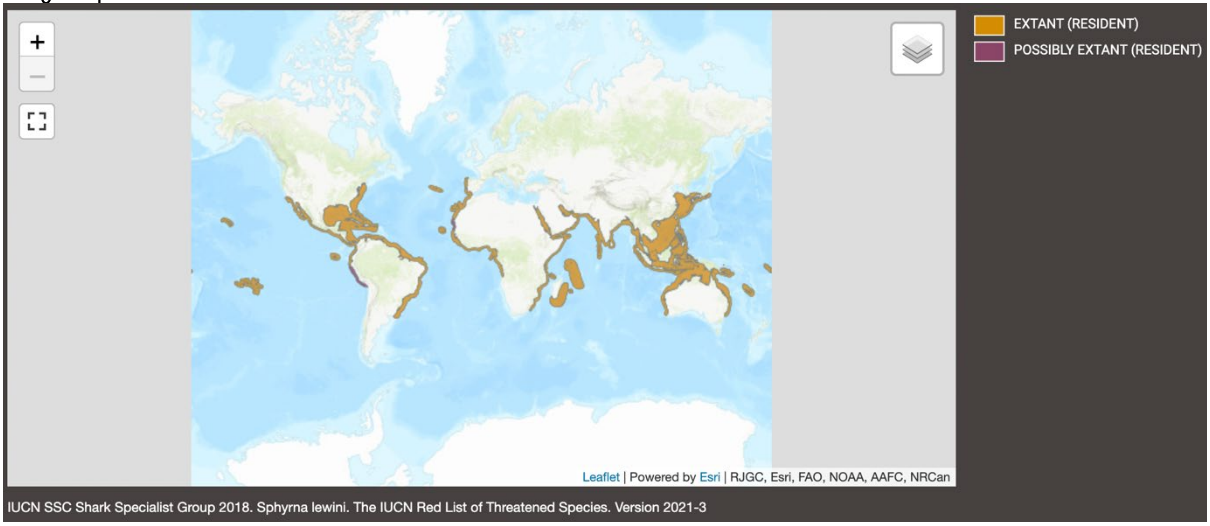
Sphyrna lewini
Scalloped Hammerhead
(CR)

Sources consulted

(1) Rigby, C.L., Dulvy, N.K., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. Sphyrna lewini. The IUCN Red List of Threatened Species 2019: e.T39385A2918526. Accessed on 25 April 2022.

(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



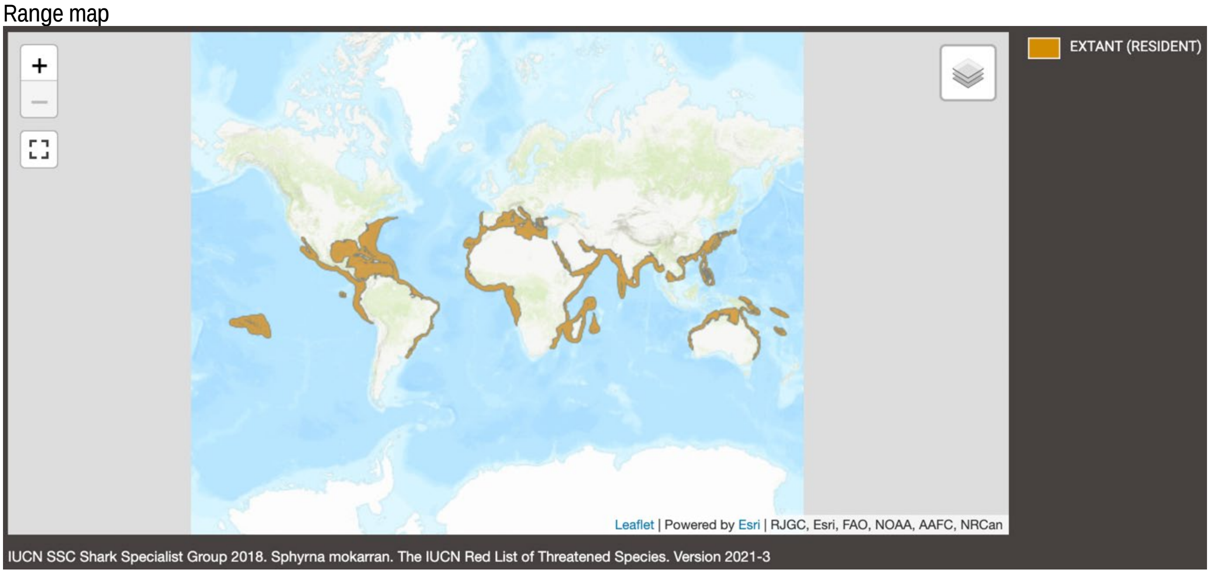
Source: Rigby, C.L., Dulvy, N.K., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. Sphyrna lewini. The IUCN Red List of Threatened Species 2019: e.T39385A2918526. Accessed on 25 April 2022.

Sphyrna mokarran
Great Hammerhead
(CR)

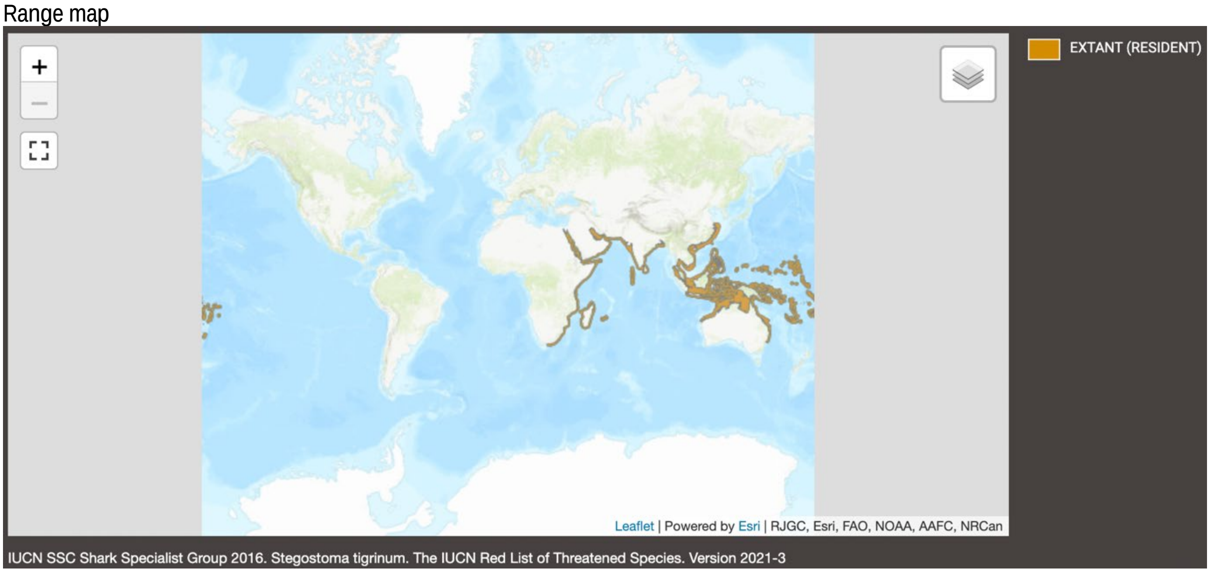
Sources consulted

(1) Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. Sphyrna mokarran. The IUCN Red List of Threatened Species 2019: e.T39386A2920499. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T39386A2920499.en. Accessed on 25 April 2022.
(2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.

Range map



Source: Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. Sphyrna mokarran. The IUCN Red List of Threatened Species 2019: e.T39386A2920499. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T39386A2920499.en. Accessed on 25 April 2022.

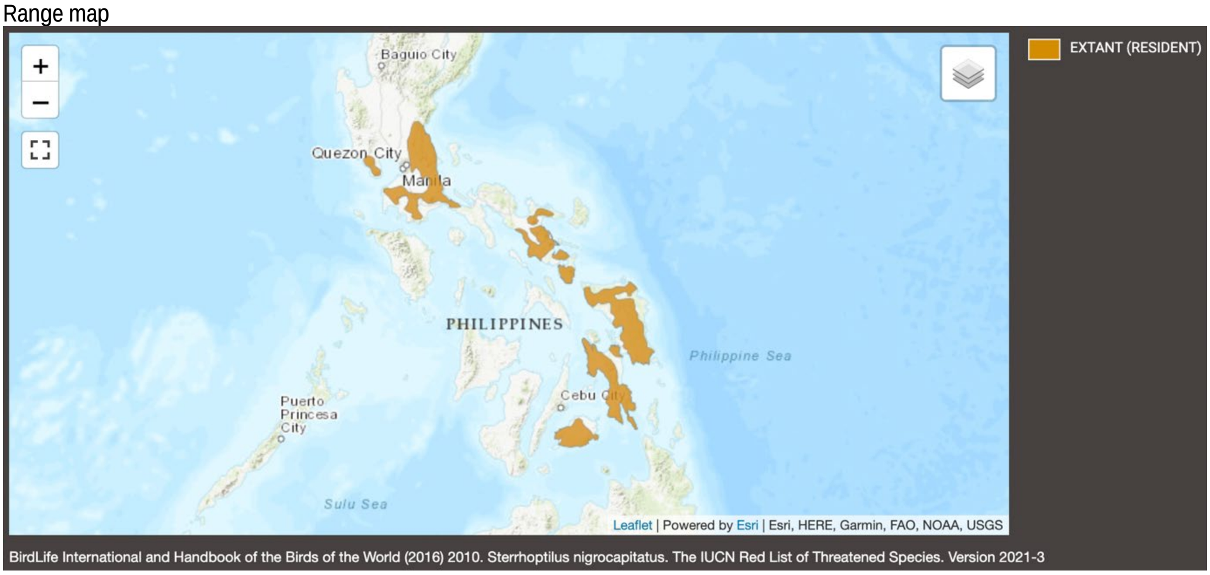
Stegostoma tigrinum Zebra Shark (EN)
Sources consulted
(1) Dudgeon, C.L., Simpfendorfer, C. & Pillans, R.D. 2019. Stegostoma fasciatum (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2019: e.T41878A161303882. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T41878A161303882.en. Accessed on 25 April 2022. (2) Froese, R. and D. Pauly. Editors. 2022.FishBase. World Wide Web electronic publication. www.fishbase.org. Accessed 17 May 2022.
Range map  Source: Dudgeon, C.L., Simpfendorfer, C. & Pillans, R.D. 2019. Stegostoma fasciatum (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2019: e.T41878A161303882. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T41878A161303882.en. Accessed on 25 April 2022.

Sterrhoptilus nigrocapitatus
Black-Crowned Babbler
(LC)

Sources consulted

(1) BirdLife International. 2016. *Sterrhoptilus nigrocapitatus*. *The IUCN Red List of Threatened Species* 2016: e.T22716204A94484596. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22716204A94484596.en. Accessed on 17 June 2022.
(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map



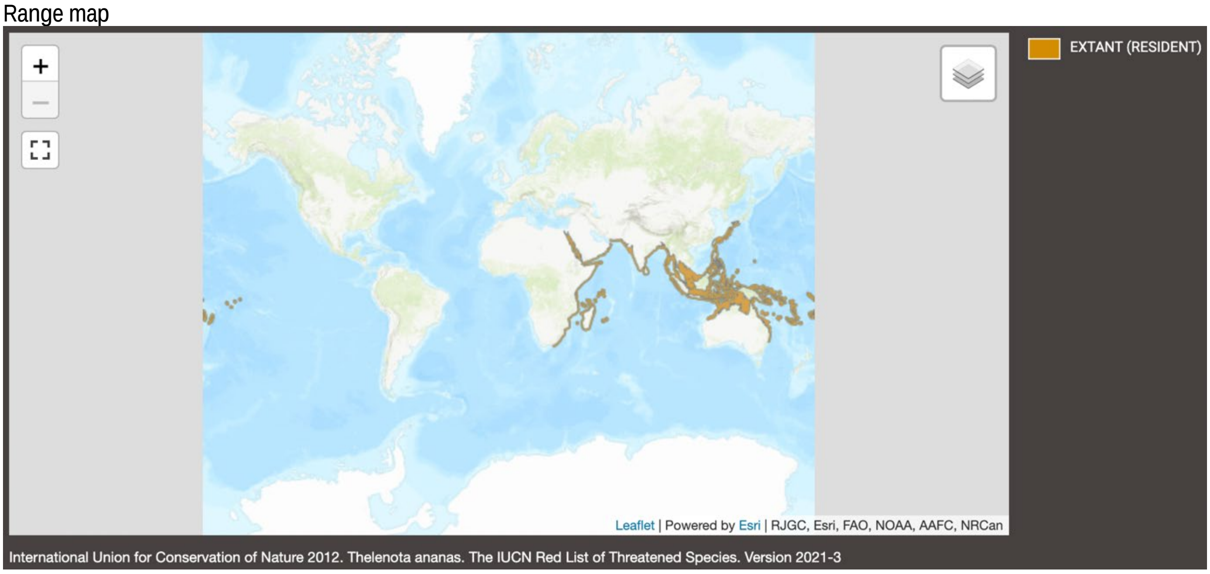
Source: BirdLife International. 2016. *Sterrhoptilus nigrocapitatus*. *The IUCN Red List of Threatened Species* 2016: e.T22716204A94484596. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22716204A94484596.en. Accessed on 17 June 2022.

Thelenota ananas
Prickly Redfish
(EN)

Sources consulted

(1) Conand, C., Gamboa, R. & Purcell, S. 2013. *Thelenota ananas*. *The IUCN Red List of Threatened Species* 2013: e.T180481A1636021. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180481A1636021.en. Accessed on 17 June 2022.
(2) Palomares, M.L.D. and D. Pauly. Editors. 2022. SeaLifeBase. World Wide Web electronic publication. www.sealifebase.org, version (04/2022).

Range map



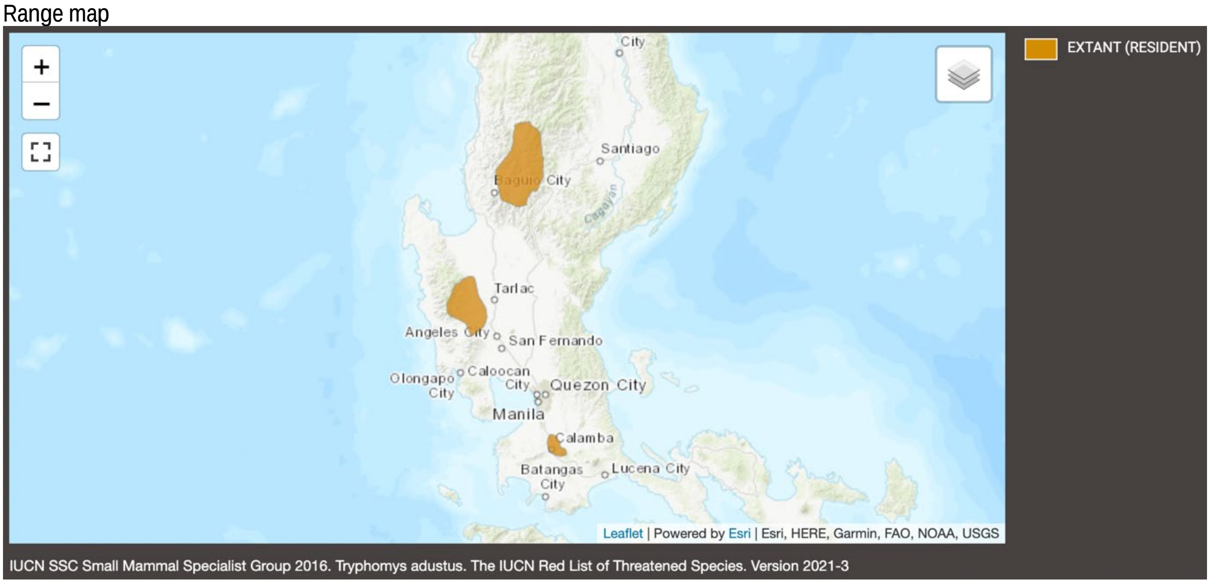
Source: Conand, C., Gamboa, R. & Purcell, S. 2013. *Thelenota ananas*. *The IUCN Red List of Threatened Species* 2013: e.T180481A1636021. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180481A1636021.en. Accessed on 17 June 2022.

Tryphornys adustus
Luzon Short-Nosed Rat
DD

Sources consulted

(1) Kennerley, R. 2016. *Tryphomys adustus*. *The IUCN Red List of Threatened Species* 2016: e.T22431A22439774. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22431A22439774.en. Accessed on 17 June 2022.
(2) Heaney, L.R., Balete, D.S. and Rickart, E.A. 2016. The Mammals of Luzon Island: Biogeography and Natural History of a Philippine Fauna. Johns Hopkins University Press, Baltimore, USA.

Range map



Source: Kennerley, R. 2016. *Tryphomys adustus*. *The IUCN Red List of Threatened Species* 2016: e.T22431A22439774. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22431A22439774.en. Accessed on 17 June 2022.

Zosterornis striatus
Luzon Striped Babbler
(NT)

Sources consulted

(1) BirdLife International. 2016. *Zosterornis striatus*. *The IUCN Red List of Threatened Species* 2016: e.T22716227A94485369. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22716227A94485369.en. Accessed on 17 June 2022.
(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map

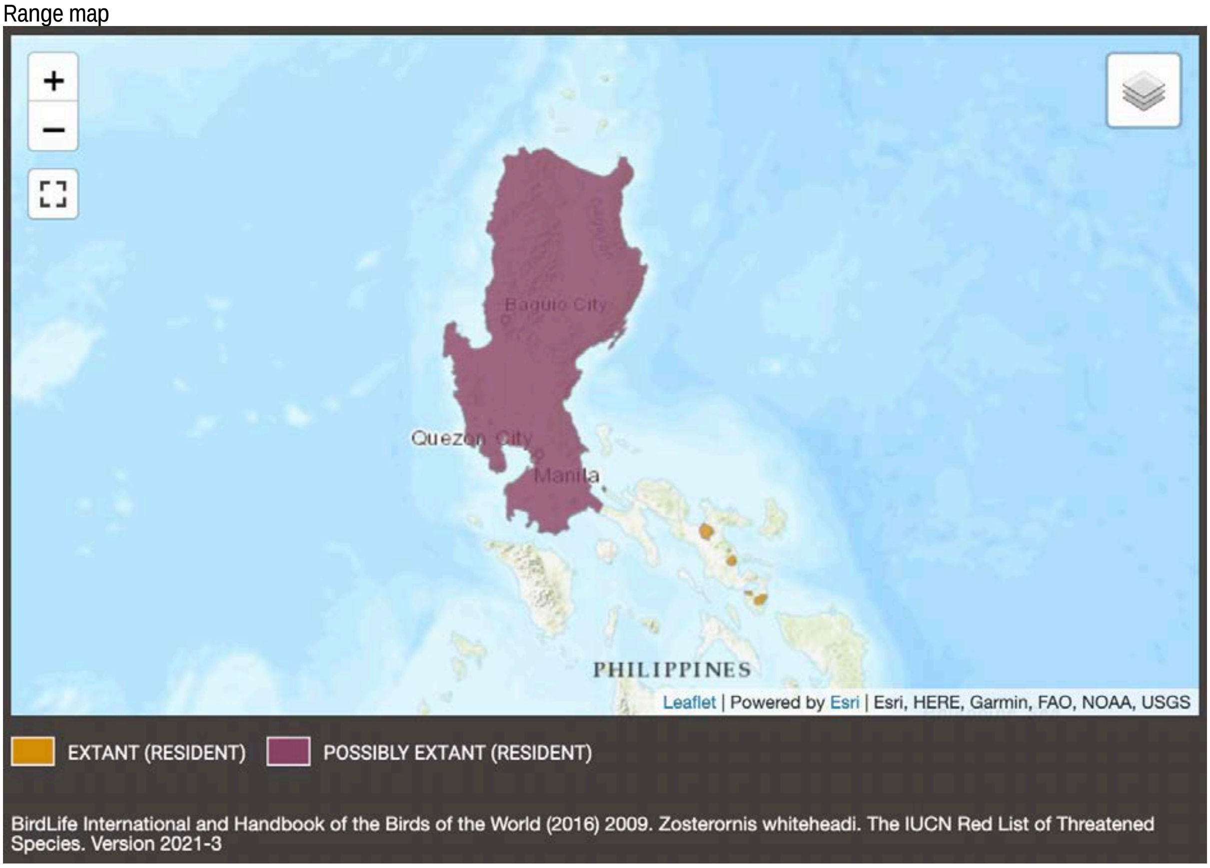
Source: BirdLife International. 2016. *Zosterornis striatus*. *The IUCN Red List of Threatened Species* 2016: e.T22716227A94485369. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22716227A94485369.en. Accessed on 17 June 2022.

Zosterornis whiteheadi
Chestnut-Faced Babbler
(LC)

Sources consulted

(1) BirdLife International. 2016. *Zosterornis whiteheadi*. *The IUCN Red List of Threatened Species* 2016: e.T22716224A94485202. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22716224A94485202.en. Accessed on 17 June 2022.
(2) Jensen et al (2020): Checklist of Birds of the Philippines. Wild Bird Club of the Philippines. www.birdwatch.ph

Range map



Source: BirdLife International. 2016. *Zosterornis whiteheadi*. *The IUCN Red List of Threatened Species* 2016: e.T22716224A94485202. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22716224A94485202.en. Accessed on 17 June 2022.

Bataan-Cavite Interlink Bridge Project

Environmental Studies: Underwater Acoustic Assessment

April 24, 2023

Prepared By:

T.Y. Lin International | Pyunghwa Engineering Consultants Joint Venture

Document Code: 481714-BCIB-PS-IRI-UWA-RPT-0002
Revision: 001

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2023-04-24	Final Report	01	Paul Donovan (Illingsworth)	Jodi Ketelsen (TYLI) Simeon Stairs (REN)	Marwan Nader (TYLI / PEC JV)

ABBREVIATIONS

BCIB	Bataan-Cavite Interlink Bridge
NOAA	National Oceanic and Atmospheric Administration
MMPA	U.S. Marine Mammal Protection Act
ANSI	American National Standards Institute
NMFS	National Marine Fisheries Service
FHWG	Federal Highway Working Group
EFH	Essential Fish Habitat
HLA	High-level approach(es)
RMS	Root-Mean-Square Pressure
SEL	Sound Exposure Level
SPL	Sound Pressure Level
SSL	Single Strike Source Level
TL	Transmission Loss
TPP	Test Pile Program

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1. INTRODUCTION

The proposed Bataan-Cavite Interlink Bridge (BCIB) will be a four-lane, median-separated roadway with total length of 32 km, of which 26 km will be over the waters of Manila Bay (Exhibit 1). The BCIB will connect to the Roman Superhighway at an interchange in Mariveles, Bataan, and to the Antero Soriano Highway at an interchange in Naic, Cavite. The bridge will be supported by 624 piers of which 101 of the piers will be by driven piles 2.8m and 3m in diameter as documented in Exhibit 2. This report is an assessment of potential underwater sound levels generated by planned construction activities for the BCIB project in the Manila Bay of the Philippines. Construction activities generating sound underwater of concern are the installation of piles to support the BCIB.

Exhibit 1 Plan View of BCIB Showing Navigation Channels

Exhibit 2 Estimated Number of Steel Piles for Each Bridge Segment

Estimated Number of Steel Piles by Project Area by Diameter (CISS & CIDH pile foundations)			
		2.8m	3m
Landside over/underpasses - Bataan	N/A (Concrete Drilled Shafts)		
Landside over/underpasses - Cavite	N/A (Concrete Drilled Shafts)		
Marine Viaduct - north			174
Marine Viaduct - central			450
Marine Viaduct – south, including nearshore bridge			414
North Channel Bridge High-Level Approaches		228	
South Channel Bridge High-Level Approaches		200	
North Channel Bridge		188	
South Channel Bridge		634	
Subtotal		1,250	1,038
Total Piles			2,288

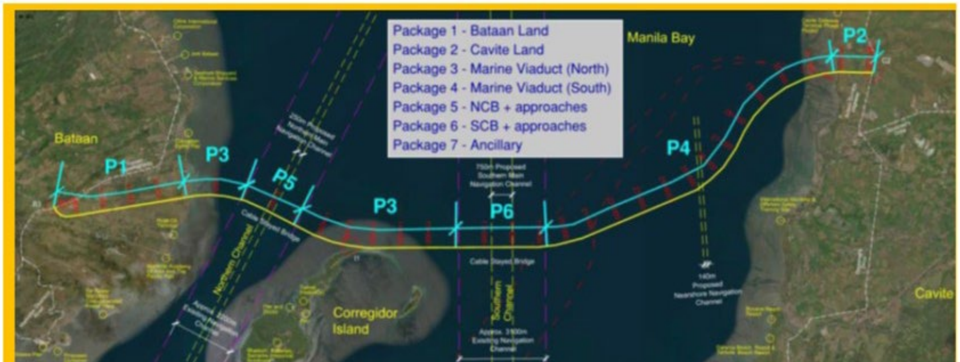
This report includes the prediction of underwater sound levels calculated based on the results of measurements for similar projects. Predicted underwater sound levels are compared against thresholds that have been accepted by the National Oceanic and Atmospheric Administration (NOAA) to protect marine mammals under the U.S. Marine Mammal Protection Act (MMPA)[1]. For fish, the predicted levels are compared to the Interim Sound Exposure Guidelines for Fishes developed under the American National Standards Institute (ANSI). To reasonably predict underwater sound levels from these activities, this analysis relies on acoustic data measured at similar projects. Available underwater sound data for projects involving the installation of similar piles were reviewed. The sound levels for pile driving activities proposed by the project were estimated using these data combined with an understanding of how and where these activities will occur. These predictions are the best estimate based on empirical data and engineering judgment and include a certain degree of uncertainty due to the site conditions and contractor means.

[1] Marine Mammal Protection Act Policies, Guidance, and Regulations, https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-protection-act-policies-guidance-and-regulations.

2. DESCRIPTION OF THE PROJECT

Geotechnical borings (2021 through 2023) throughout the BCIB alignment determined that much of the alignment underlain material contains rock or hard conglomerates that allows for a variety of pier construction options. Many construction methods are not considered to cause high degree of underwater disturbance, however pile driving has the potential to greatly affect marine life, resulting in a range from disturbance, to hearing loss and even fatality. The geologist recommendations reveal that the foundations for at least 20 and up to 101 piers of the 312 piers needed in the Manila Bay will need to be installed via pile driving methods.

The other piers will utilize spread piles or bored piles neither of which generate noise concerns. The driven piles will include 1,154 2.8m diameter piles and 1096 3m diameter. The construction is defined in packages as shown in Exhibit 3. The 2.8m diameter piles indicated in Package 5 on the high-level approaches (HLA) either side of the North Channel Bridge are currently planned to be bored steel piles, however, these could be later decided to be impact driven. The 2.8m diameter piles supporting the caissons for the North Channel Bridge (Exhibit 2) will be driven as shown. The South Channel Bridge will be supported by caissons which are in turn supported by piers consisting of multiple driven 2.8m diameter piles. The high-level approaches to the South Channel Bridge, Package 6 (HLA) are currently planned to be bored, however, could also be impact driven.



Construction Package	Works	Approximate length of works (km)
Package 1	Land approach, including interchange (Bataan)	5.0
Package 2	Land approach, including interchange (Cavite)	1.3
Package 3	Marine viaduct (North)	8.0
Package 4	Marine viaduct (South)	12.6
Package 5	North Channel Bridge and approaches	2.1
Package 6	South Channel Bridge and approaches	3.1

Exhibit 3 Planned Construction Packages

It is planned that pier construction will consist of driving 2 piles in a 24-hour period per pier with up to 4 piers being at a time. For this analysis, the distance between pile driving simultaneous driving at two piers will be either 2,000m or 4,000m. The plan for pile driving simultaneous driving at two piers will be either 2,000m or 4,000m. The plan for pile driving operations is shown in Exhibit 4 for 2025 and 2026 and for 2027 and 2028 in Exhibit 5. The orange bars in the chart denote when 2 piles are being driven in separate piers at the same time in the same package. The construction planning anticipates that installing a single pile to take up to a maximum of 7,000 pile strikes in a 24-hour period with 2 piles completed within 14,000 strikes per pier. The other piles for the BCIB will be installed by other, quieter means including boring or drilling or for some piers, the pier column will rely on spread-footing foundations.

		2025												2026											
Bridge Segment	**Packages**	Jan	Feb	Mar	Apr	Ma	Jun	Jul	Aug	Sep	Oct	No	Dec	Jan	Feb	Mar	Apr	Ma	Jun	Jul	Aug	Sep	Oct	No	Dec
North Viaduct	P3N																								
North Viaduct	P3N																								
North Channel Bridge (North HLA)	P5 (HLA)																								
North Channel Bridge (North HLA)	P5 (HLA)																								
North Channel Bridge (North HLA)	P5 (HLA)																								
North Channel Bridge (Caisson)	P5 (CSB)																								
North Channel Bridge (Caisson)	P5 (CSB)																								
North Channel Bridge (Caisson)	P5 (CSB)																								
Central Marine Viaduct	P3S																								
Central Marine Viaduct	P3S																								
South Channel Bridge (HLA)	P6 (HLA)																								
South Channel Bridge (HLA)	P6 (HLA)																								
South Channel Bridge (HLA)	P6 (HLA)																								
South Channel Bridge (CSB)	P6 (CSB)																								
South Channel Bridge (CSB)	P6 (CSB)																								
South Marine Viaduct	P4																								
South Marine Viaduct	P4																								
South Marine Viaduct	P4																								
South Marine Viaduct	P4																								
South Marine Viaduct (Nearshore Navigation Bridge)	P4 - (T4)																								
Pile Driving Fronts			3	3	3	3	4	2	2	2	1	1	4	4	3	3	3	3	3	4	4	4	4	4	4

*Yellow: Piers w/ Driven piles shown in the Updated PED plans dated December 30th, 2022
*Blue: Piers where Driven or Bored Piles are both feasible shown in table received from Jacob Chacko on January 30th, 2023
*Purple: Piers w/ Driven Piles shown in table received from Jacob Chacko on January 30th, 2023

Exhibit 4 Pile Driving for 2025 and 2026

		2027												2028							
Bridge Segment	**Packages**	Jan	Feb	Mar	Apr	Ma	Jun	Jul	Aug	Sep	Oct	No	Dec	Jan	Feb	Mar	Apr	Ma	Jun	Jul	Aug
North Viaduct	P3N																				
North Viaduct	P3N																				
North Channel Bridge (North HLA)	P5 (HLA)																				
North Channel Bridge (North HLA)	P5 (HLA)																				
North Channel Bridge (North HLA)	P5 (HLA)																				
North Channel Bridge (Caisson)	P5 (CSB)																				
North Channel Bridge (Caisson)	P5 (CSB)																				
North Channel Bridge (Caisson)	P5 (CSB)																				
Central Marine Viaduct	P3S																				
Central Marine Viaduct	P3S																				
South Channel Bridge (HLA)	P6 (HLA)																				
South Channel Bridge (HLA)	P6 (HLA)																				
South Channel Bridge (HLA)	P6 (HLA)																				
South Channel Bridge (CSB)	P6 (CSB)																				
South Channel Bridge (CSB)	P6 (CSB)																				
South Marine Viaduct	P4																				
South Marine Viaduct	P4																				
South Marine Viaduct	P4																				
South Marine Viaduct	P4																				
South Marine Viaduct (Nearshore Navigation Bridge)	P4 - (T4)																				
Pile Driving Fronts		4	4	4	3	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1

*Yellow: Piers w/ Driven piles shown in the Updated PED plans dated December 30th, 2022
*Blue: Piers where Driven or Bored Piles are both feasible shown in table received from Jacob Chacko on January 30th, 2023
*Purple: Piers w/ Driven Piles shown in table received from Jacob Chacko on January 30th, 2023

Exhibit 5 Pile Driving for 2027 and 2028

As shown in Exhibits 4 and 5, pile driving activities will endure as much as 42-months. Under the most intense period of pier foundation installation, there may be as many as 4 pile driving machines spread over the BCIB alignment for up to 1 year. Pile driving activities are assumed to be operating 24 hours per day. Due to some variabilities in the geotechnical results, some piles may be able to be bored or augured, however, a total of at least 1,460 and up to 2,288 piles are planned to be driven with hammers that create underwater acoustic impacts.

3. UNDERWATER SOUNDS FROM PILE INSTALLATION

3.1 Fundamentals of Underwater Noise

When a pile driving hammer strikes or excites a pile, a pulse is created that propagates through the pile and radiates sound into the water, the ground, and the air. The pulse amplitude and propagation are dependent on a variety of factors, including but not limited to pile size, hammer type, sediment composition, water depth, and water properties (conductivity, temperature, and pressure). Generally, the majority of the acoustic energy is confined to frequencies below 2 kilohertz (kHz) and there is little energy above 20 kHz.

Sound pressure pulse as a function of time is referred to as the waveform. In terms of acoustics, these sounds are described by the peak pressure in Pascals (Pa), the root-mean-square pressure (RMS), and the Poun. The peak pressure is the highest absolute value of the measured waveform and can be a negative or positive pressure peak. For pile driving pulses, RMS level is determined by analyzing the waveform and computing the average of the squared pressures over the time that comprises that portion of the waveform containing the sound energy.[2] The pulse RMS has been approximated in the field for pile driving sounds by measuring the signal with a precision sound level meter set to the “impulse” RMS setting and is typically used to assess impacts to marine mammals. In this report, peak pressures levels are expressed in decibels re 1 µPa. The total sound energy in an impulse accumulates over the duration of that pulse. Exhibit 6 includes the definitions of terms commonly used to describe underwater sounds.

Exhibit 7 illustrates the acoustical characteristics of an underwater pile driving pulse. The variation of instantaneous pressure over the duration of a sound event is referred to as the waveform. The waveform can provide an indication of rise time or how fast pressure fluctuates with time; however, rise time differences are not clearly apparent for pile driving sounds due to the numerous rapid fluctuations that are characteristic to this type of impulse. A plot showing the accumulation of sound energy over the duration of the pulse (or at least the portion where much of the energy accumulates) illustrates the differences in source strength and rise time.

[2] Richardson, Greene, Malone & Thomson, *Marine Mammals and Noise*, Academic Press, 1995, and Greene, personal communication.

Exhibit 6 Definitions of Underwater Acoustical Terms

Term	*Definitions*
Peak Sound Pressure Level, (dB re 1 µPa)	Peak sound pressure level based on the largest absolute value of the instantaneous sound pressure. This pressure is expressed in this report as a decibel (referenced to a pressure of 1 µPa) but can also be expressed in units of pressure, such as µPa or PSI.
Root-Mean-Square Sound Pressure Level (SPL), (dB re 1 µPa)	The average of the squared pressures over the time that comprise that portion of the waveform containing 90 percent of the sound energy for one pile driving impulse.
Sound Exposure Level, (dB re 1 μPa^2 sec)	Proportionally equivalent to the time integral of the pressure squared and is described in this report in terms of dB re 1 µPa2 sec over the duration of the impulse. Similar to the unweighted Sound Exposure Level (SEL) standardized in airborne acoustics to study noise from single events.
SEL_{cum}, or Cumulative SEL (dB re 1 μPa^2 sec)	Measure of the total energy received through an acoustical event such as a pile-installation event or multiple pile installation events (here defined as pile installation that occurs within a day).
Waveforms, µPa over time	A graphical plot illustrating the time history of positive and negative sound pressure of individual pile strikes shown as a plot of µPa over time (i.e., seconds).
Frequency Spectra, dB over frequency range	A graphical plot illustrating the distribution of sound pressure vs. frequency for a waveform, dimension in rms pressure and defined frequency bandwidth.
PTS	A noise induced shift in the threshold of hearing that persists after a recovery period subsequent to the exposure. In this assessment, PTS is assumed to be the onset of a noise induced permanent threshold shift that causes a PTS, or NIPTS.
TTS	A noise induced shift in the threshold of hearing that subsides to normal hearing after a recovery period subsequent to the exposure.

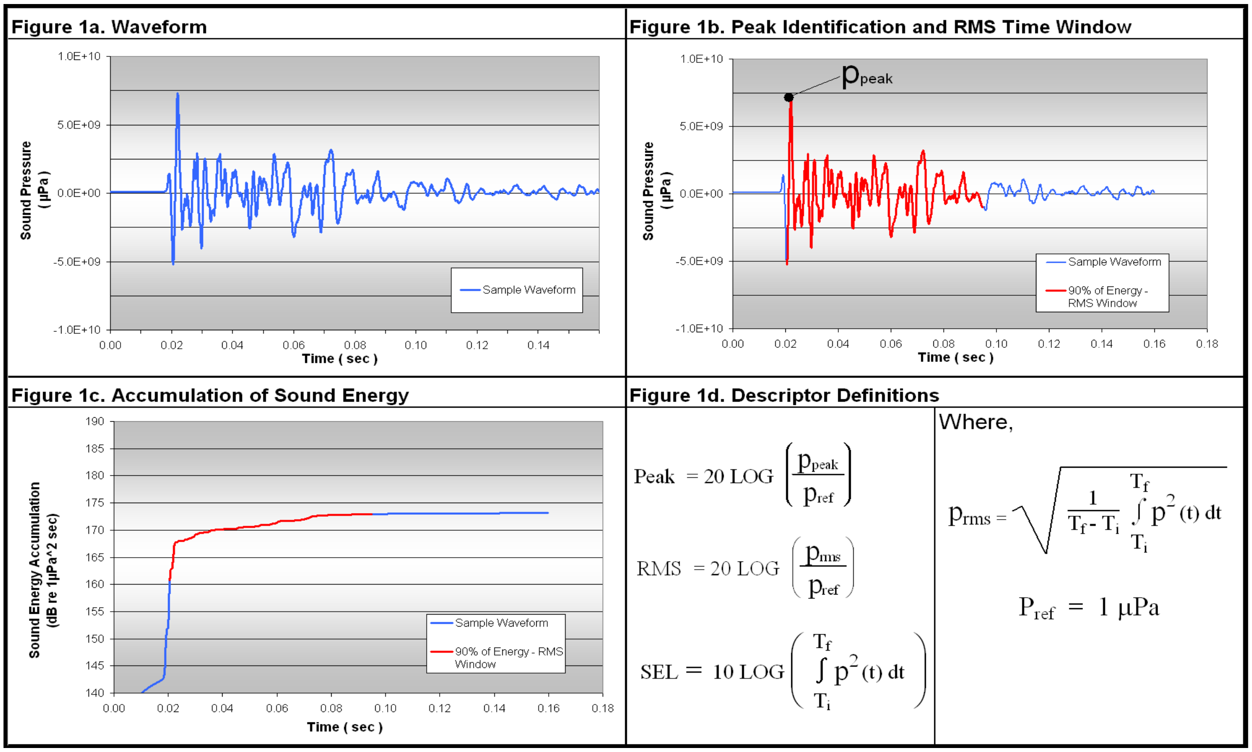


Exhibit 7 Acoustical Characteristics of an Underwater Pile Driving Pulse

SEL is an acoustic metric that provides an indication of the amount of acoustical energy contained in a sound event. For pile driving, the typical event can be one pile driving pulse or many pulses such as pile driving for one pile or for one day of pile driving. Typically, SEL is measured for a single strike and a cumulative condition. The cumulative SEL associated with the driving of a pile can be estimated using the single strike SEL value and the number of pile strikes through the following equation:

$$SEL_{CUMULATIVE} = SEL_{SINGLE\ STRIKE} + 10 \log (\#\ of\ pile\ strikes)$$

For example, if a single strike SEL for a pile is 165 dB and it takes 1000 strikes to drive the pile, the cumulative SEL is 195 dBA (165 dB + 30 dB = 195 dB), where 10 * Log10(1000) = 30.

3.2 Underwater Noise Mitigation Measures

There are several alternatives to mitigate the generation of underwater noise generated by impact driving of piles. These are enumerated in the updated (2020) version of the Technical Guidance for the assessment of Hydroacoustic Effects of Pile Driving published by the California Department of Transportation (Caltrans)[3]. These include air bubble curtains, cofferdams, isolation casings, and use of smaller piles, if feasible. More recent methods employ acoustic resonators to absorb the radiated sound close to the pile. Each of these have issues in regard to effectiveness, cost to deploy, and complexity, however, the use of bubble curtains is generally the most often deployed due to its simplicity. Exhibit 8 provides a conceptual drawing of a bubble curtain.

[3] Technical Guidance for the Assessment of Hydroacoustic Effects of Pile Driving on Fish, Division of Environmental Analysis California Department of Transportation 1120 N Street, MS-27 Sacramento CA 95814 www.dot.ca.gov/hq/env/, October 2020

Essentially air is supplied to perforated ring(s) surrounding the pile providing a “curtain” of bubbles as illustrated in the left side of the figure. Each ring is fed by a compressor(s). The bubbles provide an impedance mismatch with the water which acts like a cushion to reduce the sound being radiated by the pile. Multiple rings may be necessary in deep water to assure complete coverage of the pile.

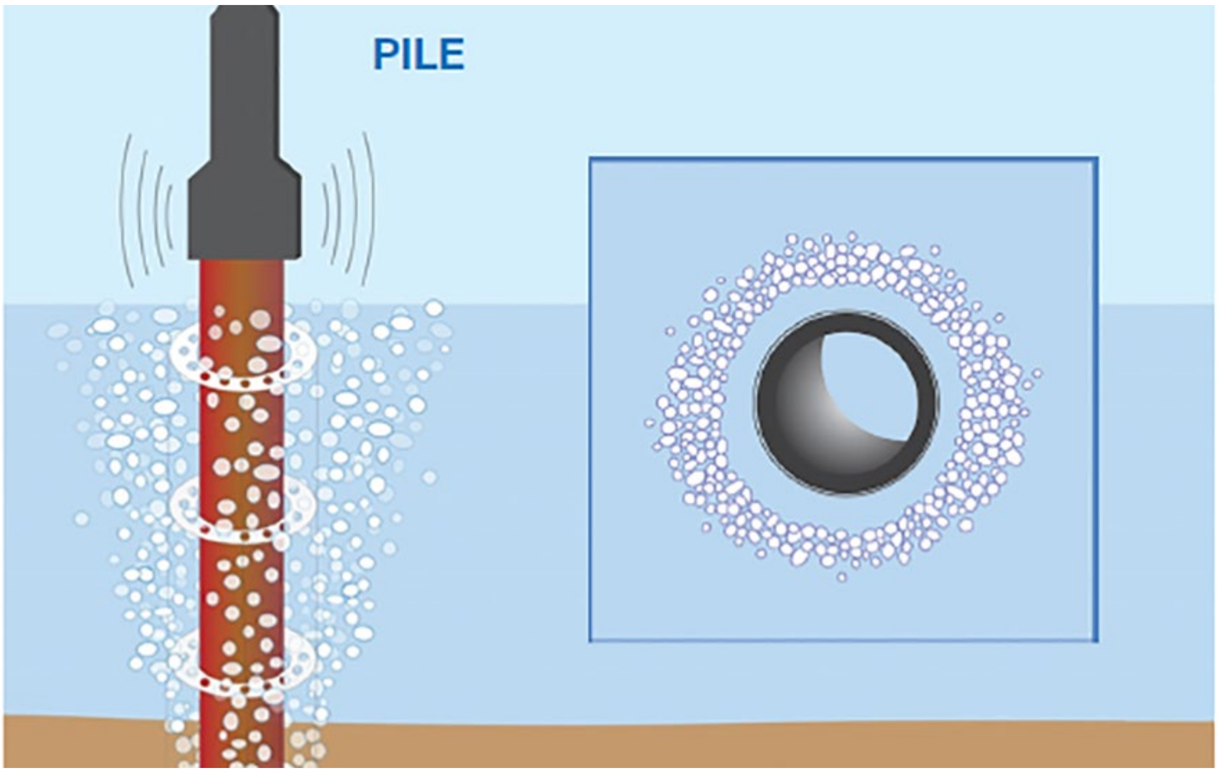


Exhibit 8 Bubble Curtain Concept for Reducing Pile Driving Noise

Additional measures can also be used such as shutting down the pile driving once a criteria noise level is reached in a 24-hour period or when marine mammals are spotted in the vicinity of the pile driving by spotters continually observing the entire Level A zone. For the BCIB, the zones will be large and may require many resources in terms of personnel and boats. Mitigation can also be provided by providing the greatest separation distance between piers where impact driving is occurring.

3.3 Underwater Sound Thresholds – Marine Mammals

Under the MMPA, the National Marine Fisheries Service (NMFS) has defined levels of harassment for marine mammals. Level A harassment is defined as “Any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild.” Level B harassment is defined as “Any act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to migration, breathing, nursing, breeding, feeding or sheltering.

Current NMFS guidance[4] categorizes marine mammals into five hearing groups, low-frequency cetaceans, mid-frequency cetaceans, high-frequency cetaceans, Phocids, and Otariids as shown in Exhibit 9 along with their hearing ranges. Of these, only the low-, mid-, and high-frequency cetaceans are found in the BCIB project area. The sound thresholds for Level A and Level B harassment for these species are shown in Exhibit 10. Injury harassment (Level A) takes into consideration the onset of auditory injury thresholds as defined by permanent threshold shifts (PTS). Level A thresholds are distinct for each hearing group, based on the frequency-weighted hearing sensitivity of the associated species. Exposure to impulse sounds includes the evaluation of the Peak and SEL_{cum} as a dual criterion.

Exhibit 9 Definition of Marine Mammal Hearing Groups

Marine Mammal Functional Hearing Group	Functional Hearing Range[1]
LFC - Low-frequency cetaceans – humpback and minke whales*	7 Hz to 35 kHz
MFC - Mid frequency cetaceans – killer whales	150 Hz to 160 kHz
HFC - High frequency cetaceans – hourglass dolphins	275 Hz to 160 kHz
PP - Phocid pinnipeds - Crabeater, Southern Elephant, Leopard and Weddell seals*	50 Hz to 86 kHz
OP – Antarctic fur seals*	60 Hz to 39 kHz

Exhibit 10 Underwater Acoustic Thresholds used for Marine Mammals in the BCIB Vicinity

Species Hearing Group	Level A Dual Criteria		Level B dB (RMS)
	(dB Peak SPL)	(dB SEL_{cum})	
Low-Frequency Cetaceans (e.g., humpback whales)*	219	183	160
Mid-Frequency Cetaceans (e.g., killer whales)*	230	185	
High-Frequency Cetaceans (e.g., hourglass dolphins)	202	155	

Behavioral harassment (Level B) is considered to have occurred when marine mammals are exposed to sounds of 160 dB RMS or greater for impulse sounds (e.g., impact pile driving) and 120 dB RMS or greater for continuous sounds (e.g., vibratory pile driving). It should be noted that the Level B criteria impact pile driving apply only to one pile strike and does not accumulate as SEL_{cum} does. Further, it is not additive when multiple impact pile driving is occurring.

[4] NMFS. 2018 *2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts*. April.

3.4 Underwater Sound Thresholds – Fish

NOAA currently has no general policy on underwater noise limits for fish. Interim criteria were developed in 2008 by a Federal Highway Working Group (FHWG) to address the needs in assessing the noise impact on endangered fishes on the West Coast of the United States where endangered species were present. The FHWG consisted of representatives from the state Departments of Transportation (California, Oregon, and Washington), Federal Agencies, and technical experts. The criteria have been applied to all pile driving projects on the west coast including those in Alaska ever since. Revised sound exposure guidelines for fishes were developed in 2014 under the American National Standards Institute (ANSI) to update those developed in 2008 as Interim Criteria. Based on more recent research, the older criteria were found to be excessively conservative[5]. The FHWG criteria were based only on fish weight while the 2014 guidance is grouped by anatomical characteristics which is thought to be more generally applicable to the variety of fishes that would be in the Manila Bay. The 2014 sound exposure guidelines for mortality, recoverable injury, and temporary threshold shift are shown in Exhibit 11.

Exhibit 11 2014 Sound Exposure Guidelines for Fishes exposed to impact pile driving developed under the American National Standards Institute (objective criteria only)

Fish Hearing Type	Mortality or Potential Mortal Injury	Recoverable Injury	Temporary Threshold Shift
No swim bladder (detects particle motion); e.g., flatfishes, eulachon	>219 dB SEL_{cum} or >213 dB peak	>216 dB SEL_{cum} or >213 dB peak	>>186 dB SEL_{cum}
Swim bladder not involved in hearing (detects particle motion); e.g., Pacific salmon	210 dB SEL_{cum} or >207 dB peak	203 dB SEL_{cum} or >207 dB peak	>>186 dB SEL_{cum}
Swim bladder involved in hearing (primarily detects pressure); e.g., walleye pollock and cod	207 dB SEL_{cum} or >207 dB peak	203 dB SEL_{cum} or >207 dB peak	>>186 dB SEL_{cum}
Eggs and larvae	>210 dB SEL_{cum} or >207 dB peak		
Source: American National Standards Institute (ANSI) 2014.			

[5] Port of Alaska Modernization Program Essential Fish Habitat Technical Report – Cargo Terminals Replacement Project, Attachment 2 Essential Fish Habitat (EFH) Technical Report, prepared for the Municipality of Anchorage/Port of Alaska, CH2M Hill, Inc., February 2023. Available from the National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Washington, DC.

3.5 Underwater Sound Thresholds – Sea Turtles

Recently, there has been increasing concerns about underwater noise impacts on sea turtles. NMFS and the U.S. Navy[6] have developed criteria relative to impact pile driving that need to be considered for the Manila Bay and the BCIB. NMFS has developed user guidance spreadsheet which incorporates these criteria in 2022 version of the marine mammal sheet. The guidance addresses the onset of permanent hearing loss and behavior effects. For the onset of PTS, it provides peak sound pressure and SEL_{cum} of 232 dB and 204 dB. It also provides a behavior threshold in RMS sound level of 175 dB. These criteria apply to unweighted sound pressure levels.

4. PREDICTION OF UNDERWATER SOUND LEVELS

4.1 Relevant Data

The prediction of sound levels from pile installation for this project relies on empirical data collected from other sites with similar conditions and pile sizes. Unfortunately, there is only limited data on large diameter piles similar to those planned for BICB. The most relevant is from the hydroacoustic monitoring report done for the Port of Alaska Modernization Program from 2021.[7] This monitoring included impact driven steel piles 3.66m (144 inches) in diameter. Using this data along with that from the Caltrans Compendium of Pile Driving Sound Data[8], estimated single strike SEL and other metrics could be developed for unattenuated levels. This analysis indicated that single strike SEL values for the 3m diameter piles would be 2 dB lower than the 3.66 m piles and 3 dB lower for the 2.8m piles as shown in Exhibit 12. For estimating bubble curtain attenuated levels, the results of the impact pile driving from the Port of Alaska were used for the 3.66m piles adjusted for the 2.8 and 3m diameter piles to be used in the BICB project. The single strike source level (SSL) for a pile with a bubble curtain in the Port of Alaska project was 193 dB. This yields SSLs of 191 dB for the 3m diameter piles and 190 dB for the 2.8m piles. The other parameter necessary to estimate the SELs at distance is the rate at which the levels reduce with distance or transmission loss (TL). For modeling the SEL at distances beyond the 10m distance, the TL from the Port of Alaska of 18.3 dB per doubling of distances was used. The TL result of the Port of Alaska monitoring is shown graphically in Exhibit 13. For the BICB, the equation for the average level versus distance is:

$$y = -18.3 \log (x) + 208.56$$

[6] Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III), Technical Report, June 2017

[7] Port of Alaska Modernization Program Petroleum and Cement Terminal Phase 2 Hydroacoustic Monitoring Report, prepared for the Port of Alaska by James Reyff, Illingworth & Rodkin, Inc., published by CH2M Hill, Inc. Anchorage, Alaska, August 2021.

[8] Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish, California Department of Transportation, Report CTHWANP-RT-15-306.01.01, November 2015

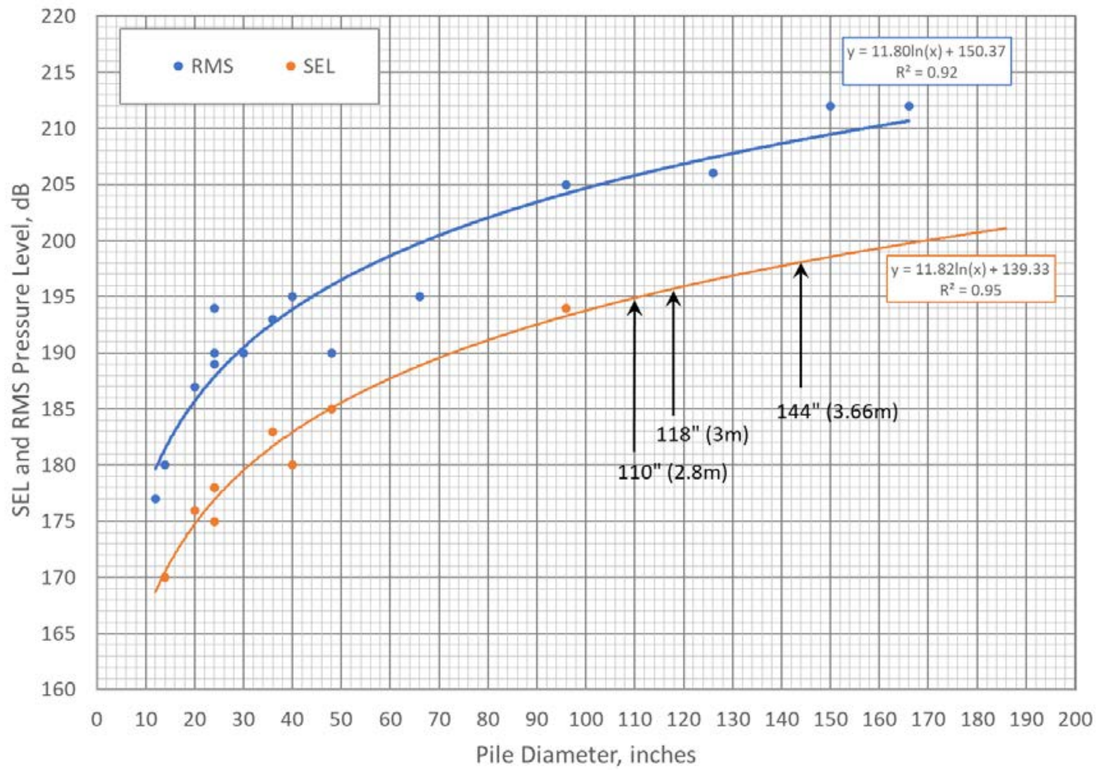


Exhibit 12 SEL and RMS Sound Levels as a Function of Pile Diameter Based on the Caltrans Compendium of Pile Driving Sound Data

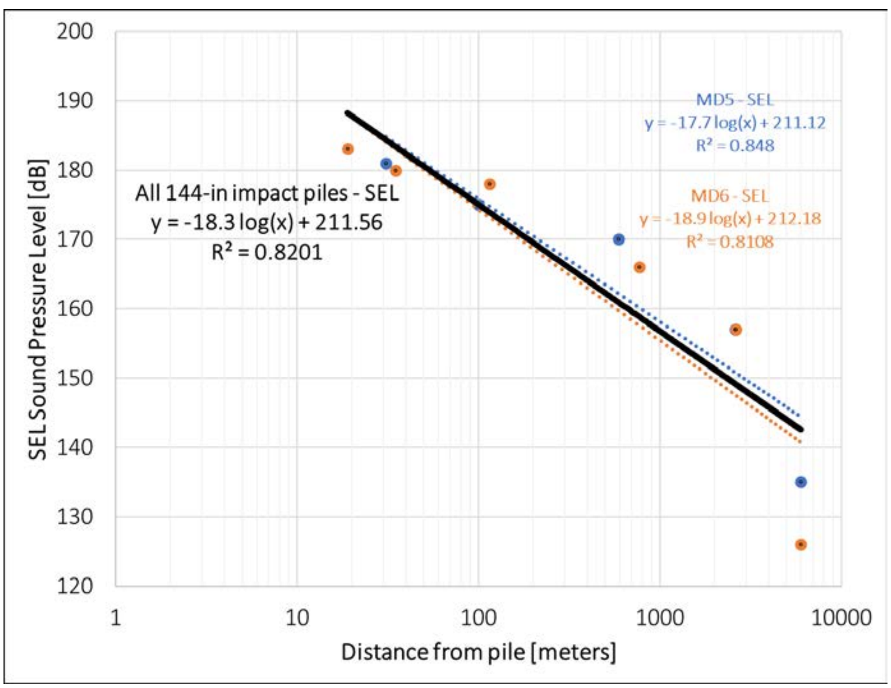


Exhibit 13 Single strike SEL vs. Distance from Port of Alaska Monitoring

4.2 Predicted Impacts to Marine Mammals

The simplest case to consider is that of impact pile driving at one pier only. For this case, the piles are assumed to be close enough to each other in the pier that the small separation between them is insignificant compared to the distances at which the thresholds are not exceeded. The construction planning is that it will take up to 7,000 strikes to set each pile or a total of 14,000 strikes at one pier in a 24-hour period. An example of calculated cumulative SELcum as function of distance is shown in Exhibit 14 for 14,000 strikes occurring at a single pier for the LF weighted marine mammal species. In this case, the distance to the threshold is reduced from 14km to 4km with the bubble curtain and the zone in which permanent hearing threshold shift (Level A criterion) is expected to occur is reduced from 645 sq km to 50.

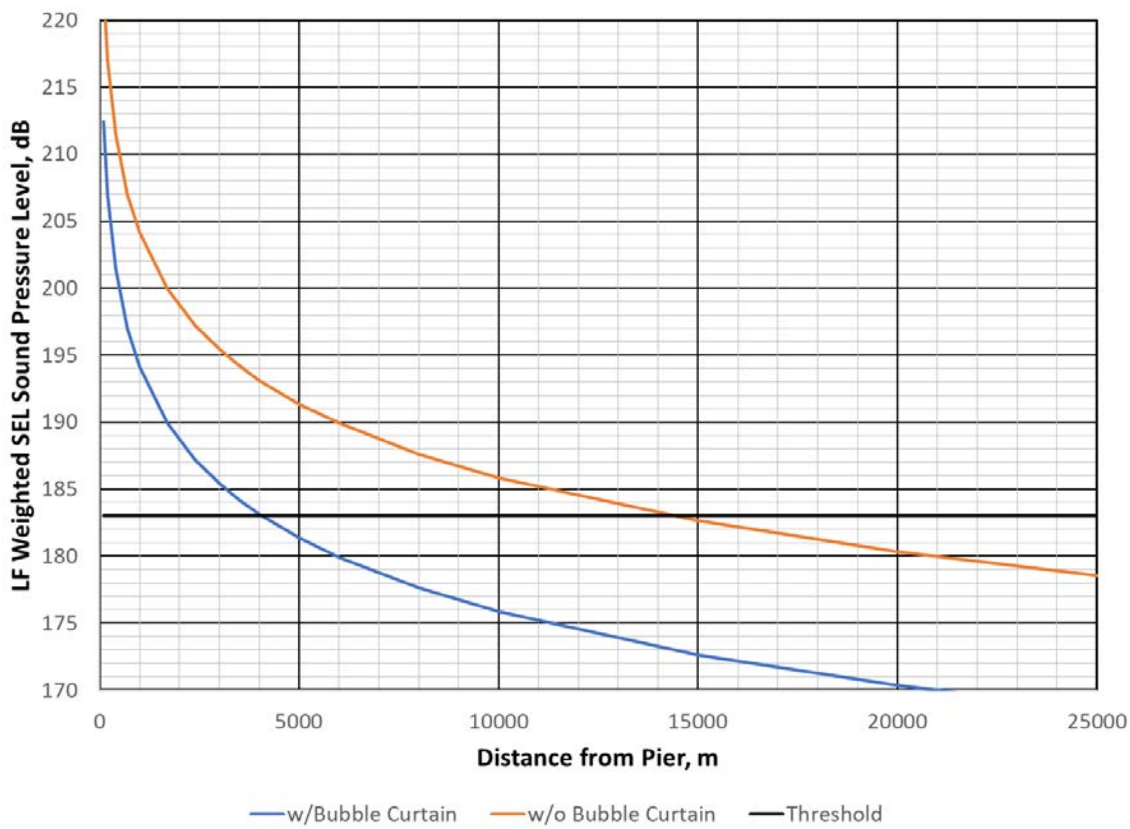


Exhibit 14 Calculated SELcum vs. LF Weighted Distance for a Single Pier (2 piles) with the Threshold Distance for the Level A Criterion

For the purposes of this assessment, the primary concern is the Level A criteria as it applies to the five marine mammal categories. The distance to the Level A and Level B criteria for the single pier case is provided in Exhibit 15 for all of the species with and without the use of a bubble curtain.

Exhibit 15 Distance in Meters to Marine Mammal Level A and B Criteria for Driving Two Piles in One for One Pier in 24-Hour Period With and Without Bubble Curtains (BC)

Species	Level A Criteria		Level B Criterion	
	With BC (m)	Without BC (m)	With BC (m)	Without BC (m)
HF	2,225	7,830	3,667	21,464
MF	106	373		
LF	4,071	14,324		

As shown in Exhibit 5 and 6, the number of simultaneous piles driving operations can be as high as four at given times. However, these are all not necessarily in close proximity to each other. These are expected to be separated by 2,000m or 4,000m. From Exhibit 15 with the bubble curtains, overlapping zones for a 2,000m separation would occur for the HF and the LF species. For the 4,000m separation, only the LF species would have some small overlap. For the with-bubble-curtain case with a pier separation of 2,000m, MF would not overlap, and they would be considered as one pier producing the zone as shown in Exhibit 14. For the zones that do overlap, in the area of overlap, the levels will be higher than they would be for than the case presented in Exhibit 14.

For the cases where two piers have two piles being driven with overlapping zones, the sound field becomes more complex. Along the line between the piers, they do not overlap. As the prediction moves toward the centerline between the piers and zones overlap, the presence of the second pier combines with the other increasing the sound level. To understand this effect, the case of LF weighted levels for two piers separated by 2,000m can be considered graphically. Exhibit 15 illustrates the case where the measurement point is on the centerline between the piers and then moves closer to Pier 2.

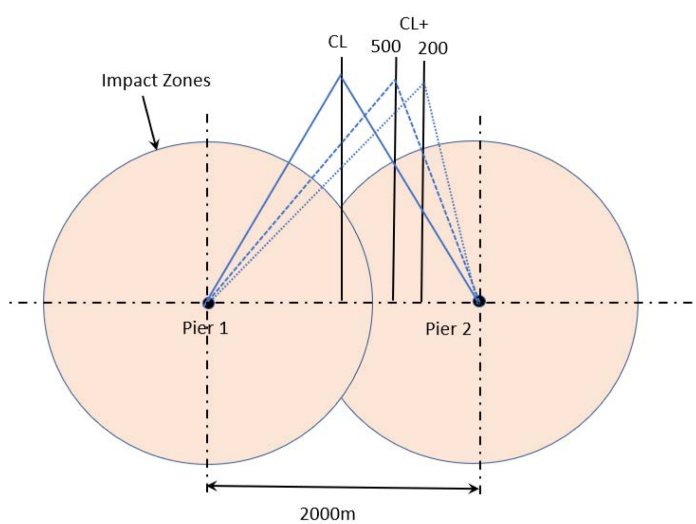


Exhibit 16 Geometry for Analysis of Two Piers Separated by 2000m

The calculated LF SEL is shown in Exhibit 16 for the CL measurement line. Since the levels from both piers are identical, the individual pier levels from P1 and P2 are identical in the plot and the total is consistently 3 dB greater than the individual piers. The falloff in level, however, does not follow the shape of a logarithmic curve (indicated by the dashed line) as would occur for a single pier. Moving further to the right in Exhibit 15 where the measurement line is offset from the centerline by 500m producing LF SEL shown in Exhibit 17. In this case, closer to the piers, the levels are separated and then begin to merge as separation between the piers becomes insignificant compared to the distance from the piers' centerline. The total of the piers also becomes about 3 dB greater than the individual piers. The falloff rate for the farther Pier 1(P1) does not follow a typical logarithmic rate. The same trends from Exhibit 17 are also seen in Exhibit 18 when the measurement line is offset from the centerline by 200m. It should be noted that the lines for the total SEL in all three Exhibits cross the threshold line slightly below 6000m.

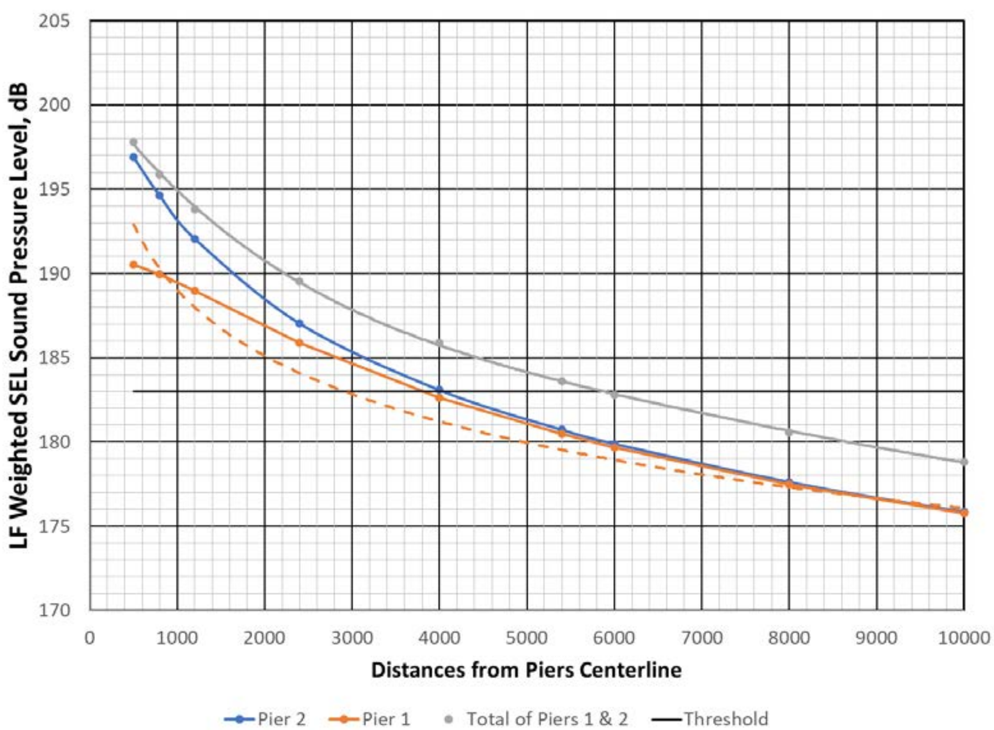


Exhibit 17 SEL Versus Distance From the Two Piers Separated by 2,000m Along a Line Offset 500m From the Centerline Between the Piers

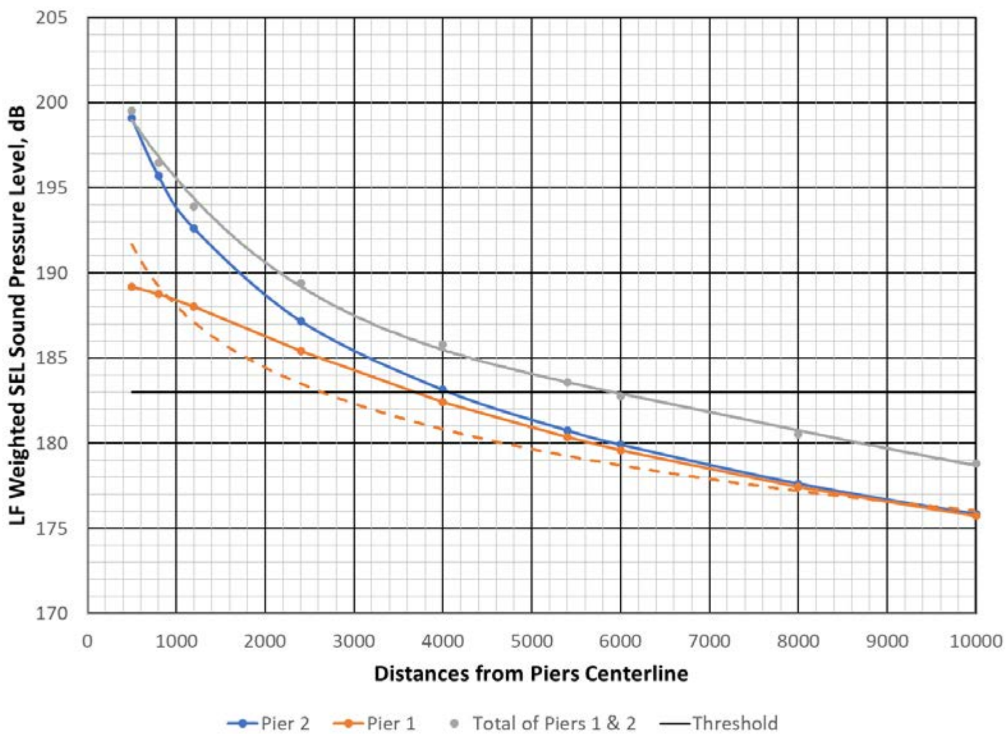


Exhibit 18 SEL versus Distance From the Two Piers Along a Line Offset 200m From the Centerline Between the Piers

The distances to marine mammal thresholds for all three species were calculated for the piers separated by 2,000m along the offset lines shown in Exhibits 16-18. These are presented in Exhibit 19. In Exhibit 20, the distances for the piers are separated by 4,000m.

Exhibit 19 Distance in Meters to Marine Mammal Level A Criteria for Pile Driving at Two Piers Separated by 2,000m in a 24-hour Period with Bubble Curtains

Offset from Center line	Level A Injury Zone (m)		
	HF	MF	LF
0m	3,130	0	5,800
500m	3,050	0	5,850
800m	3,070	0	5,895
1000m	3,000	0	5,900

Exhibit 20 Distance in Meters to Marine Mammal Level A Criteria for Pile Driving at Two Piers Separated by 4,000m in a 24-hour Period with Bubble Curtains

Offset from Center line	Level A Injury Zone (m)		
	HF	MF	LF
0m	2,610	0	5,700
1000m	2,650	0	5,500
1500m	2,620	0	5,170
1900m	2,620	0	5,350

The extent of the impact zones was also evaluated along the axis of the two pier configurations (see Exhibit 15) for the 2,000 and 4,000m separations between simultaneous impact pile driving. The extent of the zones in that direction are presented in Exhibit 21.

Exhibit 21 Distance in Meters to Marine Mammal Level A Criteria for Pile Driving at Two Piers Separated by 2,000 and 4,000m in a 24-hour Period with Bubble Curtains

Pier Separation	Level A Injury Zone (m)		
	HF	MF	LF
2000m	2,460	0	4,600
4000m	2,450	0	4,600

From these results, it is seen that the zone at the end of the array does not extend further than those to the sides of the array for all of those cases. Using the results of Exhibits 17 through 19, the area of impact can be determined.

4.3 Predicted Impacts to Fishes

For assessing the potential impact on fishes in the Manila Bay due to the project generated underwater sound, the ANSI criteria presented in Exhibit 10 were used. The results of these calculations with and without a bubble curtain are shown in Exhibit 22 for impact pile driving at two piers separated by 2,000m. For Recoverable Injury with bubble curtains, the zones from the piers would not overlap, however, without bubble curtains the zones would overlap. For Mortality/Mortal Injury, no overlapping of zones would occur for a 2,000m separation between piers.

Exhibit 22 Distance to Thresholds Under 2014 ANSI Guidelines for Fish Exposure to Underwater Sound with and without Bubble Curtains

Fish Hearing Type	Mortality or Potential Mortal Injury (m)		Recoverable Injury (m)		Temporary Threshold Shift (m)	
	With BC	Without BC	With BC	Without BC	With BC	Without BC
No swim bladder	54	191	79	279	3,458	12,171
Swim bladder not involved in hearing	169	594	407	1,433	3,458	12,171
Swim bladder involved in hearing	246	867	407	1,433	3,458	12,171

Fish Hearing Type	Mortality or Potential Mortal Injury (m)		Recoverable Injury (m)		Temporary Threshold Shift (m)	
	With BC	Without BC	With BC	Without BC	With BC	Without BC
Eggs and larvae	169	594				

4.4 Predicted Impacts to Sea Turtles

In Exhibit 23 the unweighted SEL_{cum} levels are plotted for a single pier and two piles being impact driven with and without a bubble curtain along with the 204 dB criterion for Level A. The criteria are also shown. Exceedance of the criteria without a bubble curtain occurs at a distance of 1270m. With a bubble curtain, this distance is reduced to 360m. At this distance, there would be no overlap with other piers.

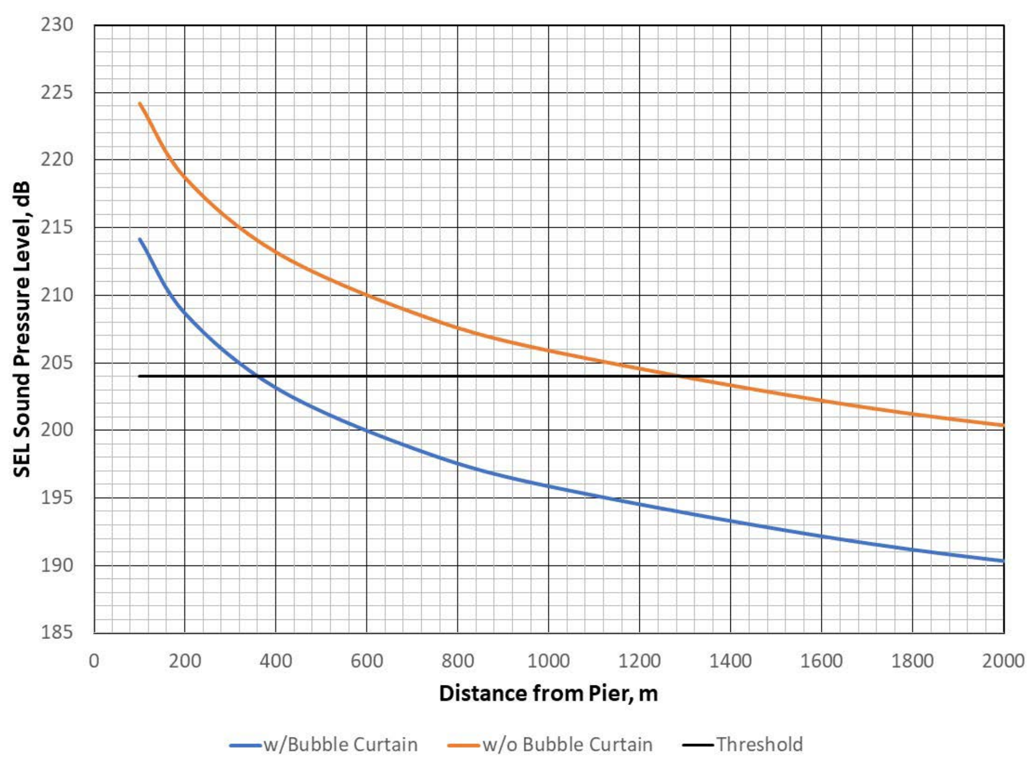


Exhibit 23 Calculated SELcum vs. LF (Sea Turtle Hearing) Weighted Distance for a Single Pier (2 Piles) with the Threshold Distance for the Level A Threshold Level

5. RECOMMENDATIONS

The overriding recommendation of this report is that noise mitigation measures be implemented to reduce the size of the impact zones. Of the possible mitigation measures, the use of bubble curtains is recommended. As the analysis provided in this document is based primarily on the results of previous pile driving measurements and results, to fully develop a noise assessment of the BCIB project, it is recommended that a Test Pile Program (TPP) be conducted prior to embarking on the full construction project. The purpose of the TPP would be to collect site-specific information on noise reduction of impact pile driving noise as a function of distance (falloff rate) which is crucial to determining the actual size of the noise impact zones. It would also provide actual source levels for the piles which is also needed to determine the size of the zones. Additionally, it would be used to determine the effectiveness of mitigation measures, in particular, bubble curtains. The performance of bubble curtains can then be optimized prior to the actual start of production pile driving. TPPs have often been use in major bridge construction projects.

6. SUMMARY CONCLUSION

Geotechnical borings (2021 through 2023) throughout the BCIB alignment have determined that much of the alignment contains rock or hard conglomerates that allows for a variety of pier construction options. Many of the techniques are not considered to cause high degrees of underwater disturbance, however impact pile driving has the potential to greatly affect marine life, resulting in a range from disturbance, to hearing loss and even fatality. The geologist recommendations reveal that the foundations for at least 20 and up to 101 piers will need to be installed via pile driving methods. The results in a total of at least 1,460 and up to 2,288 piles will be installed via impact pile driving over a 42-month period. Under the most intense period of pier foundation installation, there may be as many as 4 pile driving machines spread over the BCIB alignment for up to 1 year. These are assumed to be operating 24 hours per day.

Impact pile driving during construction of the BCIB would result in the generation of underwater sounds that could affect marine mammals and fishes that may be present in waters at or near the project. The National Oceanic Atmospheric Administration’s National Marine Fisheries Services (NMFS) provides guidance for assessing underwater impacts to marine mammals based on potential for permanent hearing loss (considered Level A harassment) and behavioral responses (considered Level B harassment). For impact pile driving at a single pier including two piles in a twenty-four-hour period, the use of bubble curtains would reduce the radius of the Level A impact zones from over 14,324m to 4,071m for the most sensitive marine mammal species. The Level B impact radius would be reduced from 21,464m to 3,667 with bubble curtains. At times during the construction, it is anticipated that pile driving would occur at two or more piers in the same day. Providing separation between the piers is also a means of mitigation as shown by this assessment.

7. REFERENCES

Caltrans 2015. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish, California Department of Transportation, Report CTHWANP-RT-15-306.01.01, November 2015

Caltrans 2020. Technical Guidance for the Assessment of Hydroacoustic Effects of Pile Driving on Fish, Division of Environmental Analysis California Department of Transportation 1120 N Street, MS-27 Sacramento CA 95814 www.dot.ca.gov/hq/env/, October 2020

Marine Mammal Protection Act Policies, Guidance, and Regulations, https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-protection-act-policies-guidance-and-regulations, Accessed by Paul Donovan April 20, 2023.

NMFS. 2018 *2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts*. April.

Port of Alaska 2021. Port of Alaska Modernization Program Petroleum and Cement Terminal Phase 2 Hydroacoustic Monitoring Report, prepared for the Port of Alaska by James Reyff, Illingworth & Rodkin, Inc., published by CH2M Hill, Inc. Anchorage, Alaska, August 2021.

Port of Alaska 2023. Port of Alaska Modernization Program Essential Fish Habitat Technical Report – Cargo Terminals Replacement Project, Attachment 2 Essential Fish Habitat (EFH) Technical Report, prepared for the Municipality of Anchorage/Port of Alaska, CH2M Hill, Inc., Available from the National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Washington, DC. February 2023.

Richardson, Greene, Malone & Thomson, *Marine Mammals and Noise*, Academic Press, 1995, and Greene, personal communication.

US Navy 2017. Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III), Technical Report, June 2017.

Bataan-Cavite Interlink Bridge Project

Preliminary Biodiversity Action Plan

3 July 2023

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A JOINT VENTURE

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Section 7: TERMS OF REFERENCE, Subsection E. Environment Safeguard Plan, Task 11
TASK 11 – Preparing Environmental Impact Assessment (EIA)/ Environmental Management Plan (EMP) Deliverable: (i) Updated EIA and (ii) Updated Comprehensive EMP

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Abbreviations

ADB	Asian Development Bank
AoA	Area of Analysis
BAP	Biodiversity Action Plan
BCIB	Bataan–Cavite Interlink Bridge Project
BFAR	Bureau of Fisheries and Aquatic Resources
CIMP	Corregidor Islands Marine Park
CSC	Construction Supervision Consultant
DENR	Department of Environment and Natural Resources
DENR-EMB	DENR Environmental Management Bureau
DPWH	Department of Public Works and Highways
DPWH-BMU	DPWH Bridge Management Unit
DPWH-ESSD	DPWH Environmental and Social Safeguards Division
ECC	Environmental Compliance Certificate
EIA	Environmental Impact Assessment
EMA	External Monitoring Agent
EMF	Environmental Monitoring Fund
EMP	Environmental Management Plan
IBAT	Integrated Biodiversity Assessment Tool
IFC	International Finance Corporation
KBA	Key Biodiversity Area
MENRO	Municipal Environment and Natural Resources Office
PS6	IFC Performance Standard 6
SPS	Safeguards Policy Statement

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1 INTRODUCTION

This preliminary Biodiversity Action Plan (BAP) elaborates a set of planning, coordination. and management measures deemed necessary to ensure that the Bataan–Cavite Interlink Bridge (BCIB) project can achieve 'no net loss' and 'net gain' for key biodiversity values identified through ecological baseline studies and a critical habitat assessment. The 'no net loss' and 'net gain' objectives are mandated for projects financed by the Asian Development Bank (ADB), as stipulated in the ADB's Safeguard Policy Statement (SPS), and in Performance Standard 6 (PS6) developed by the International Finance Corporation (IFC), which has become the global standard for assessment and management of biodiversity risks in relation to large donor-financed development projects, and is expected to be applied to ADB projects. The ADB's Environmental Safeguards Good Practice Sourcebook (2012) indicates that for "projects with potentially significant biodiversity impacts and risks (e.g., involving critical habitats), the development of a Biodiversity Action Plan (BAP) or its equivalent may be appropriate."[1] Meanwhile, PS6 states that "a Biodiversity Action Plan (BAP) is required for projects located in critical habitat and is recommended for high-risk projects in natural habitats."[2] A draft critical habitat assessment was prepared for the BCIB project in 2022, and identified biodiversity features that qualify as natural habitat and critical habitat.

It is noted that this preliminary BAP is reflective of the findings of the draft Environmental Impact Assessment (EIA) and draft Critical Habitat Assessment (CHA) at the time of publishing and will not be the final version. BAPs can appropriately be managed as living documents, updated iteratively as additional information (e.g., biodiversity baseline data, stakeholder feedback) becomes available to inform and refine the plan's focus and measures. As indicated in the EIA and referenced in the CHA, biodiversity baseline data gathering begun during the feasibility and detailed design stages will be augmented by further surveys (including longitudinal ones) carried out during the project's pre-construction and construction periods. It is anticipated that additional baseline data may result in updates to the project's residual impact assessment and may expand or subtract from the list of critical habitat trigger features, which in turn will result in an updated version of the BAP. Although change is expected, it is nevertheless useful to advance a preliminary version as a tool for constructive dialogue with stakeholders and create a foundation upon which to build later adaptations.

1.1 Project Overview

The BCIB project will entail construction and operation of a 32-km, four-lane road link across the mouth of Manila Bay, joining the provinces of Bataan and Cavite. The project aims to establish an alternative road transport corridor between Region III (Central Luzon) and Region IV-A (Calabarzon), to help ease traffic congestion in Metro Manila; achieve greater regional economic integration; ease disparities in public service access and economic opportunity that exist between Metro Manila and other parts of Luzon; enable development of ports in southern Bataan to take some of the pressure off the overburdened Port of Manila; and boost nature-based tourism on Bataan's west coast. The project has been proposed by the Department of Public Works and Highways (DPWH), and is being

[1] Asian Development Bank. 2012. Environment Safeguards: A Good Practice Sourcebook - Draft Working Document. December 2012. (p. 49)

[2] International Finance Corporation. 2012. Performance Standard 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources. January 1, 2012.

pursued under the umbrella of the 'Build, Build, Build' economic development program of the Government of the Philippines. The BCIB project is under consideration for financing by the Asian Development Bank, through its Infrastructure Preparation and Implementation Facility (IPIF) for the Philippines.

The BCIB will connect to the Roman Highway in the Municipality of Mariveles, on the southern tip of the Bataan peninsula, and to the Antero Soriano Highway in the Municipality of Naic, in Cavite. The over-water alignment will be 26 km long and will encompass two high cable-stayed bridges over navigation channels that transit the mouth of Manila Bay, as well as a smaller nearshore navigation bridge near the Cavite shore. The longest over-water component of the BCIB, at approximately 23 km, will be a series of marine viaducts, with road decks about 20 m above the water. The viaduct will pass nearby the east coast of Corregidor Island, which sits in the mouth of the bay. The bridges and viaducts will be supported on a combination of pilings and spread-foot foundations placed in the seafloor. Pilings will be installed by impact driving and boring methods, in accordance with seabed composition. It is expected that the project's construction phase will last approximately 5.5 years, with the marine construction works accounting for the vast majority of construction activity.

1.2 Key Biodiversity Values

The spatially-extensive BCIB project infrastructure will traverse a range of terrestrial and marine ecosystems, and some elements of these ecosystems have been determined to qualify as natural habitat in accordance with the habitat classification guidance provided in PS6 and its supporting Guidance Note 6 (GN6).[3] Although the terrestrial and marine ecosystems present in the BCIB project area have experienced considerable disturbance and degradation as a result of human activity, the natural habitat classification is considered to apply to grassland areas along parts of the approach road alignment on the Bataan side, and to all parts of the marine environment along the over-sea alignment. Following the ADB SPS and IFC PS6, project mitigation shall aim to achieve 'no net loss' of biodiversity values in areas classified as natural habitat.

Based on screening using the Integrated Biodiversity Assessment Tool (IBAT),[4] desktop research, field studies and key informant interviews, a total of 37 wildlife species considered endangered (EN) or critically endangered (CR) by the IUCN are believed more likely than not to use habitat within the BCIB project area; 34 of these are marine species.

As per IFC PS6 a net gain is required from biodiversity features that have been found to trigger critical habitat thresholds. At the time of writing, insufficient data was available to define species-level ecologically appropriate areas of analysis (EAAA), and a broader area of analysis (AoA) was adopted as the spatial unit for assessment until additional baseline data becomes available. In the interim a precautionary approach has been taken to the assessment. This is discussed in further detail in the draft CHA.

[3] IFC. 2019. International Finance Corporation's Guidance Note 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources January 1, 2012 (updated June 27, 2019).

[4] (1) IBAT PS6 & ESS6 Report. Generated under licence 4846-21884 from the Integrated Biodiversity Assessment Tool on 13 September 2021 (GMT). www.ibat-alliance.org (Marine screening report); (2) IBAT PS6 & ESS6 Report. Generated under licence 4846-21885 from the Integrated Biodiversity Assessment Tool on 13 September 2021 (GMT). www.ibat-alliance.org (Terrestrial screening report)

In its current form, the Draft CHA did not find that any of the IBAT-identified EN and CR species were present in the AoA in significant enough numbers to meet PS6 thresholds for Criteria 1–3. However, local individuals and populations of many of these EN and CR species can reasonably be considered vulnerable to disturbance or habitat loss as a result of project construction activities.

Notwithstanding the finding that no EN or CR species could be considered to trigger a critical habitat determination, the critical habitat assessment did identify a number of non-EN and non-CR species that may meet thresholds under Criterion 1 and Criterion 3, as well as habitat types and conservation areas that may qualify as critical habitat elements under Criterion 4. One avian species was deemed a likely qualifying species in relation to Criterion 1, Threshold (b), while another six waterbird species were found to be probable qualifying species under Criterion 3, Threshold (a). The potential for each of these seven species to experience significant adverse impacts from the BCIB project's construction or operation was subsequently evaluated (see Exhibit 1); none were found to be likely to experience significant impacts, due either to having a very low probability of actually being present within the project area (five species), or being adaptable habitat generalists with very low dependency on particular natural resources that may be affected by project activities (two species).[5]

The following is a provisional list of the Project's critical habitat qualifying features, although again it is noted these may be updated and/or refined with future iterations of the CHA and BAP as additional baseline data becomes available.

Exhibit 1: Assessment of Potential for BCIB Impacts on Identified Qualifying Species

Qualifying Species	Criterion and Threshold	Probability of Significant Impact	Rationale for Assessment
Anas luzonica Philippine Duck VU	Criterion 1 Threshold (b)	Very low	Known to be present in Naic, but habitat generalist with low expected exposure to project activities
Calidris ruficolllis Red-Necked Stint NT	Criterion 3 Threshold (a)	Very low	Habitat within the project area can be considered marginal at best for the species, and there is no evidence of presence
Calidris subminuta Long-Toed Stint LC	Criterion 3 Threshold (a)	Very low	Habitat within the project area can be considered marginal at best for the species, and there is no evidence of presence
Charadrius alexandrinus Kentish Plover LC	Criterion 3 Threshold (a)	Very low	Habitat within the project area can be considered marginal at best for the species, and there is no evidence of presence
Childonias hybrida Whiskered Tern LC	Criterion 3 Threshold (a)	Very low	Known to be present in Naic, but habitat generalist with a varied diet and low reliance on any particular habitat within the project area
Himantopus himantopus Black-Winged Stilt LC	Criterion 3 Threshold (a)	Very low	Habitat within the project area can be considered marginal at best for the species, and there is no evidence of presence
Pluvialis fulva Pacific Golden Plover LC	Criterion 3 Threshold (a)	Very low	Habitat within the project area can be considered marginal at best for the species, and there is no evidence of presence

[5] The vulnerability of these species to project impacts is discussed in the forthcoming EIA report.

The CHA found that four general habitat types, four specific terrestrial conservation areas, and all marine protected areas present within the AoA (which encompassed all of Manila Bay and selected surrounding land areas) may qualify as critical habitat, on the basis of their meeting the conditions of Criterion 4, Threshold (b) - *Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning*.

Qualifying habitat types within the broad AoA are coral reefs, seagrass, mudflats and mangroves. Coral habitat is confirmed to be present within the BCIB project area, in the nearshore zones along the south coast of Mariveles and around Corregidor Island and will have high exposure to BCIB project impacts. Limited mangrove remnants are found in the estuaries of rivers and creeks in both the Bataan and Cavite portions of the project area, and to a lesser extent along the rocky shore of Mariveles. Some of these scattered mangrove patches will have minor exposure to construction activity. There are no significant mudflats or seagrass beds in the BCIB project area.

In addition to the four critical habitat types mentioned, one terrestrial key biodiversity area (Mariveles Mountains KBA), which qualifies as critical habitat, overlaps with the BCIB project area, and can be considered potentially vulnerable to land use change and enhanced exploitation risk over the long term as a result of the project's development. The other three terrestrial conservation areas were not considered vulnerable to project impacts due to distance. Two marine protected areas are within range of various impacts expected from BCIB construction activity; these are the Corregidor Islands Marine Park (CIMP) and Naic Fish Sanctuary (NFS). These marine conservation areas are both considered qualifying critical habitat elements.

2 GUIDING PRINCIPLES

2.1 Mitigation Hierarchy

The mitigation hierarchy is a fundamental organizing principle in environmental impact assessment, most particularly in relation to the selection and design of measures to manage expected impacts. Outright prevention or avoidance of anticipated impacts is the priority action under the hierarchy, with minimization being the next best option. Only once prevention and minimization have been considered and developed to the maximum extent feasible, and residual impacts are still anticipated despite such effort, should some form of compensation be proposed. The mitigation hierarchy as it applies to biodiversity is illuminated in Exhibit 2.

Many potential biodiversity impacts can be successfully avoided or substantially minimized by measures developed and implemented in the context of a project's Environmental Management Plan (EMP), and this is applicable to the EMP under development for the BCIB project. However, where biodiversity impacts cannot feasibly be avoided or minimized to an extent sufficient to render them insignificant or otherwise palatable to project stakeholders, then compensatory measures such as restoration offsets, protection offsets and other additional conservation actions have to be developed and pursued. Such measures for addressing significant residual biodiversity impacts are appropriately collected and implemented under the auspices of a BAP.

Exhibit 2: Mitigation Hierarchy Applied to Biodiversity Impacts

Avoid	Minimize	Restore	Offset
As a matter of priority, the project proponent should seek to avoid impacts on biodiversity and ecosystem services, through siting adjustments, design adaptations, selection of alternative construction methods and modification of planned project phasing	When total avoidance of significant impacts is not possible, the project proponent should seek to minimize the extent and severity of impacts, through siting adjustments, design adaptations, selection of alternative construction methods and modification of planned project phasing	When minimization measures are not expected to reduce anticipated biodiversity impacts to insignificant levels or at least levels acceptable to project stakeholders, post-impact restoration of biodiversity values and ecosystem services should be implemented by the project proponent	Biodiversity offsets may be proposed by the project proponent only after appropriate avoidance, minimization and restoration measures have been developed and significant residual impacts are still anticipated, or when additional conservation benefits are sought as an enhancement to the project

2.2 Offset Design

The objective of the BAP is to achieve net gains in biodiversity values by compensating for the expected significant residual impacts on existing values, primarily through offsets. Two main types of offset designs are delineated in PS6: restoration offsets and protection offsets.

Restoration offsets. Sites with similar underlying biodiversity characteristics to project-affected sites (e.g., species assemblages, ecosystem types, ecological functions) may often be found in degraded form nearby the project area, and such areas can be legitimate targets for an offset. Implementing durable restoration or ecological enhancement on sites of similar or greater area than the site destroyed or degraded by the project may more than compensate for the loss. In a more extreme approach, entirely new habitat may be created to replace what is to be lost, as is the case with created wetlands and artificial reefs; over time, the biodiversity values in created habitat may exceed those of the original even on an equal-area basis, particularly if the original had suffered heavy pre-project degradation, but reserving a significantly larger area for created habitat is typically appropriate to secure the desired level of offset within a program-relevant timeframe.

Protection offsets. Also called averted loss offsets, protection offsets deliver biodiversity values by securing durable protection for habitat of similar characteristics to the project-affected habitat. This is only applicable in situations in which the target offset site is realistically assessed to be at high or very high risk of being degraded or destroyed as a result of ongoing or imminent processes (e.g., general land use change, change in ownership, public policy shifts, resource concession issuance, resource market developments, etc.). Projection of the biodiversity loss that can be averted by protection of target sites requires thoughtful and rigorous analysis of the relevant threat trends.

Design of both restoration and protection offsets is guided by four principles: proportionality, additionality, equivalence and permanence.

Proportionality. The measures proposed for inclusion in the BAP should reflect the significance—and particularly the scale—of anticipated residual impacts. This is implicit in the notions of 'no net loss' and 'net gain', but it bears emphasizing that it is in the Proponent's interest, and those of at least some other stakeholders, to develop measures commensurate with the expected loss or degradation of biodiversity resources. In the face of poor data availability and predictive uncertainty, it is reasonable to try and err on the side of 'too much' by adding a surplus of management effort.

Additionality. The measures in the BAP are to be understood as incremental action relative to what would be expected to take place in the absence of the plan. Ongoing or planned activities that are not part of the offset should not normally be counted towards net biodiversity gains achieved under the BAP. That said, the probability of pre-existing plans and programs (e.g., a management plan for a protected area) actually coming to fruition on their own should be critically assessed. It may be reasonable for a BAP to count pre-existing plans if support delivered through BAP implementation is realistically the only way the plans' objectives will be fully reached. Indeed, supporting existing programs may sometimes be the most efficient and durable path to successful BAP implementation.

Equivalence. A BAP should aim to conserve the same biodiversity values (e.g., species, habitats, ecosystems or ecological functions) as what are expected to be lost or degraded due to residual project impacts. This is sometimes referred to as the 'like-for-like' principle. In some cases, this may mean that offsets are appropriately developed in locations physically removed from the project area.

Permanence. The biodiversity benefits of a BAP should be set up to last, rather than being left to fate and circumstances as soon as the project's construction winds down, consultants' contracts come to an end, regulators and funding entities lose interest and influence, and control of the project is transferred to an operating entity which may lack the expertise and resources to grapple with biodiversity management. As a general rule, the BAP's term of implementation should be set to match the expected duration of adverse biodiversity impacts from the project; for some impacts, this is likely to equate to the planned operating life of the project, which may be very long in the case of road infrastructure in particular. At least some components of the BAP may need to be conceived as permanent project features, and many or most may appropriately be conceived as parallel long-term initiatives that are linked to but largely independent of the project EMP. In this sense, the BAP can be a useful vehicle for ensuring that biodiversity-related measures that require implementation well into the project's operation phase (and which may or may not be offsets) receive sustained attention.

3 STEPS IN BAP DEVELOPMENT

Development of a BAP should progress through a series of steps, beginning with the first realization that there will be residual impacts to be addressed and ending with adaptive implementation of the plan informed by monitoring. A schematic of expected BAP planning steps is shown in Exhibit 3. It will be noted that this preliminary BAP has, at the time of writing, progressed through the first two steps in plan development, with consultations with experts and stakeholders being the next task in line. In many cases it may be appropriate to advance BAP development through to the end of the third step by the time of loan processing and defer negotiation amongst the concerned stakeholders to the pre-construction period. The fourth to sixth steps are carried forward through the formulation of a supplementary Offset Management Plan, which will complete the BAP by adding agreed-upon details of site-specific activities, roles and responsibilities, timing, costs, and funding mechanisms.

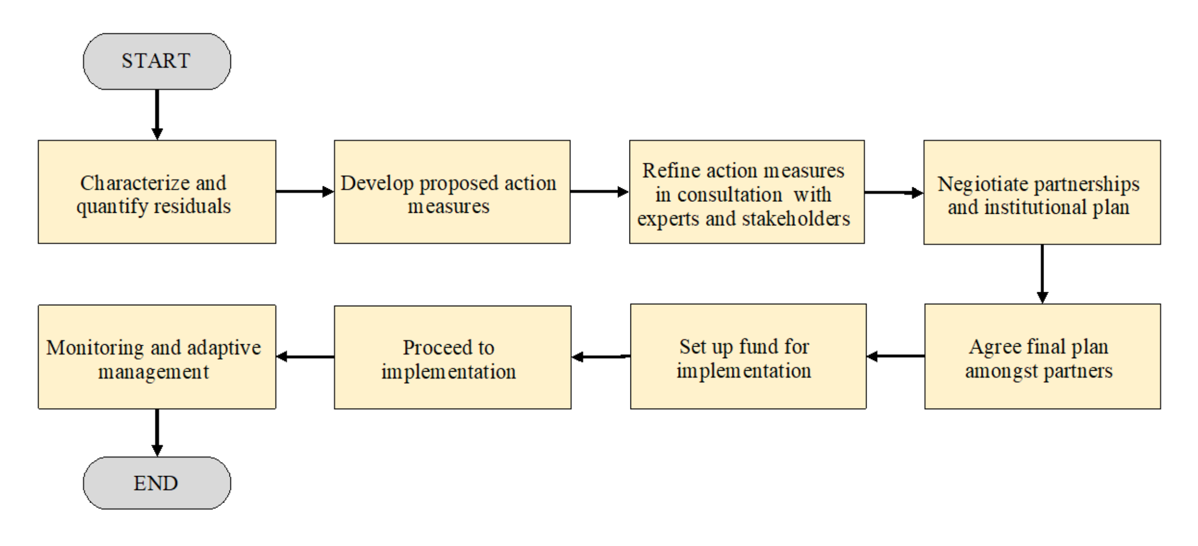

Exhibit 3: Biodiversity Action Plan Development Process

4 ANTICIPATED BIODIVERSITY LOSSES AND PROPOSED OFFSET OBJECTIVES

At the time of writing, precise quantification of some of the BCIB project's key anticipated impacts on biodiversity remains slightly beyond the horizon. It has nevertheless been possible to scope the nature and approximate scale and severity of impacts, and to develop initial proposals for practical action to be included in the BAP. The significant residual impacts on biodiversity that are foreseen as results of the BCIB project, with preliminary insights on quantification where possible, and preliminary action plan concepts, are shown in Exhibit 4.

It is acknowledged that the suitability of proposals floated in Exhibit 4 may change over time as the residual impact assessment is updated in line with additional longitudinal baseline data gathering that is planned during the pre-construction and construction phases of the project. The possible BAP measures listed below are indicative and will be subject to review by suitable experts and discussion with stakeholders as the Project refines a set of appropriate net gain (and no net loss) measures.

Exhibit 4: Preliminary Accounting of Residual Impacts and Possible BAP Measures

	Residual Impact	Preliminary Quantification of Expected Residual Impact	Possible BAP Measures
1	Increased risk of forest/grassland (Natural Habitat) loss from induced development, informal settlement, logging and mining in Mariveles Mountains KBA	Numerous factors contribute to the increased risk profile for forest/grassland areas, making quantification difficult. Based on proximity to road corridors alone, it may be inferred that as much as one quarter of the KBA's total area of 12,156 ha may be at increased risk over the long term due to the establishment of the BCIB, primarily along the southern and eastern flanks of the volcano. This is the most significant terrestrial biodiversity risk associated with the BCIB project.	Given high uncertainty regarding actual future risk to the KBA (i.e., how, where and how quickly exploitation may be manifest), an adaptive management approach that pairs regular monitoring with formulation of proactive land use controls is proposed. A long-term monitoring program could be set up to detect and analyze emerging patterns of change in forest/grassland use in the southern and eastern portions of the KBA, under the control of a multi-stakeholder partnership entity with participation of DPWH, Mariveles LGU, Limay LGU, the Ayta Magbukún indigenous community, DENR-BMB and interested NGOs. Based on information gained from the monitoring program, the same partnership entity could formulate plans to counteract threats through application of various land use controls at their disposal. What forms such protective actions would ultimately take would depend on the nature of identified threats as well as the cooperative synergies of the partner entities, but it is reasonable to speculate that tools including zoning, protective easements, protected area designations, community forestry, enhanced surveillance and law enforcement, and enhanced conservation management would likely be considered, possibly in combination. As the KBA is probable critical habitat, the overarching target of the collaborative scheme would be to achieve a net gain in biodiversity values within the KBA.
2	Direct loss of grassland (Natural Habitat) beneath ROW for approach road in Mariveles	An estimated 12.3 ha of somewhat degraded natural grassland/scrubland falls within the project ROW, primarily in the portion of the approach nearest Manila Bay (11.7 ha), but also around the Roman Highway interchange (0.6 ha).	A Natural Grassland Replacement Plan is be integrated in the project EMP to generate substantial grassland conservation using land along the approach road alignment in Bataan. However, given normally anticipated failures to achieve perfect restoration outcomes within the desired timeframe, as well as probable difficulties in securing adequate land in the immediate vicinity, a conservation offset is proposed for implementation in a suitable area elsewhere to ensure that 'no net loss' can be achieved.
3	Displacement and degradation of benthic habitat in coral habitat (Critical Habitat) areas (Mariveles nearshore and Corregidor Island nearshore)	The project's construction will directly displace or remove benthic life in areas known or predicted to be characterized by coral and coral-associated lifeforms. Permanent displacement losses (defined as the cross-section of piles or foundations installed on the seabed) are considered likely to be canceled out by development of diverse fouling communities on the piles and foundations over time. Losses of benthic life to dredging and placement/removal of rock jetties will not be permanent, but it can be expected that natural recovery would be very slow (on the order of decades), and likely impeded by presence of stressors such as fishing activity. The area of loss can be approximated based	The benthic habitat destruction that will result from dredging for the drydock facility and placement of temporary rock jetties is considered most effectively addressed through an ex-situ biodiversity offset rather than in-situ restoration, due to the existing and expected future circumstances along the Mariveles shore. The area has no statutory protected status, will be subject to continuing fishing pressure, and is considered very likely to suffer further disturbance as a result of future industrial development. An ex-situ offset based on enhanced protection of similar habitat in the nearby CIMP is proposed.

	Residual Impact	Preliminary Quantification of Expected Residual Impact	Possible BAP Measures
		on currently available information regarding the temporary and permanent in-water infrastructure, as follows: • Dredged area for drydock facility: 10.0 ha (tentative) • Area under temporary rock jetties: 3.6 ha (tentative) • Area dredged for spread foot foundations in coral habitat areas: 1.1 ha (tentative) • Total permanent/long-term loss of coral habitat: 14.7 ha In addition to benthic area that is totally removed, significant degradation of benthic life is anticipated in a zone along the alignment in coral habitat areas, where repeated disturbance over a 5 to 6- year period from anchoring, barge spuds, vessel contact, prop wash and thruster surge is to be expected. Such degradation would be expected to take some time to repair itself, a process made slower and less likely by the existence of other degradation factors such as fishing activity. The area within coral habitat that will be subject to non-trivial levels of degradation is estimated at approximately 15 ha in the Mariveles nearshore zone and 42 ha in the Corregidor Island nearshore zone, for a total of 57 ha of coral habitat subject to moderate degradation during construction. Additionally, underwater noise from piling work is likely to damage coral habitat indirectly through mortality of fish and other organisms, as well as habitat avoidance by species that play a role in coral reef maintenance. During operation, the bridge's presence will have permanent effects on benthic life in coral habitat, due to shading by the viaduct decks and effects of artificial light at night (ALAN). Direct light emissions to the water surface are to be minimized through sensitive roadway lighting design, but reflected light is difficult to eliminate, so there will be some residual effect on the ecological integrity of coral habitat areas crossed by the alignment. The significance of shading and ALAN in the BCIB context is impossible to assess with any degree of confidence with the information available (regarding both the infrastructure and the existing benthic ecology), but a modest residual effect is hypothetically assumed.	For destroyed and degraded coral habitat in the Corregidor Island nearshore zone, both habitat restoration and ex-situ protection are proposed. Careful restoration of benthic habitat via installation of reef balls or similar artificial reef materials near the viaduct alignment could significantly speed recovery of damaged areas. Ex-situ protection could offset residuals that would remain even with successful restoration, due to shading and ALAN effects. The proposed approach is to support the management activities already envisioned for the nascent Corregidor Islands Marine Park (CIMP). Ex-situ protection is compatible with the park management plan's objective of enforcing prohibition on fishing and exploitation in almost all of the park's named management zones. Proposed support to the CIMP could include provision of technical expertise, help with capacity-building, financial support and training to establish a competent surveillance and enforcement corps, and coral restoration projects. No part of the CIMP's 508 ha presently enjoys any meaningful marine resource protection, so there is substantial scope for conservation gains. A multiplier of 10 times is probably the minimum appropriate for calculation of new area under protection to achieve net gain in coral conservation values over time, so the CIMP would need to be expanded to at least 715 ha to meet the net gain objective. Eventual expansion of the CIMP to include the sea area encompassing all of the islands in the vicinity of Corregidor has been a component of the park stakeholders' long-term vision (this is why Islands is in the plural in the park's name); expanding to include just Caballo Island along with Corregidor in a contiguous block would reasonably be expected to expand the park to about 2,500 ha, and including La Monja Island (to the west) might easily double that to about 5,000 ha. It is proposed that competent protection over such an area for at least 40–50 years could have a reasonable chance of achieving net gain in biodiversity values relative to pre-project conditions.
4	Impacts on marine turtle use of local beaches for nesting	Impacts on marine turtle use of beaches for nesting will have both permanent and temporary effects. An estimated 400 m^2 of beach area at the Naic landing point will become permanently unviable for nesting due to shading by the overhead viaduct. An estimated 2,000 m^2 of beach area adjacent to the alignment at this location is likely to suffer permanently reduced habitat suitability for nesting due to road noise and light leakage from the overhead viaduct. While it is known that marine turtles use this beach occasionally, there is insufficient data to enable quantification of the significance of the displacement. Underwater noise, especially but not exclusively from pile driving, is very likely to disrupt marine turtle use of local beaches. This is likely to apply not just to beaches near the	A protection offset is proposed to compensate for expected residual effects on marine turtles. This would consist of financial, in-kind and institutional support for substantially expanding and building the long-term institutional capacity of existing turtle hatchery programs run by the MENROs of local municipalities and establishing new programs in municipalities that currently lack one. The muncipalities of Mariveles, Naic, Tanza, Rosario,Ternate and Cavite City are all known to have sandy beaches used by marine turtles for nesting, and all would be targeted for inclusion in the capacity-building program. The offset would not protect habitat, but rather protect nesting turtles and especially hatchlings from known threats, thereby increasing the viability of the subject species in local waters. The program would aim to implement sufficient activities within the

	Residual Impact	Preliminary Quantification of Expected Residual Impact	Possible BAP Measures
		landing points, but to all nesting beaches further into Manila Bay as well, since the turtles have to transit the project area to access them. It is possible that no nesting will occur at all on any of the known nesting beaches inshore of the BCIB alignment, and within several kilometers seaward, for the duration of pile driving works (at least three years). Underwater noise impacts are expected to be partially mitigated by use of noise attenuation at pile driving sites, but mitigation is likely to achieve a 60 % reduction in impact radii, at best. The abundance of turtles nesting on beaches likely to be affected by project-related disturbance is very difficult to quantify based on existing hatchery program data, due to limited and irregular coverage of beaches, and other monitoring is presently non-existent.	construction and pre-construction phases of the project to ensure coverage of all known nesting beaches for the duration of the nesting season each year. It is suggested that sustained hatchling releases from substantially expanded hatchery programs over many years would more than make up for the expected loss of nesting opportunities on local beaches during the BCIB's heavy marine works period, and for the permanent loss and impairment of nesting habitat at the Naic landing point, thus potentially achieving a net gain. *NB: A Marine Turtle Management Plan is proposed for implementation under the project EMP, and it may be possible to subsume all elements of this proposed Action Program under that plan's measures. However, the Action Program may be seen as a better vehicle for the inter-institutional coordination that will be needed, and also provide a means of continuing monitoring well into the project's operation phase, which would allow verification of conservation results. Decisions about priorities and the ultimate shape of marine turtle conservation efforts (i.e., under the EMP, under the BAP, or some combination) are for future discussion with the relevant stakeholders.*
5	Possible impacts on nocturnal volants (avian migrants and bats) from collisions with BCIB tall bridges	Manila Bay is positioned within the East Asian-Australasian Flyway, and the northern and eastern fringes of the bay are known to host globally significant concentrations of waterbirds, numerous passerine species also use the flyway and accordingly transit through the central part of Luzon. Tall infrastructure including suspension bridges and cable-stayed bridges is known to pose significant mortality risks to nocturnal avian migrants, particularly during periods of low visibility due to weather. It is considered possible that placement of two cable-stayed bridges near the mouth of Manila Bay could result in bird deaths, and mitigation is to be pursued through adoption of a programmable lighting scheme thought likely to reduce collision risk. However, avian collision risk is highly context specific, and there are many unknowns in the BCIB situation, including the density and routes of bird movements through the project area, species composition, timing of migration for different species, and prevalence of particular atmospheric conditions. In light of these uncertainties, optimal configuration of lighting-based mitigation is not known, and residual risk cannot be quantified with any confidence. The precautionary approach supports additional action to ensure that residual risk is minimized to the greatest extent possible. Bats are also known to be at risk of mortality from collisions with bridge infrastructure.	Given the high level of uncertainty regarding conditions and residuals, an adaptive management approach is recommended. A bird and bat mortality monitoring program is proposed for the early operation phase of the BCIB bridges, coupled with a systematic program of experimentation to seek optimal programming for the BCIB bridge lighting schemes, based on empirical data. The adaptive management program is proposed as a precautionary measure to address a common but poorly understood impact of tall infrastructure, one that is assuming greater importance as populations of many migrant bird species is in decline. *NB: Both a Bird Management Plan and Bat Management Plan are proposed for implementation under the project EMP, and mitigation collision risk may be a main focus of each. It may be possible to subsume all elements of this proposed Action Program under those management plans, although the BAP mechanism may be better suited for carrying forward monitoring of actual bridge effects well into the operation phase (which is when the impacts will mainly occur). Decisions about priorities and the ultimate shape of efforts to manage nocturnal collision risk and associated monitoring (i.e., under the EMP, under the BAP, or some combination) are for future discussion with the relevant stakeholders.*
6	Injury and disturbance of protected marine mammals	Underwater noise from pile driving operations is expected to be intense over a period of at least three years. Even with mitigation, the piling works can be expected to seriously affect all of the 8–15 cetacean species thought likely to be present in Manila Bay at least	An Underwater Noise Management Plan is proposed under the project EMP, but this will primarily seek to manage construction activity in order to minimize effects on cetaceans, e.g., via longitudinal and real-time acoustic monitoring,

	Residual Impact	Preliminary Quantification of Expected Residual Impact	Possible BAP Measures
		occasionally, with possible effects including injury and eventual death, stress, habitat avoidance, and disruption of communication, feeding and reproduction. As underwater noise is suspected to be a contributing factor in some cetacean groundings, increased groundings within the bay may become more frequent during the piling period. Significant mitigation of underwater noise from piling work is possible with existing technology, and this will be required of contractors, substantial residual effects are expected, even if they can't be quantified due to very low availability of data on abundance, distribution and movements of marine mammals in Manila Bay.	worksite visual monitoring for cetacean presence, imposition of work stoppages and temporal restrictions on piling activity, and enforcement of controls on work vessel operation. A complementary Action Program is proposed under the BAP to offset accumulated harm to cetacean populations within and around Manila Bay from the project. This would involve strong action to support and build the capacity of existing or purpose-built cetacean rescue and conservation programs, primarily during the project's construction phase. The BAP could also serve as a mechanism for continuing support and oversight well into the operation phase. Although both the extent of harm to cetacean populations from the project and population restoration effects of the proposed conservation action will be impossible to measure with any degree of confidence, the Action Program is justified based on the precautionary principle.

5 PROPOSED ACTION PROGRAMS

The following descriptions of the action programs represent an initial high-level scoping of the practical implications of the proposed approaches to achieving net gain for the receptors of focus for this Preliminary BAP. The project will engage appropriate expertise (within the staff of the Construction Supervision Consultant) to further explore and shape these proposals—in dialogue with relevant partner entities and also with ADB— into workable programs backed up with appropriate levels of commitment, institutional foundation and fiduciary governance. It is probable that most or all will undergo substantial evolution during that process, and possible that some may be replaced entirely. As indicated earlier, a BAP should be treated as a living document in its earlier stages, and it is to be expected that this Preliminary BAP will go through multiple iterations before all Action Programs are fully agreed and set on a path to implementation under a finalized BAP and accompanying—and more detailed and technical—Biodiversity Offset Management Plan and Biodiversity Monitoring Plan.

5.1 Action Program A – Management of Exploitation Risk in Mariveles Mountains KBA

Plan Element	Explanation
Action	Proactive monitoring and management program for forest and grassland areas on the southern and eastern flanks of Mt. Mariveles, within the Mariveles Mountains KBA
Objective	To proactively protect forest and grassland areas in the Mariveles Mountains KBA from increased exploitation pressure as a result of the establishment of the BCIB, achieving a net gain in biodiversity values
Approach	Monitoring to Inform Conservation Action Long-term monitoring of forest/grassland use trends and land use change in the southern and eastern parts of the KBA, with participation from DPWH, Mariveles LGU, Limay LGU, the Ayta Magbukún indigenous community and DENR-BMB, is proposed to detect the emergence of worrisome trends and help focus and drive formulation of biodiversity conservation action within the KBA. Monitoring could consist of yearly collection and analysis of relevant data, as follows: (1) Land cover change analysis using newly acquired high-resolution satellite imagery, conducted by a qualified GIS technician using the same analysis and ground-truthing methodology each time; (2) Field surveys of locations with suspected emerging land use change; (3) Field interview surveys with residents along access roads regarding possible evidence of resource extraction, informal settlement, road improvements, etc. (e.g., logging and mining truck traffic, local hearsay, influx of settlers) An annual monitoring report would be expected to provide a comprehensive picture of land cover change linked to ground-level insights regarding change factors. Each annual monitoring report would include a threats analysis. Conservation Action for Net Gain Appropriate conservation action to achieve net gain in biodiversity values will have to be agreed by the partnering entities, and the choice of measures would ideally be influenced by results from the first 3–4 years of monitoring. Protective tools at the partners' disposal would include various municipal land use planning and permitting mechanisms, protected area and buffer zone designations, exercise of indigenous tenurial rights, and community mobilization. Development of an action plan for the KBA based on the threats analysis may also be a useful step. Restoration offsets targeted at key species could be integrated with protective efforts. This component of the Action Program will be subject to further feasibility consideration and early dialogue with potential institutional partners prior to development of the next iteration of the BAP.
Outcome	The expected outcome of the proposed program is the long-term maintenance and restoration of stable land cover over the Mariveles and Limay portions of the Mariveles Mountains KBA, despite the possibility of increased exploitation pressure due to development of the BCIB.

Plan Element	Explanation
Timing	Details of timing will need to be discussed with key stakeholders and will be contingent upon formation of a solid working partnership. The monitoring program should begin as soon as possible after project approval, to allow refinement of methodologies and establishment of a baseline and longitudinal trends analysis prior to opening of the BCIB link. The monitoring should continue until at least the tenth year of BCIB operation, to capture the emerging influence of the anticipated BCIB induced development effect and inform continuing adaptation of the protective measures selected for implementation. Practical conservation actions defined by the implementing partnership should ideally be implemented beginning in the first half of the construction phase, to cement durable mechanisms as much as possible ahead of anticipatory land development.
Responsible Parties	It is proposed that the Action Program should be implemented under a partnership entity composed of, at minimum, DPWH (Chair), Mariveles LGU, Limay LGU, Ayta Magbukún indigenous community, DENR-BMB Region III, and an established biodiversity-focused NGO. Funding would be provided by DPWH, through a comprehensive Biodiversity Action Plan Fund for the BCIB project. Annual monitoring would be carried out on a contract basis by a qualified firm with solid GIS and qualitative field survey capabilities, with logistical support and participation from the partners as needed. Early coordination and guidance for partnership formation and planning, as well as implementation guidance for the duration of the construction phase, would be the responsibility of biodiversity specialists in the employ of the Construction Supervision Consultant. ADB would provide specialist review inputs and coordination assistance as needed for the duration of the construction phase.
Accountability	It is recommended that a Biodiversity Offset Committee be established to provide oversight for all Action Programs grouped under the BAP, to be chaired by ADB with representation from DPWH Environmental and Social Safeguards Division (DPWH-ESSD), DENR-Biodiversity Management Bureau (DENR-BMB), Bureau of Fisheries and Aquatic Resources under the Ministry of Agriculture (BFAR), the Marine Sciences Institute of the University of the Philippines (MSI), and a selection of nationally-recognized NGOs.
Verification	Verification measures will need to be confirmed once final actions have been confirmed.
Estimated Cost	Due to uncertainty regarding the final set of actions that will be developed by the partners in this Action Program (particularly with regards to the practical conservation actions that may be developed), only a broadly indicative breakdown of costs for the Action Program can be suggested, as follows: Monitoring: PHP 20,000,000 Conservation actions: PHP 300,000,000 – 1,000,000,000 Total: PHP 320,000,000 – 1,020,000,000

5.2 Action Program B – Biodiversity Offset for Natural Grassland Habitat of Alas-Asin

Plan Element	Explanation
Action	Establishment of a supplementary off-site biodiversity offset
Objective	To formulate, plan and implement permanent protection and/or restoration of grassland habitat somewhere in southern Bataan to help offset biodiversity values lost to conversion of 12.3 ha of Natural Habitat for development of the BCIB approach road in Bataan.
Approach	A Natural Grassland Replacement Plan is proposed under the project EMP to set aside and restore grassland on remnant parcels along the BCIB approach road alignment in Bataan, but this is not expected to achieve no net loss of biodiversity values due to land availability constraints. The Action Program is proposed under the BAP to derive additional biodiversity benefits, bringing the overall balance of biodiversity values to at least the no net loss threshold (required for Natural Habitat). Determination of an appropriate offset hectarage and location for the supplemental offsite will be subject to prior calculation of biodiversity values contributed by the actions implemented under the Natural Grassland Replacement Plan. Accordingly, further formulation of the offset plan should appropriately wait until the Natural Grassland Replacement Plan has been prepared. A broadly indicative estimate at this early stage is for a supplemental offset area somewhere in the range of 10–20 ha.
Outcome	The expected outcome of the Action Program is no net loss (and ideally some net gain) of biodiversity values despite the conversion of 12.3 ha of Natural Habitat for the Bataan approach road.

Plan Element	Explanation
Timing	The timing of offset design will be dependent on development of the Natural Grassland Replacement Plan under the project EMP. That plan is expected to be prepared during the late pre-construction phase, for implementation beginning around the start of construction. Thus, determination of a target offset hectarage, identification of appropriate site or sites, and formation of necessary implementation partnerships could proceed from the start of the construction phase. Timing of subsequent steps would be dependent on the balance of protection and restoration needed to achieve the desired offset values on the selected site, and on the particular institutional arrangements required (i.e., land acquisition vs partnership with managers of an existing conservation site).
Responsible Parties	It is expected that the Action Program would need to be implemented through a partnership agreement between DPWH and at least one other entity, such as DENR-BMB or a land conservancy. Involvement of an established NGO with biodiversity expertise in an advisory role would also be advisable. The Action Program's formulation and development would be spearheaded by the biodiversity specialists to be engaged by the Construction Supervision Consultant, per the project EMP. Funding for the Action Program would be supplied by DPWH, through a proposed Biodiversity Action Plan Implementation Fund, which is accounted for in the EMP cost estimate. ADB would provide specialist review inputs and coordination assistance as needed for the duration of the construction phase.
Accountability	It is recommended that a Biodiversity Offset Committee be established to provide oversight for all programs grouped under the BAP, to be chaired by ADB with representation from DPWH Environmental and Social Safeguards Divisions (DPWH-ESSD), DENR-Biodiversity Management Bureau (DENR-BMB), Bureau of Fisheries and Aquatic Resources under the Ministry of Agriculture (BFAR), the Marine Sciences Institute of the University of the Philippines (MSI), and a selection of nationally-recognized NGOs.
Verification	The approach to verification will need to be developed once the action Program has been more fully developed.
Estimated Cost	Due to high uncertainty regarding the magnitude of the supplemental offset that will ultimately be needed, and also regarding mechanisms (land acquisition vs partnership) and actions (protection vs restoration), only a broadly indicative estimate of costs for the Action Program can be suggested, as follows: Total: PHP 50,000,000 – 200,000,000

5.3 Action Program C – Offset of Residual Effects on Coral Habitat Through Enhancement of Corregidor Islands Marine Park Management Programs

Plan Element	Explanation
Action	Support for enhancement and expansion of protection and management plans proposed for the Corregidor Islands Marine Park (CIMP)
Objective	To help build a competent and stable protective management and restoration scheme for the marine environment in the vicinity of the BCIB project area to secure net gain in marine biodiversity values despite anticipated losses due to project implementation, based around the existing Corregidor Islands Marine Park concept.
Approach	The main thrust of the proposed Action Program would be a protection offset of sufficient magnitude to secure, with a high degree of confidence, net gain in biodiversity values despite loss of approximately 14 ha of benthic habitat and significant reversible degradation of about 57 ha of benthic habitat. Determination of an appropriate offset ratio will be informed by longitudinal marine surveys to be carried out during the pre-construction and construction phases under the EMP, but it is provisionally suggested that a multiplier of at least 10 x (and most likely well above that) would be appropriate. Accordingly, substantial expansion of the CIMP would be envisioned under the Action Program, to include at least Caballo Island and environs, as well as the entirety of the San Jose Bay caldera (essentially the entire underwater area of the Corregidor seamount); this would encompass approximately 4,500 ha. As virtually none of this sea area is now under meaningful protection, the potential biodiversity value gains from long-term protection would be substantial. Activities provisionally proposed to achieve effective long-term protection of an expanded CIMP are as follows:

Plan Element	Explanation
	• Coordination with the existing multi-stakeholder CIMP Management Board to expand the CIMP to the proposed 4,500 hectares (or larger, to include the area around La Monja Island as well) via ordinance of the Cavite City council; • Capacity-building support for the CIMP Secretariat, including establishment of permanent staff positions and training • Establishment and training of a professional surveillance and enforcement corps; • Provision of equipment for surveillance and management of restoration projects already envisioned by the CIMP Management Board; • Development of a long-term fixed-transect biodiversity monitoring program as a component of the CIMP's management; and • Establishment of an endowment fund to support maintenance of the CIMP's protective management capacity. All of the actions proposed above would be subject to discussion and agreement with the multi-stakeholder management board of the CIMP, most especially its Chair, the Cavite City LGU, which has jurisdiction over all waters surrounding the Corregidor and La Monja seamounts.
Outcome	The desired outcome of the action program is an expanded CIMP with a strengthened management team capable of ensuring effective long-term protection and management of the park's marine resources, resulting in a net gain of marine biodiversity values relative to pre-project conditions.
Timing	Timing of Action Program formulation would be a matter for discussion with the stakeholders but given that an agreed management entity already exists for the CIMP, formation of the necessary support partnership with DPWH and development of a formal offset plan could conceivably begin shortly after approval of the BCIB project. There would be no need for the proposed actions to accommodate the construction schedule, with the possible minor exception of boundary demarcation. It is foreseeable that all proposed components of the Action Program could be implemented before the end of the BCIB construction phase.
Responsible Parties	It is proposed that the action program would be implemented by a formal partnership formed between DPWH and the CIMP Management Board. The Action Program's formulation and development would be spearheaded by the biodiversity specialists to be engaged by the Construction Supervision Consultant, per the project EMP. Funding for the Action Program would be supplied by DPWH, through a proposed Biodiversity Action Plan Implementation Fund, which is accounted for in the EMP cost estimate. ADB would provide specialist review inputs and coordination assistance as needed for the duration of the construction phase.
Accountability	It is recommended that a Biodiversity Offset Committee be established to provide oversight for all programs grouped under the BAP, to be chaired by ADB with representation from DPWH Environmental and Social Safeguards Divisions (DPWH-ESSD), DENR-Biodiversity Management Bureau (DENR-BMB), Bureau of Fisheries and Aquatic Resources under the Ministry of Agriculture (BFAR), the Marine Sciences Institute of the University of the Philippines (MSI), and a selection of nationally-recognized NGOs.
Verification	The approach to verification will need to be confirmed once this action program has been finalized.
Estimated Cost	Due to uncertainty regarding the final set of actions that will be agreed by the partners in this Action Program, only a broadly indicative breakdown of costs for the Action Program is suggested at this early stage, as follows: Capacity-building for CIMP Secretariat: PHP 50,000,000 Establishment and training of professional surveillance and enforcement corps; PHP 20,000,000 Equipment provision: PHP 10,000,000 Set-up of permanent monitoring program: PHP 10,000,000 Management endowment: PHP 400,000,000 – 900,000,000 (dependent on selected term of offset) Total: PHP 500,000,000 – 1,000,000,000

5.4 Action Program D – Offset of Residual Effects on Marine Turtles Through Support of Municipal Hatchery and Outreach Programs

Plan Element	Explanation
Action	Implement a support and capacity-building program for local marine turtle hatchery and conservation programs
Objective	To offset residual effects on marine turtles from construction of the BCIB, including limited nesting habitat loss and medium-term exclusion from the bay due to marine pile driving
Approach	A Marine Turtle Management Plan is proposed under the project EMP (primarily aimed at minimizing risks to turtles during construction), and it may be possible to meet the objective of the Action Program under that plan alone; feasibility of this will be worked out when the Marine Turtle Management Plan is prepared based in part on findings from longitudinal marine turtle monitoring to be undertaken in the pre-construction phase. Elements of the proposed Action Program as a stand-alone offset initiative are provisionally outlined here. An understanding of turtle abundance, movements and habitat use is essential for formulation of a realistic offset proposal. Longitudinal monitoring including tracking and beach monitoring will be undertaken under the EMP during the pre-construction and early construction phases. Although offset targets cannot be set until the appropriate level of understanding is reached, mechanisms for implementation can be conceptualized. The proposed protection offset would not protect habitat, but rather protect nesting turtles and especially eggs and hatchlings from known threats, thereby increasing the viability of the subject species in local waters. The Action Program would direct attention and investment to substantially increasing the capacity of existing municipal hatchery programs around the mouth of Manila Bay, which currently provide protective intervention for only a small portion of assumed nesting activity on sandy beaches in the area. Support may include establishment of new programs in some municipalities where the operational status of existing programs has not been confirmed. The Action Program would target programs in the municipalities of Mariveles, Naic, Ternate, Tanza and Cavite City, all of which have at least one known nesting beach. Proposed supports for municipal programs are as follows: • Capacity-building for the Municipal Environment and Natural Resources Offices (MENROs) responsible for coastal conservation programs, including training in public outreach, volunteer recruitment and mobilization, beach monitoring methods, egg handling, hatchery management, hatchling handling, mapping and data management; • Investments in establishment, expansion and improvement of hatchery facilities; and • Establishment of an endowment fund to support ongoing implementation of hatchery programs. The above support activities would be implemented primarily during the pre-construction and construction phases of the project. If assessment of offset needs developed under the Marine Turtle Management Plan indicates a mismatch between proposed activity and achievable benefits, additional hatchery programs outside the bay could be selected for inclusion, or the length of time over which financial support is provided could be extended.
Outcome	Increased marine turtle populations in Manila Bay over time despite disturbance from the BCIB construction process.
Timing	Implementation of the proposed Action Program (if not subsumed within the Marine Turtle Management Plan under the EMP) could begin in the pre-construction phase and be completed before the end of construction.
Responsible Parties	It is proposed that the Action Program should be implemented at a minimum by formal partnerships between DPWH and each of the concerned LGUs (Mariveles, Naic, Ternate, Tanza, Cavite City). Participation of interested turtle-focused NGOs would also be advisable. Implementation would be spearheaded by biodiversity specialists engaged by the Construction Supervision Consultant. DPWH would provide funding for the Action Program. ADB would provide specialist review inputs and coordination assistance as needed for the duration of the construction phase.
Accountability	It is recommended that a Biodiversity Offset Committee be established to provide oversight for all programs grouped under the BAP, to be chaired by ADB with representation from DPWH Environmental and Social Safeguards Divisions (DPWH-ESSD), DENR-Biodiversity Management Bureau (DENR-BMB), Bureau of Fisheries and Aquatic Resources under the Ministry of Agriculture (BFAR), the Marine Sciences Institute of the University of the Philippines (MSI), and a selection of nationally-recognized NGOs.
Verification	The approach to verification will need to be confirmed once this Action Program has been finalized.

Plan Element	Explanation
Estimated Cost	Due to uncertainty regarding the final set of actions that will be agreed by the partners in this Action Program, only a broadly indicative breakdown of costs for the Action Program is suggested at this early stage, as follows: Training for personnel of MENRO hatchery programs: PHP 500,000 Support for hatchery improvements: PHP 2,000,000 Management support endowment: PHP 55,000,000 – 100,000,000 Total: PHP 57,500,000 – 102,500,000

5.5 Action Plan E – Management of Bird and Bat Collision Risk

Plan Element	Explanation
Action	Compensation measures for bird and bat mortality.
Objective	To compensate for possible residual impacts of the project on birds.
Approach	Aside from the broad-scale appreciation of the seasonal migration of passerine and waterbird species within the East Asian-Australasian Flyway, movements (including nocturnal flight) of local and migrating birds through the BCIB project area are very poorly understood. Prediction of possible avian impacts from the tall bridge infrastructure of the BCIB is essentially impossible, although other tall infrastructure including cable-stayed bridges has a record of killing substantial numbers of birds, particularly during times of reduced visibility, so the risk can be assumed to be greater than zero and possibly significant at least part of the time. Bats are also known to suffer mortality from contact with tall infrastructure. Given very high uncertainty on the scale of impacts and species affected, conceptualization of offset measures is not appropriate at this early stage. However, it is anticipated that longitudinal bird and bat surveys conducted during the pre-construction and construction phases of the project (as provided for under the EMP) may identify risks for particular species and species groups, and indicate a need for mitigation measures. This Action Program is proposed as a mechanism to address this possible eventuality, following the precautionary principle. The particular elements of the Action Program cannot be identified at this time. A preliminary high-level scoping of possible measures might include modifications to the design and operation of bridge lighting (and evaluating the effectiveness of same during operation), as well as other conservation actions to offset expected and even measured losses. Depending on what specific measures are ultimately proposed based on evaluation of longitudinal monitoring data, the Action Program objective may be more suitably achieved through the Bird Management Plan and Bat Management Plan proposed under the EMP, but this will have to be worked out and formulated for a later iteration of the BAP.
Outcome	Losses of bird and bat biodiversity values as a result of the BCIB minimized, and appropriately offset if they are found to occur.
Timing	This will need to be finalized once the appropriate set of compensation actions have been identified.
Responsible Parties	This will need to be confirmed once the final set of actions are confirmed. The action program would likely be implemented by a partnership, as a minimum, formed between, at minimum, DPWH and an established local bird advocacy group or academic institute with avian research expertise.
Accountability	It is recommended that a Biodiversity Offset Committee be established to provide oversight for all programs grouped under the BAP, to be chaired by ADB with representation from DPWH Environmental and Social Safeguards Divisions (DPWH-ESSD), DENR-Biodiversity Management Bureau (DENR-BMB), Bureau of Fisheries and Aquatic Resources under the Ministry of Agriculture (BFAR), the Marine Sciences Institute of the University of the Philippines (MSI), and a selection of nationally-recognized NGOs.
Verification	Methods for verification will need to be developed following more certain development of the Action Program elements.
Estimated Cost	Due to very high uncertainty regarding the need to develop offsets for one or more species, an indicative cost estimate is provided primarily to ensure that a provisional allocation is set aside for this Action Program, as follows: Total: PHP 50,000,000 – 250,000,000

5.6 Action Plan F – Offset for Expected Impacts on Marine Mammals from Project-Produced Underwater Noise

Plan Element	Explanation
Action	Actions to offset anticipated residual impacts of pile-driving noise on whales and dolphins in Manila Bay
Objectives	(1) To expand and enhance existing cetacean grounding rescue programs in Manila Bay on a precautionary basis, on the expectation that piling works may increase the incidence of groundings even with mitigation in place (2) Implement long-term cetacean conservation programs that could serve as appropriate offsets for residual impacts
Approach	A longitudinal cetacean monitoring program comprising passive acoustic monitoring and tracking is proposed under the EMP for the pre-construction and early construction phases of the BCIB project, to better characterize the presence, abundance, movements and habitat use of cetaceans within and nearby Manila Bay. Data from this monitoring effort will inform development of an Underwater Noise Management Plan under the EMP. In recognition that even thorough mitigation of noise emissions and careful species-specific management of construction activity to minimize noise-derived and other impacts on cetaceans will not eliminate harm, offset actions are proposed in this Action Program under the BAP. The proposed approach is (at present) precautionary, as it is necessitated not so much by uncertainty about whether impacts on resident cetaceans can be expected, but rather uncertainty regarding the magnitude and severity of impacts. The proposed Action Program comprises two elements, as follows: • Financial support and capacity-building for existing cetacean rescue and rehabilitation programs operating in and around Manila Bay (or establishment of one or more of these if found more appropriate); and • Development and implementation of long-term cetacean conservation programs in Manila Bay, in partnership with relevant stakeholder entities (this could include enhanced surveillance and enforcement of existing wildlife protection laws, development of whale protection measures applicable to local shipping and fishing, and public awareness programs.
Outcome	The provisional outcome of the proposed Action Program is long-term viability of cetacean populations within Manila Bay, despite anticipated adverse impacts experienced during the marine piling works carried out for the BCIB project.
Timing	Capacity-building for local cetacean rescue and rehabilitation programs would ideally be developed and implemented soon after loan approval, so that some capacity improvements can be realized before piling work begins. Formulation of long-term cetacean conservation programs should wait until the planned longitudinal monitoring yields insights regarding species presence, abundance, movements and habitat use, i.e., early construction phase. Cetacean conservation programs set up under the Action Program should be long-term initiatives, and so would extend well into the BCIB operation phase.
Responsible Parties	The program should be developed and implemented through a partnership between (at minimum) DPWH, the Bureau of Fisheries and Aquatic Resources (BFAR), the Marine Science Institute of the University of the Philippines, and local organizations already involved in cetacean rescue and cetacean conservation advocacy. Funding would be provided by DPWH, through the comprehensive Biodiversity Action Plan Fund for the BCIB project, as accounted for under the EMP cost estimate. Formation of the necessary partnerships and development of capacity building shall be spearheaded by biodiversity specialists in the employ of the Construction Supervision Consultant.
Accountability	It is recommended that a Biodiversity Offset Committee be established to provide oversight for all programs grouped under the BAP, to be chaired by ADB with representation from DPWH Environmental and Social Safeguards Divisions (DPWH-ESSD), DENR-Biodiversity Management Bureau (DENR-BMB), Bureau of Fisheries and Aquatic Resources under the Ministry of Agriculture (BFAR), the Marine Sciences Institute of the University of the Philippines (MSI), and a selection of nationally-recognized NGOs.
Verification	Verification of the biodiversity benefits of the action program will be applicable only in the event that an offset component (cetacean conservation programs, allowed for on a contingency basis) are developed in response to a finding of significant residual impact from pre/post monitoring results analysis. A means of verification tailored to the program or programs developed should be defined at that time. The approach to verification will need to be identified once this Action Program has been developed in dialogue with potential partner entities.

Plan Element	Explanation
Estimated Cost (Preliminary)	Due to uncertainty regarding the final set of actions that will be agreed by the partners in this Action Program, only a broadly indicative breakdown of costs for the Action Program is suggested at this early stage, as follows: Financial support and capacity-building for cetacean rescue and rehabilitation programs: PHP 50,000,000 Development and implementation of cetacean conservation programs: PHP 20,000,000 – 150,000,000 Total: PHP 70,000,000 – 200,000,000

In line with IFC PS6, a quantifiable net gain is required for all critical habitat qualifying trigger features. As the Draft CHA is likely to undergo significant revision once additional biodiversity baseline data is gathered, detailed action programs for the Project's CHA triggers are not in place.

As next steps however the Project is committed to the following steps to best ensure net gain is achieved for critical habitat qualifying trigger features:

- Once additional baseline is available, update the CHA,
- Develop a set of net gain actions (and identify responsible parties, means of verification, timing, cost, etc.) for all final CHA trigger features (and any biodiversity receptors subject to residual significant impacts),
- Confirm net gain actions with ADB and external stakeholders, and update and re-disclose BAP, and finally,
- Once the BAP is finalized, develop a detailed Biodiversity Offset Management Plan (BOMP) for offset delivery.

6 FUNDING PLAN

Due to uncertainty in the final set of actions that will be developed, a detailed breakdown of implementation costs and required funding amounts for the BAP cannot yet feasibly be produced. Indicatively, based on experience delivering similar BAPs elsewhere, an overall estimated cost range of PHP 1,000,000,000 to PHP 3,000,000,000 is suggested, and this amount has been accounted for in the cost estimate presented in the project EMP. It is to be emphasized that the program costs are being estimated at an early stage of BAP development, when understanding of some residual impacts and Critical Habitat determinations are still subject to considerable uncertainty, and before substantial expert consultation and dialogue with potential partner entities to scope program proposals has taken place. Accordingly, this estimate is preliminary and largely hypothetical.

It is proposed that a dedicated replenishable fund be established to support long-term implementation of the BAP, under a trusteeship approved by ADB. The BAP Implementation Fund should be segregated according to the agreed allocations for the action programs included in the BAP, to reduce the risk of unexpected or runaway costs on one action program affecting implementation of the others. The logistics of the fund's establishment and fiduciary oversight will be subject to negotiation between DPWH and ADB.

7 BAP UPDATES

As indicated above, this Preliminary BAP will need to be updated as additional information becomes available and relevant stakeholders and potential partners are engaged. Future development of the BAP will be led by professionals with appropriate expertise, including at a minimum:

- Over 15 years working in biodiversity management and offset development to international standards
- Expertise in relevant marine and terrestrial ecology (e.g., coral reefs and forest/grassland)
- Expertise in socio-economic considerations, sustainable livelihood development, ecosystem service risks and benefits

Detailed Terms of Reference will be drawn up separately.

Future iterations of the Preliminary BAP will be publicly disclosed, including on the ADB website.

8 MONITORING AND EVALUATION

The success of each Action Program in achieving its biodiversity aims will need to be verified through monitoring. A verification methodology and benchmarks will be formulated for each Action Program as it is developed, and monitoring requirements for all programs will be collected under a comprehensive Biodiversity Monitoring Plan. As most biodiversity benefits will accrue gradually over many years, the Biodiversity Monitoring Plan must be conceived as a long-term plan. Implementation of the Biodiversity Monitoring Plan would normally be contracted to one or more qualified NGOs or research institutes.

It is proposed that ADB should engage a monitoring and evaluation consultant to conduct an annual audit of overall BAP implementation, as well as mid-term and post-completion evaluations of each component action program. The timing of the mid-term and final evaluations of the action programs would be determined by the indicated operational lifespan of each.

Audits and evaluations should be conducted by an entity with substantial expertise in biodiversity management program implementation and oversight. Unfavorable findings emerging from annual audits and mid-term evaluations should be accompanied by proposals for action program adaptations, to be reviewed by ADB and implemented by DPWH and other partners as directed by ADB.

Bataan-Cavite Interlink Bridge Project

Draft Visual Impact Assessment

27 December 2022

Prepared By:

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1 INTRODUCTION

The Bataan–Cavite Interlink Bridge (BCIB) Project is a proposed new transportation link between the northern and southern parts of Luzon Island, Philippines. The project will entail construction of a 32-km, 4-lane roadway between the provinces of Bataan and Cavite, with a 26-km sea crossing near the mouth of Manila Bay. The project will establish a third major travel corridor through the central part of Luzon Island, thereby alleviating pressure on existing major travel corridors through Metro Manila, which suffer from heavy congestion. The BCIB project will be built over a span of 5.5 years, and will incorporate two land approaches, two high-clearance cable-stayed navigation bridges, a small nearshore navigation bridge, and approximately 22 km of marine viaducts. The project terminus on the Bataan side will be an interchange at the Roman Highway, in the Municipality of Mariveles, while the southern terminus in Cavite will be an interchange at the Antero Soriano Highway in the Municipality of Naic. The project location in shown in Exhibit 1.

The BCIB has been proposed under the umbrella of the Build, Build, Build Program of the Government of the Philippines, and will be implemented by the Department of Public Works and Highways (DPWH). The proposed BCIB project is being considered for financing by the Asian Development Bank (ADB), under its Infrastructure Preparation and Innovation Facility (Roads and Bridges Component) for the Philippines.

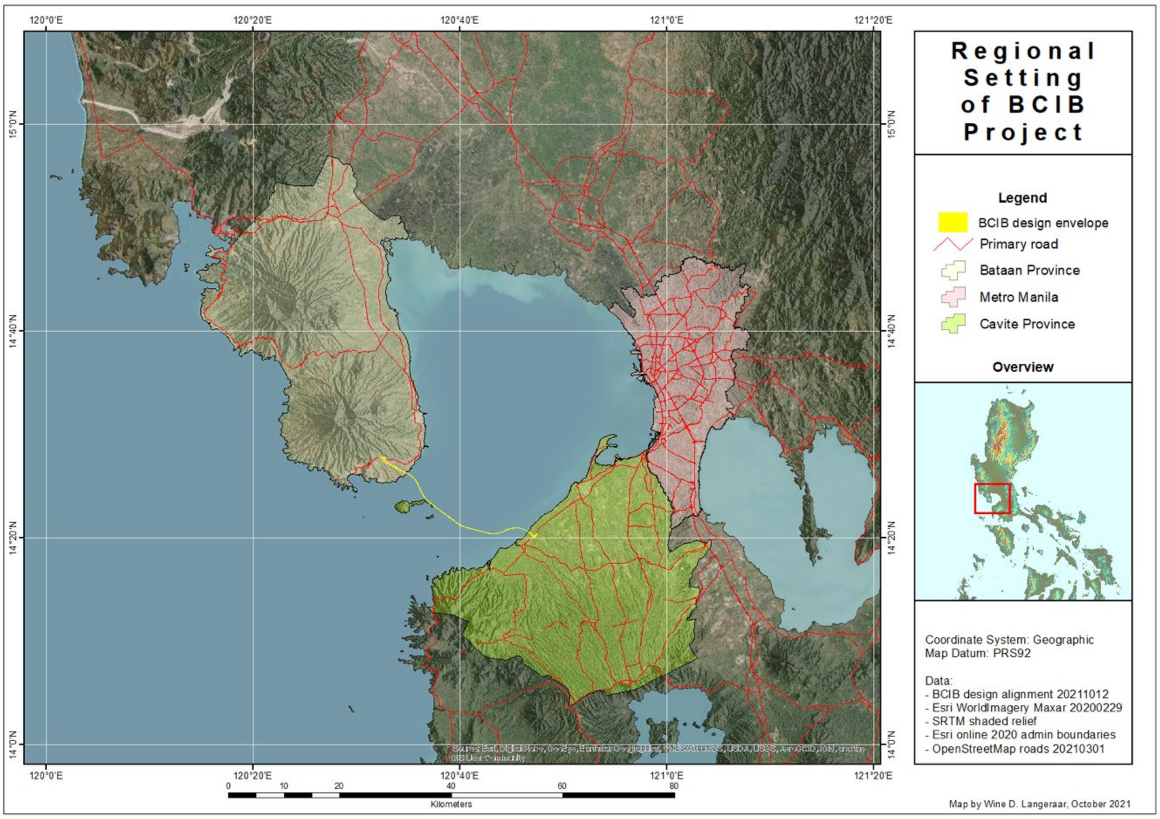


Exhibit 1: Location of Proposed BCIB Project

2 REQUIREMENTS AND GUIDANCE

This visual impact assessment (VIA) has been prepared in support of the environmental impact assessment (EIA) of the proposed BCIB project. Environmental impact assessment of infrastructure development projects is required under the Philippine Environmental Impact Statement System (PEISS), pursuant to Presidential Decree No. 1586 (1978) and further defined by a series of subsequent proclamations and administrative orders. As the proposed project is under consideration for financing by ADB, an EIA is also required in accordance with the Bank's Safeguard Policy Statement, 2009 (SPS). Under both the PEISS and SPS, visual impact assessment may be considered a necessary component of the consideration of potential impacts on socioeconomic and cultural aspects of a project's proposed environment, when the nature of the project and characteristics of the project's environment warrant it. The BCIB will be a large project with significant physical breadth and prominently visible infrastructure, implemented in an environment endowed with recognized scenic elements. Accordingly, a VIA is warranted in this case.

There are no laws or statutory standards stipulating criteria for visual quality in the Philippines, and there are likewise no international standards for visual quality that ADB would typically require adherence to in project development. However, DPWH has produced a set of aesthetics guidelines applicable to bridges, aimed at avoiding blandly utilitarian bridge designs and promoting visually pleasing, eye-catching ones.[1] The design of the BCIB infrastructure has been informed by these guidelines. Further, an aesthetics manual has been developed specifically for the BCIB project to articulate and guide the development of a visually coherent, consistent and attractive appearance for the varied infrastructure components that will make up the project.[2]

With respect to the conduct of VIA, neither the Government of the Philippines nor ADB specifies methodological guidance or standards regarding process or outputs. This VIA follows the methodology developed by the United States Federal Highways Administration (FHWA), as most recently articulated in its Guidelines for the Visual Impact Assessment of Highway Projects (January 2015).

3 METHODOLOGY

3.1 Assessment Steps

Following the methodology laid out in the 2015 FHWA guidelines, preparation of this VIA for the BCIB project has worked through four assessment phases: (1) Establishment; (2) Inventory; (3) Analysis; and (4) Mitigation. Each phase is outlined briefly below.

Establishment. The objectives of the establishment phase are to define the study area, considering topography, land cover and sight lines, and also to come to a clear understanding of the visual character of the proposed project based on available project design information. A key task of this phase of VIA is identifying and defining an area of visual effect (AVE), based on analysis of both viewsheds (areas visible from particular key

[1] Department of Public Works and Highways. 2018. Bridge Aesthetics Guidelines, 1st Edition. Bureau of Design, Bridges Division.
[2] Bataan–Cavite Interlink Bridge Project Aesthetics Manual, September 2021. TY Lin International – Pyunghwa Engineering Consultants JV.

vantage points) and landscape units (portions of the landscape with high-level homogeneity of features, characteristics and visual flavor that could be considered to have local cultural relevance or scenic value). Analysis of maps and satellite imagery is a key tool of the establishment phase.

Inventory. The objectives of the inventory phase are to characterize the salient components of the proposed project's environment and the characteristics of viewers (people who will take in the visual impacts of the project), and to consider the relationships between the environment and the viewers. In this phase of the assessment, attention is devoted to identifying the key visual resources involved (physical, cultural and project-derived), and delineating the various groups of people whose visual experiences could be affected by the project's implementation. The opinions and perspectives of people within each group regarding expected changes to the visual environment are also considered at this stage, based on both field research and professional judgement. The inventory phase is informed by map analysis, field reconnaissance, and stakeholder engagement.

Analysis. The objectives of the analysis phase are to assess the proposed project's impacts on both the existing visual resources in the project environment and the viewers of the proposed project infrastructure, and to synthesize the findings to assign the anticipated impacts to one of three categories: 'beneficial', 'adverse' or 'neutral'. Within these categories, further judgements can be made regarding the magnitude or significance of impacts, as well as the duration over which they will be experienced.

Mitigation. The objective of the mitigation phase is to define measures that could counter specific anticipated adverse visual impacts, and ultimately help to ensure that the proposed project ends up being a good aesthetic fit for its host landscapes and appreciated by the sectors of the population that will be in a position to experience its visual effects. The proposed mitigation measures can be recommendations for the project's ongoing detailed design, or as the basis for mitigation prescriptions in the Environmental Management Plan for the project.

3.2 Scope of Assessment

The VIA methodology just described has been applied to the BCIB project as known at the intermediate and late stages of the detailed design work. The physical footprint of the proposed project infrastructure was well understood and established at the time of assessment. The permanent infrastructure features are the focus of the VIA. The locations, scales and specific site uses of the numerous temporary work sites that will be necessary to support the project's construction (e.g., casting yards, construction worker camps, storage yards) were considered tentative, but have been referenced in the VIA where information about likely siting could be considered reasonably firm at the time of assessment, and where activities carried out on such sites could be considered likely to result in permanent impacts on a significant visual resource or have economic implications linked to impairment of visual amenity values. Support sites such as quarries, which may be expected to be at a considerable distance from the project location and outside the reference landscapes, were not included in the VIA.

4 VISUAL CHARACTER OF THE PROJECT

The visual character of the proposed project will vary according to the component infrastructure types, as well as location along the 32-km alignment. The on-land project infrastructure will comprise two road segments of length 5 km (Bataan side) and 1.3 km (Cavite side). Each of the segments will terminate at an interchange. The largest project component by linear length will be the assortment of marine viaducts and high bridge approaches that will carry the roadway for most of the 26-km crossing; included in the viaducts will be a turnaround interchange structure near Corregidor Island, which may in future enable development of a road link to the island. Two large, high-clearance cable-stayed bridges will span the major shipping channels that pass to the north and south of Corregidor Island near the bay's mouth; these high-towered components will be the centerpieces of the BCIB project. The visual character of each of these three classes of infrastructure is described in more detail below.

4.1 On-Land Road Segments

The two on-land approach road segments will generally follow the existing terrain, however somewhat raised. On the sloping hillside in Bataan, the roadway is designed to balance cut and fill, with structures to traverse ravines and deep gullies. On the flatter terrain in Cavite, the roadway is raised an average of 6.25 to 7 meters above grade for several reasons. It is raised to gradually meet the marine viaduct height, which must also be high enough to pass various boats and vessels under. It must be raised to pass existing roadways under through grade-separated structures since intersections are not compatible with this facility. Finally, storms and sea level rise threaten the Cavite shoreline due to the low profile of the land area. In Cavite, the BCIB will be raised on a sloped fill bank from the interchange with Antero Soriano Highway to 100 meters before the Timalan-Balsahan Road underpass. The sloped fill embankment transitions to a mechanically stabilized earthened wall for a total of approximately 300 meters, (100 meters upland of Timalan-Balsahan Road underpass and 200 meters towards water from this underpass). From the MSE retained fill embankment, the BCIB transitioning to land viaduct and then to the marine viaduct. The land viaduct is supported on piers made of two columns with a re-enforced coping beam to support the pre-cast box girder that forms the base of the roadway. The land viaduct will permit beach visitors to cross under the BCIB for approximately 80 meters in depth from the typical water edge.

The Cavite portion of the BCIB passes through residential and beach-front community buildings and small businesses. For this reason, noise barriers are recommended as mitigation for the future traffic noise that may affect the existing residential areas. Noise walls will increase the height and mass of the roadway embankment. The roadways will have overhead lighting, which can be expected to make them noticeable from nearby areas at night. It is expected that the rights-of-way will be vegetated where safety precautions allow. The vegetation will be developed to address wildlife impacts, climate change mitigation and erosion control, and this will tend to soften the visual character of the infrastructure on land, making it less prominently visible during both day and night.

Exhibit 2: Approach Road (Bataan Side)

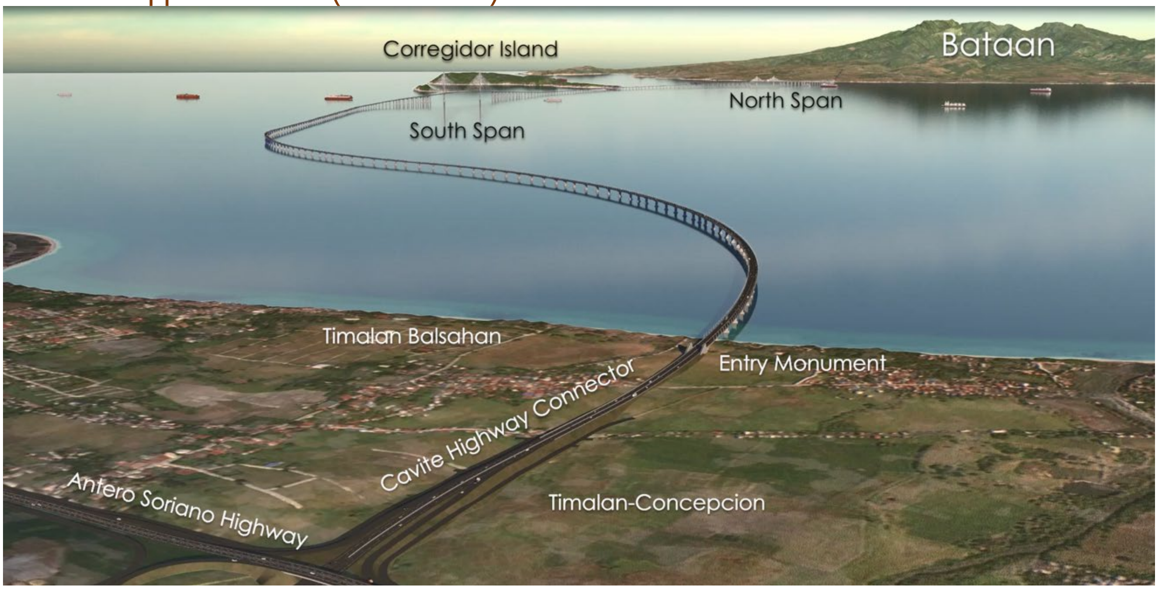


Exhibit 3: Approach Road (Cavite Side)

The approach road on the Bataan side will include a modest bridge monitoring and maintenance compound, comprising a minor 2-story administrative building, several smaller outbuildings, and parking areas. This compound will be just 5,000 m^2 in area and will be accessed exclusively from the approach road itself; the compound is not considered a significant visual feature of the project.

Source: Bataan–Cavite Interlink Bridge Aesthetics Manual, September 2021 (TY Lin International – Pyunghwa Engineering Consultants JV)

Exhibit 4: Proposed Bridge Maintenance and Monitoring Compound (Bataan Side)

4.2 Marine Viaducts

The visual character of the over-water components of the proposed project will be more striking than that of the on-land components. The project alignment, 85% of whose linear length of 26 km will be composed of viaducts and bridge approaches, will follow a moderately sinuous path across the bay, and the curvature of the long viaduct segments will be a noticeable aesthetic feature from many vantage points, both on the crossing and on nearby land. The marine viaducts and high-level bridge approaches will be constructed of light-colored concrete with some textured surfaces and decorative aquamarine-colored stainless-steel elements in the support piers. The deck will be about 20 m above mean sea level along much of the viaduct's length but will rise as high as 62 m to meet the navigation bridge structures. The piers will be spaced every 100 m in deeper waters and every 60 m in shallow areas. The viaduct segments and high-level approaches will be a visually semi-permeable component of the landscape, in that they will not constitute a solid barrier within the field of view.

Source: Bataan–Cavite Interlink Bridge Aesthetics Manual, September 2021 (TY Lin International – Pyunghwa Engineering Consultants JV)

Exhibit 5: Viaduct Curving Away Into the Distance (Cavite Shore)

Renderings of typical segments of the marine viaduct and high bridge approaches are shown in Exhibit 6 and Exhibit 7. The textured surface features and aquamarine-colored stainless-steel inlays, both aesthetic themes also reflected in the cable-stayed bridge structures, may be noted in these renderings.

Source: Bataan–Cavite Interlink Bridge Aesthetics Manual, September 2021 (TY Lin International – Pyunghwa Engineering Consultants JV)

Exhibit 6: Rendering of Typical Marine Viaduct Segment

Source: Bataan–Cavite Interlink Bridge Aesthetics Manual, September 2021 (TY Lin International – Pyunghwa Engineering Consultants JV)

Exhibit 7: Rendering of Selected High Bridge Approach Segment

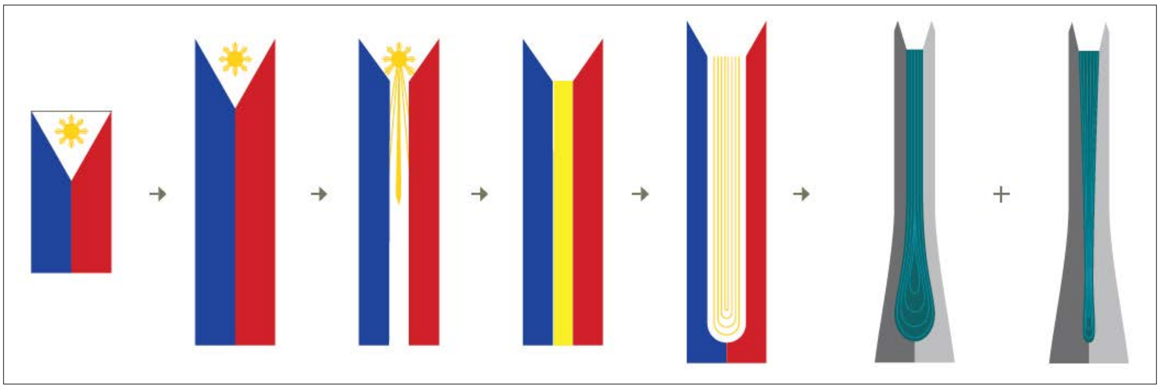
The turnaround structure will be a grade-separated interchange positioned on a pile-supported platform beneath the main alignment, just off the east coast of Corregidor Island. The interchange design will employ concrete styling consistent with the viaduct. A visual rendering of the turnaround structure is shown in Exhibit 8.

Source: Consultant's preliminary design renderings

Exhibit 8: Rendering of BCIB Turnaround Interchange

4.3 Cable-Stayed Navigation Bridges

The two cable-stayed navigation bridges are conceived as symbolic gateways to Manila and will be highly visible showpieces with tall light-colored monopole concrete towers, elegant sprays of support cables, and dynamic floodlighting. The proposed styling of the towers is inspired by the Philippine national flag when held in vertical orientation, with a complementary 'praying hands' motif (see Exhibit 9).



Source: Bataan–Cavite Interlink Bridge Aesthetics Manual, September 2021 (TY Lin International – Pyunghwa Engineering Consultants JV)

Exhibit 9: Symbolism of Proposed Bridge Styling

Vertical bands of aquamarine-colored stainless steel inlaid in the tower sides will provide a thematic element that will also carry through to the anchor piers, for overall aesthetic continuity. Sharp edges will be maintained to enable strong shadowing as light conditions change over the course of the day, enhancing the bridges' visibility from long distances.[3]

Source: Bataan–Cavite Interlink Bridge Aesthetics Manual, September 2021 (TY Lin International – Pyunghwa Engineering Consultants JV)

Exhibit 10: Rendering of Proposed North Channel Bridge

Although they will be situated at some considerable distance from land, the cable-stayed bridges will be a highly visible feature of the landscape when viewed from the water, and of course will be visually striking from the vantage point of vehicles passing along the BCIB crossing. The towers, stays and anchor piers of the two bridges will be equipped with LED floodlighting with the capability for color changes to enhance the visual prominence and attractiveness of the gateways after dark.

[3] Bataan–Cavite Interlink Bridge Project Aesthetics Manual, September 2021. TY Lin International – Pyunghwa Engineering Consultants JV.

Source: Bataan–Cavite Interlink Bridge Aesthetics Manual, September 2021 (TY Lin International – Pyunghwa Engineering Consultants JV)

Exhibit 11: Rendering of Proposed South Channel Bridge

5 LANDSCAPE UNITS

A landscape unit is a spatially defined area with a more or less coherent character or identity, and definition of such units is an analytical building block of VIA. Definition of landscape units helps to conceptualize the values people may attach to their landscapes, and to scope the ways in which they are likely to perceive visual impacts on those values from new infrastructure. For the BCIB project, five partially overlapping landscape units can be delineated; these are described below and shown on the map in Exhibit 12.

5.1 Mariveles Coastal Slope

The portion of Mariveles that will host the interchange and approach road for the BCIB is a varied landscape with an overall southerly slope aspect, being part of the toe slope of the Mt. Mariveles volcano. The land mass is composed primarily of volcanic materials and alluvial deposits and has been incised over time by numerous streams running southward off the higher slopes of the mountain. The substantial valley of the Pangolisanin River borders the landscape unit to the east, and Mariveles Bay to the west. There are numerous minor gullies and washes dispersed across the landscape.

Present land use on the Mariveles Coastal Slope is characterized by low-intensity agricultural activities; there are numerous orchards, mixed homestead plantations and hedgerows, and expanses of grassy and scrub land that are periodically burned to bring on new growth of grasses for extensive grazing by cattle, sheep and goats.

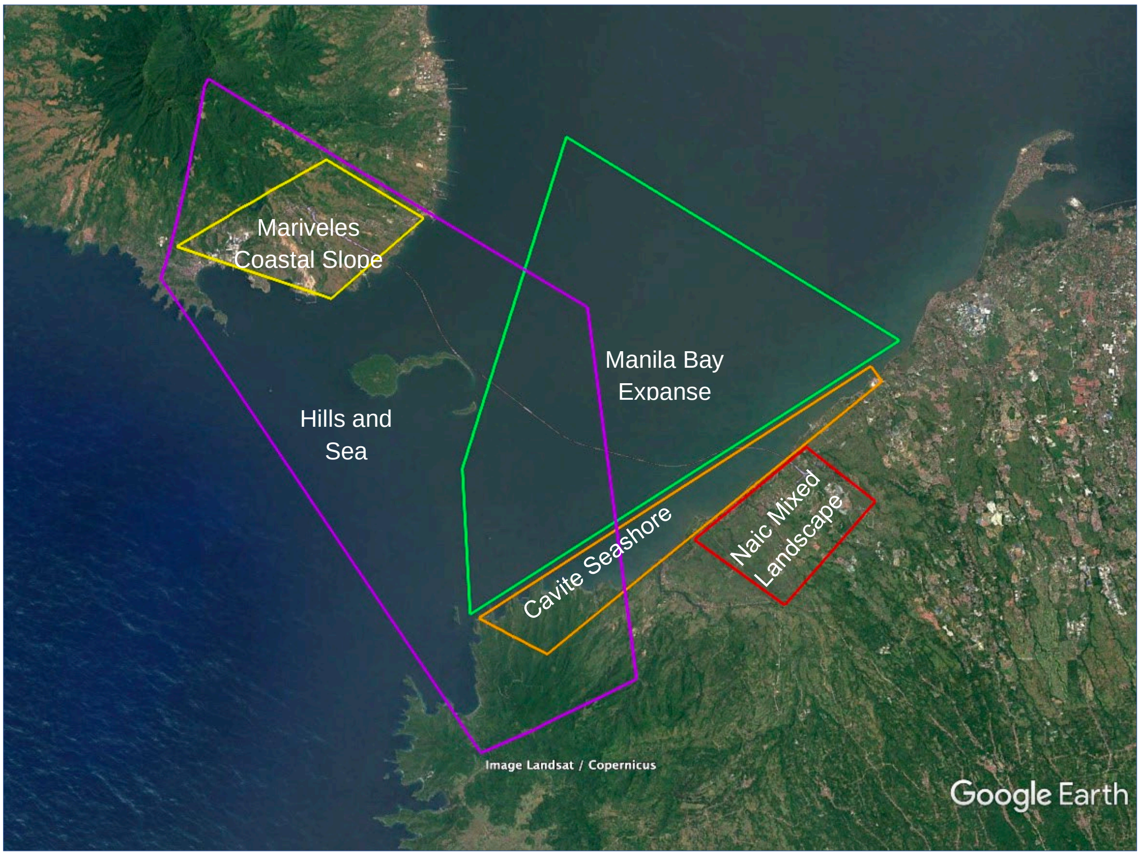


Exhibit 12: Landscape Units Defined for the BCIB Project Area

Exhibit 13: Pasture and Mango Orchards, Mariveles Coastal Slope

Non-agricultural uses have assumed increasing importance in recent decades, with growth in residential and commercial development in the barangays of Alas-Asin, Mountain View and Cabcaben. Major industrial facilities, including oil and gas terminals, a pair of large coal-fired power plants, port facilities, quarries, a solar farm and a cement plant have been developed, mostly near the shore. To the west, numerous manufacturing and import-export processing facilities have been established within the Freeport Area of Bataan, clustered around the north side of Mariveles Bay. Many locations within this landscape unit have views over Manila Bay and as far as the hills in western Cavite and northern Batangas, and Mt. Mariveles is a dominant backdrop feature of the visual landscape.

Exhibit 14: GN Power Generating Stations, Mariveles Shore

5.2 Hills and Sea

Roughly centered on the sea channel running between Corregidor Island and the Bataan landmass, Hills and Sea is a large landscape unit that overlaps with the Mariveles Coastal Slope. This broader landscape unit can be defined by its interesting maritime-orogenous flavor. Key landscape features include the volcanic formations of Mt. Mariveles and Corregidor Island on either side of the channel, a varied coastline that includes the photogenic cliff-ringed coves of the Five Fingers headland area, as well as a number of small pleasing beaches and the conical Mt. San Miguel that stands by the eastern entrance to Mariveles Bay at Barangay Sisiman. The shipping activity that takes place in and around the navigation channel is also a notable landscape feature.

Exhibit 15: Typical Open Scrubland, Mt. Mariveles in Background

Exhibit 16: North Channel and Mt. Mariveles as Seen from Corregidor Island

Most of Corregidor Island and the upper slopes of Mt. Mariveles are thickly vegetated, lending a hint of wild nature to the landscape despite the presence of significant industrial and shipping activity. On the southern side of Corregidor Island, where shipping and industrial activity are out of view, the sense of the natural is more predominant, with Caballo Island, the curving Corregidor Island coast, Mt. Mariveles and the hills of western Cavite and northern Batangas all on display. The landscape unit is also imbued with a powerful sense of history, as all of Corregidor Island is a protected zone commemorating the island’s role as a defensive military stronghold throughout history, most notably during WWII. As the island’s natural resources have rebounded following cessation of intensive military use and heavy bombardment, scenic, recreational and ecological values have increasingly been elevated alongside historical values in land use and development plans. The island's future development and management are now intended to balance historical commemoration and ecotourism, and the waters around the island have been proposed as a marine park, with zones dedicated to strict preservation, research, controlled water sport activities, artificial reef creation and limited seaweed farming.

Exhibit 17: Sisiman Bay and Mt. San Miguel, with Mariveles Bay and Five Fingers Beyond

Exhibit 18: Northwest Side of Corregidor Island As Seen From the North Channel

Exhibit 19: Caballo Island With Hills in Cavite and Batangas Beyond

Exhibit 20: Tail End of Corregidor Island With Hills of Cavite and Batangas Beyond

5.3 Manila Bay Expanse

The least diverse of the identifiable landscape units in the project area is the open expanse of Manila Bay between Corregidor and Caballo Islands and the Cavite shore. Bordered by the open ocean to the west and a long expanse of open water stretching some 40 km to the northeast, this zone has distant views of Mt. Mariveles, Corregidor and Caballo Islands, the hills of western Cavite and northern Batangas, and the low-lying Cavite shoreline. On clear days, the Manila skyline is also visible. In this context, the always changing state of the sea and cloudscape become dominant in visual character. This is a busy shipping zone and is also plied by local fishing fleets, and significant visual interest is supplied by these activities to viewers with a reason to visit or pass through the area.

Exhibit 21: Looking Out to South China Sea (Corregidor and Caballo Islands at RIght)

5.4 Cavite Seashore

At the interface of sea and land, the various stretches of beach along the Cavite coast in the municipalities of Naic, southwest Tanza and northeast Ternate constitute a distinct, if spatially limited, landscape unit. The dark sand beaches of this coastal zone are broken here and there by river mouths and their associated sandbar formations, including those of the Maragondon, Bucalan and Timalan Rivers. Established residential and light commercial areas are to be found within the 200–300 m coastal strip along much of the coastline. Inshore fishing fleets line several of the beaches, the boats typically pulled up on the sand rather than docked in port facilities. Along most beaches, low-key resort operations catering to local and regional clientele can be found; these are incongruously interspersed with small and apparently informal shipyards. There are also a few institutional and industrial facilities along this stretch of coast, and a recently constructed cargo shipping terminal (the Cavite Gateway Terminal in Tanza). The aesthetic character of the Cavite Coast is tied to the sea and the open space and views it engenders, and the community areas immediately inland reflect the beach town ambience. When atmospheric conditions permit, Mt. Mariveles and Corregidor Island can be readily seen, and lend a sense of perspective and aspect of visual interest. Looking westward along the coastline, the hills along the border of Cavite and Batangas can be seen rising up from prominent headlands.

Exhibit 22: Cavite Coast at Aroma Beach Resort, Naic (Looking East)

Exhibit 23: Cavite Coast near BCIB Landing Site (Looking West)

Exhibit 24: Informal Shipyard Flanked by Bathing Beaches, Naic Shore

5.5 Naic Mixed Landscape

The portion of the project area that lies landward of the coastal zone in Naic is a mixed agricultural and residential mosaic undergoing a rapid transformation. The rice paddies, pastures and plantations that once dominated the landscape are increasingly being converted to dense residential subdivisions and industrial estates. Modest residential and commercial strips have long occupied the roadsides in this area, but the green spaces between such roadside strips are becoming smaller and less evident as land development proceeds. The land is very gently sloped, with a general northerly slope aspect, and there is little in the way of topographical variability.

Exhibit 25: Pastureland With New Residential Units in Background, Naic

Exhibit 26: Rice Paddy With New Industrial Park in Background, Naic

6 AREA OF VISUAL EFFECT

The area of visual effect (AVE) is the area within which a proposed project would be easily visible. Project visibility is heterogeneous through time and space within the AVE, as topography, land cover, atmospheric conditions, light and distance all constrain the ability of viewers to perceive built infrastructure.

The AVE can be characterized with reference to both static and dynamic viewsheds. For transportation infrastructure, static viewsheds pertain mainly to viewers in the project's environment: what can the people who live and work near the proposed project see of it as they go about their lives? Dynamic viewsheds refer mainly to the proposed project's visibility to the users of the infrastructure: what visual experience will users of the infrastructure have as they move along it? Especially in the case of a bridge, there is also an element of dynamism for certain non-users, such as people approaching and passing beneath the infrastructure on watercraft of various types.

6.1 Static Viewsheds

6.1.1 Mariveles

The Mariveles portion of the BCIB project area is topographically variable; viewsheds are broad in elevated locations, and less so where the surrounding land is only moderately sloped. A limited number of populated on-land locations in Bataan have good views out over the portion of Manila Bay where the BCIB crossing will be located; some buildings in Alas Asin village have excellent views from their upper stories, as do some vantage points in grassland areas nearer the shore, but land cover prevents long views from most locations in the intervening spaces. The coastline itself is difficult to access in many places, and lightly populated except for the waterfront areas of Cabcaben (2 km northeast of the BCIB landing point) and Kamaya Point (2.5 km west of the landing point).

6.1.2 Naic

Due to very gentle topography and frequent hedgerows and buildings, viewsheds from inland locations on the Naic side of the bay are quite constrained. Few vantage points offer lines of sight longer than about 200–300 m. Buildings greater than 2-3 stories in height are rare and are thus not a prominent landscape feature visible from afar; similarly, broad viewsheds that might be enabled for viewers using the upper floors of tall buildings are non-existent.

The viewshed of most points along the Naic shore is a broad one, taking in a wide sweep of open water with the ocean to the west, the bay mouth to the north, and the long stretch up Manila Bay in the direction of Metro Manila; in clear conditions, Corregidor and Caballo Islands, as well as Mt. Mariveles, are readily visible in the distance. The proposed alignment of the marine viaduct will depart from the shore near a populated beachfront area, and curve to nearly parallel the shore for 2-3 km before extending offshore to meet the South Channel Bridge.

6.1.3 Corregidor Island

Corregidor Island is not permanently inhabited except by the staff of a small number of modest tourist sites and accommodations. The view from most tourist areas on the island takes in either the North Channel with Mt. Mariveles beyond, or Caballo Island with the

South Channel and hills of western Cavite and northern Batangas beyond. The viewshed from the eastern side of the island is more expansive, and includes the full throat of Manila Bay, in addition to the two navigation channels and Mt. Mariveles; however, this part of the island has long been a restricted military area with no tourist facilities, so these views go mostly unappreciated from land. From various elevated historic sites on the south and west sides of Corregidor, there are attractive views southeast and northeast to rocky headlands and islands of northern Batangas and western Bataan, and out to the open South China Sea.

6.2 Dynamic Viewsheds

The viewshed of BCIB users will include a number of visual highlights or marquee elements, encompassing views of both the infrastructure itself and the landscape along the alignment. As motorists proceed southwards from the proposed BCIB interchange on the Mariveles side, they will be on a 5-km incline towards the sea, with a vertical drop of approximately 200 m. Sweeping views of Manila Bay and Corregidor Island will open up in the last 1-2 km before reaching the shoreline. Drivers and passengers will be afforded increasingly clear views of Corregidor Island, as well as shipping activity through the North Channel, as their vehicles proceed out onto the marine viaduct and gradually upwards to meet the North Channel Bridge. The cable-stayed bridge will soon become the focus of attention; the visual experience of passing along the roadway beneath the dramatic cable sprays of a large bridge of this type is a stimulating one for most people. The expected day and night views from the bridge deck is shown in the renderings in Exhibit 27 and Exhibit 28.

Exhibit 27: Expected View Driving Southwards Over North Channel Bridge

On the gradual descent from the North Channel Bridge, BCIB users will get increasingly close views of the forested and topographically varied Corregidor Island, including its undeveloped rocky coastline. Caballo Island will come into view a few kilometers away to the right, and a wide-open view of Manila Bay will be appreciated to the left. A few kilometers on, the ascent to the South Channel Bridge—of similar design but significantly larger and higher than its counterpart over the north navigation channel—will dominate motorists' visual experience, and views of shipping activity in the South Channel will be afforded from the high bridge deck. Such views of ships entering and leaving Manila Bay will be a novel addition to many people's aesthetic experience, as marine traffic through this area is not easily observed otherwise.

For motorists and passengers coming from the Naic side, the multiple rim summits of volcanic Mt. Mariveles will come into view in the distance immediately upon leaving land behind and will remain visible on the right for several kilometers as the alignment curves westward to line up for the approach to the South Channel Bridge. Views of the bay and shipping activity will open up and improve with increasing elevation in the approach to the bridge. The descent from the South Channel Bridge will offer a direct and unimpeded view of Corregidor Island and Mt. Mariveles rising up beyond. Mt. Mariveles will increasingly catch and hold the viewer's eye for the rest of the trip, even while transiting past the coast of Corregidor Island and over the North Channel Bridge.

Exhibit 28: Expected Night View Driving South Over North Channel Bridge

For people viewing the BCIB infrastructure from the water, the viewshed will also be dynamic. The North Channel Bridge will be an additional feature of interest in an already varied visual landscape that includes Mt. Mariveles standing off to the north, the hills and shoreline of Corregidor Island, the rocky headlands around Mariveles Bay to the west, and the tall stacks of the GN Power Plants in Barangay Sisiman, as well as the active shipping in the area. Approaching and passing beneath the cable stayed bridge will be a visual milestone for people transiting through this part of the bay on passenger ferries, tourist boats, cruise ships, fishing boats and cargo vessels. Much the same may be said for the South Channel Bridge, although this structure will be set in a more isolated and less varied landscape, so passage up to and beneath the bridge will be an even more significant perceptual milestone in navigation of the landscape.

6.3 Existing Visual Resources of the AVE

Visual resources can be categorized as natural, cultural and project visual resources. Natural visual resources are existing features of the landscape that derive from geological and ecological processes, such as landforms, water bodies, forests, grasslands and seascapes. Cultural visual resources are landscape attributes that have been produced and regenerated by human activity through time, such as historical landmarks, distinctive land use patterns and stylistic consistencies in built form. Nature and culture are of course intertwined and inevitably combine in the shaping of the landscape (agricultural land use patterns are a classic example of this). Unlike natural and cultural visual resources, project visual resources are not pre-existing features, but features that will be introduced to the visual landscape when a project is built. Prominent local resources in each of these categories are identified below.

6.3.1 Natural Visual Resources

The project area is well endowed with natural visual resources, and some of these can be considered quite significant. The most prominent natural visual resource is Mt. Mariveles, which can be seen from virtually everywhere in the project area, except where the view from ground level is blocked by vegetation or buildings. This volcano provides strong visual interest to the landscape all around the mouth of Manila Bay, and it is likely to be considered attractive by anyone living in or visiting the area. Incidentally, Mt. Mariveles is also visible from the Metro Manila waterfront, and typically figures prominently in sunset photographs from that location (see Exhibit 29).

Corregidor and Caballo Islands are another major natural visual resource, with their thickly vegetated slopes, interesting topographical profiles, and varied (in some places dramatic) coastlines. The islands lend much visual interest to the waters around the mouth of the bay, and are visible from the Mariveles and Naic shores, as well as from the water. The visual interest contributed by these islands is amplified by the fact that they can be viewed from multiple directions, with a significantly different impression from each perspective. The priority placed by the Cavite City government on developing the touristic potential of Corregidor Island is in large part a testament to the perceived attractiveness of this visual resource.

Coastlines other than those of Corregidor Island and Caballo Island are minor visual resources in the project area. A handful of small pocket beaches can be found along the Mariveles shore in the vicinity of the proposed BCIB alignment's landing point, but these are less photogenic than the cliff-ringed coves of the Five Fingers coast, 10 km to the west of the proposed alignment, and are quite difficult to access. One very striking local feature of the North Channel is Mt. San Miguel, a 200-m crag that stands at picturesque Sisiman Bay, seven kilometers west of the BCIB project area (this was shown in Exhibit 17).

Exhibit 29: Sunset View from Malate, Manila (Mt. Mariveles at left)

The Cavite shore is low-lying and would not be considered conventionally attractive from the perspective of viewers out on the bay. The dark sand and murky waters found along this shore seem likely to guarantee that it will never attract the kind of tourist interest enjoyed by coastal areas in other parts of the country, with their clear blue waters. Nevertheless, the beaches of Naic and Tanza are attractive enough to support significant beach tourism, as is evidenced by the existence of multiple beach resorts strung out along the shore between Rosario and Ternate. These resorts are fairly low-key establishments and serve local and regional tourists.

Manila Bay is itself a significant visual resource, likely to be valued for the sense of space it affords, as well as for the contrast to more constrained views of sky and cloudscapes that prevail away from the coastline. The ever-changing sea surface and occasional sightings of dolphins, whales and sea turtles can also be considered as valued visual attributes. The visual qualities of the open waters of Manila Bay can be appreciated from many different vantage points, both on land and on vessels. Marine traffic is a major contributor of visual interest on the waters of Manila Bay.

On the Mariveles end of the BCIB alignment, the inland landscape is a patchwork of agricultural land, residential areas and industrial land. There are many orchards, fields, hedgerows and grassy fallow areas, and some dense riparian growth. The land itself has a pleasingly varied form dominated by ridges and stream valleys, but the landscape is otherwise not particularly remarkable, and the main natural visual resources are those which can be viewed *from* here: Mt. Mariveles, Corregidor Island and the North Channel, and the hills of Western Cavite and Northern Batangas beyond.

Exhibit 30: Beach Resort on Naic Shore

The Naic end of the alignment will traverse an inland landscape of fields used for pasture and wet rice, crisscrossed by residential and commercial strip developments, and increasingly hemmed in by residential subdivisions. The land is very slightly sloped, and natural visual resources consist of riparian vegetation along the three minor estuaries that wind through the landscape, and the vibrant green of young rice during part of the year.

6.3.2 Cultural Visual Resources

The major cultural visual resource in the project area is Corregidor Island, and the numerous remnants of military history that dot the island's landscape. A number of commemorative sites on the island also can be considered cultural visual resources. None of the historic or commemorative sites on the island are visible from any great distance, so the visual impact of these resources is very localized. Similarly, there are several mile markers on the Roman Highway within Mariveles that commemorate the Bataan Death March during WWII; these are cultural visual resources of very localized visibility.

Populated landscapes are partly a cultural expression, and the cultivation patterns and built features observed in the portions of the project area within Mariveles and Naic can be considered cultural visual resources. Neither is a particularly noteworthy or striking example of a significant cultural landscape type, however, with little in the way of distinctive architectural styling or cropping and irrigation systems indicative of any particular highly valued cultural heritage. Neither would be considered a crucial factor in visual impact assessment.

6.3.3 Project Visual Resources

As noted earlier, a substantial proportion of the proposed BCIB infrastructure will either have quite low visibility due to low physical profile and expected obstruction of views by land cover or be situated so far from land as to constitute a rather insignificant portion of the field of view from any on-land location. The visually impressive South Channel Bridge, for example, will stand approximately 11 km from the Mariveles shore, and almost 9 km from the nearest point of land on the Cavite shore in Ternate. Most of the marine viaduct segments' 22-km overall length will be effectively out of the visual reach of on-land viewers. The most notable exception is the North Channel Bridge, which will be much closer to shore than its larger south channel counterpart and will be visible at fairly close range from some coastal communities in Mariveles and from some vantage points on Corregidor Island. The North Channel Bridge will be the dominant project visual resource in relation to on-land viewsheds.

Visibility of the project infrastructure will be much greater from the water, and from the roadways themselves. The most visually significant components of the proposed project for on-water viewers and BCIB users will be the two high cable-stayed bridges. The marine viaducts and land approach roadways will be visible features connecting these soaring structures to each other and to land, but the eye will always be drawn to the towers and cable sprays. The cable-stayed bridges will be highly significant additions to the visual landscape, at least for viewers on vessels navigating along or near the two navigation channels, and for drivers and passengers in vehicles using the crossing. The visual prominence of the cable-stayed bridges will be most pronounced at night when their decorative floodlighting will make them stand out starkly against darkened surroundings.

While the cable-stayed bridges will naturally garner the most attention, the marine viaducts will not be without visual appeal from certain vantage points. The long curving, receding trajectory of the viaduct segments will be quite notable especially from high points such as the Mariveles slope and from the high bridge decks, but also from a number of locations on the low-level viaduct itself, where the eye will tend to seek out the way forward along the oblique sight line on the inside arc of the alignment.

6.4 Population Affected by Visual Change

The BCIB project will impinge upon the viewsheds of three broad groups: (1) viewers on land; (2) viewers on vessels; and (3) viewers using the infrastructure. These groups will encompass people who live locally, people from other areas passing through on their way to somewhere else, and people for whom the project area will be a destination in its own right (including local, regional and international tourists). It is to be expected that there will be some overlap between these groups (for instance, people who live near the approaches, and also use the crossing).

6.4.1 Viewers on Land (Project Neighbors)

Because of the fairly low physical profile of the finished land approaches and planted vegetation that will mostly obscure view of it from surrounding areas, the number of affected viewers in project-proximate areas on land will be quite limited during the operation phase. During the construction phase, the works will be visible to people living near the project sites (within about 250 m) and to those using the local roads that intersect the project alignment. The areas in which the two on-land road segments will be constructed are not heavily populated, being still partly agricultural, so the number of people with a direct view of the under-construction infrastructure will be quite small.

The Mariveles shore in the immediate vicinity of the proposed project alignment is mostly unpopulated, so very few people will have a close view across the water of either the works during construction or the completed infrastructure. Residents of the seaside portions of Mountain View and Cabcaben barangays will have a medium-range side view of the works and the completed infrastructure when looking west and south from the shore, and residents of the small community at Kamaya Point will have a similar view to the east.

Along the Naic beachfront, the viaduct will be visible on the near horizon (less than 3 km offshore). The Naic shore is almost continuously settled, and residents and visitors will be in a position to view nearshore portions of the marine viaduct at fairly close range, and the South Channel Bridge as a distant object. The proposed alignment will curve westward from the shore and roughly parallel the beach for a few kilometers, so people living along, working along, and visiting the coast in the 3–5 km stretch west of the landing point will have a view of the viaduct during construction and operation. Nearest the viaduct's shore landing, of course, the viaduct will be highly visible from shore, and will be an especially prominent visual feature for viewers on the inside arc of the alignment. The BCIB viaduct will also be within the viewshed for people on the nearby shorelines of the Municipality of Tanza and Municipality of Ternate, although at a greater distance. The people whose views will be thus affected will include residents of fishing communities and the staff and visitors of the resorts, which cater mostly to local tourists from central Luzon.

People living inland near the BCIB alignment in Cavite will experience views of the embankment, which will be approximately two stories high, and will run perpendicular to existing local roadways. Most of the embankment will be sloped and vegetated, but one section approximately 400 m long will be of mechanically stabilized earth (MSE) construction and will appear to the viewer as a wall. The embankment may only be visible from within 100-200 m, since the roadways are narrow and tree lined, but its height will be nearly double the height of many homes and other structures in the vicinity, and its presence may give the viewer the feeling of a barrier or division of the community. Viewers of the embankment will consist of residents, small business owners, and tourists traveling to and from the shoreline.

6.4.2 Viewers on the Water

The cable-stayed bridges and viaducts will be highly visible to people transiting the north and south navigation channels, or otherwise navigating in the project area. Viewers of the proposed project infrastructure from below will include local fisherfolk plying the local municipal fishing grounds; passengers on the inter-island ferries running between the Manila waterfront terminals and other ports around the country, as well as between Manila and the Corregidor Island and Mariveles Bay terminals; crew of freighters transiting in and out of Manila Bay; and recreational boaters. On-water viewers of the BCIB infrastructure will be a diverse group. On-water viewers will see the proposed infrastructure in various stages of completion over the 5 to 6-year construction phase, and for many years during operations.

6.4.3 Viewers Using the BCIB Infrastructure

Users of the BCIB will have up-close views of the project infrastructure, during the operation phase only. Such viewers can be expected to include motorists and their passengers in cars, passengers on buses, and truck drivers. People experiencing the visual appearance of the proposed infrastructure from the roadway will include both regular viewers (commuters, truck drivers and local residents of each side), as well as one-time and infrequent viewers (tourists, long-haul truck drivers, and long-haul bus passengers). Like the on-water viewers, people experiencing the visual impact of the BCIB infrastructure while using it will be a diverse group.

6.4.4 Viewer Perceptions

People experiencing the visual impact of a landscape and any infrastructure inserted into it can be expected to have differing perspectives that depend in part on their (mostly unexamined) background expectations for what a landscape should be and do, and how it should be allowed to evolve. Prospective neighbors and users of proposed infrastructure may diverge markedly in their reactions to it, and this is often linked to their perceived self-interests.

Residential neighbors of proposed infrastructure are often correctly assumed to value the landscape as it is and to be inherently skeptical that the proposed project will do anything but harm existing visual quality, although residents of marginalized rural localities in particular often associate new developments (roads especially) with progress and opportunity, and may be far less interested in preserving the status quo for the sake of visual continuity.

Commercial neighbors may be concerned about the effects of new infrastructure on the visual attractiveness of the public approaches to their establishments; entertainment and retail enterprises in particular may fear customers will be deterred by an unattractive milieu. Institutional entities may worry that their prestige and image of efficiency and competence will be damaged if favorable views of their buildings and grounds are compromised but may also be quite interested in the infrastructure's potential to enhance access by customers and suppliers to their properties. Some prospective neighbors may also perceive that the proposed infrastructure will help to correct existing visual 'eyesores', particularly when it would displace such things as abandoned industrial facilities, vacant and neglected lots, garbage dumps, or older infrastructure that is deteriorating, outmoded, disused or otherwise visually unattractive.

There will usually be substantial overlap between the opinions of prospective project neighbors in different categories, as even otherwise skeptical residential neighbors may perceive personal mobility improvements or expect increases in land values as a result of proposed infrastructure developments, and this may influence their judgement regarding both existing landscape values and the possible visual effects of proposed change. And business owners and employees of public institutions are often also local residents and may feel conflicting influences on their perceptions of the landscape.

FHWA guidance on visual impact assessment indicates that people almost universally make subconscious judgements about three aspects of a landscape's appearance while viewing and forming a reaction to it: natural harmony, cultural order, and cohesiveness. Natural harmony refers to whether natural systems are in some kind of healthy equilibrium; if something is disharmonic (e.g., an obviously polluted watercourse, dying or damaged trees, a gash on an otherwise attractive hillside), the assessment of visual quality will be less favorable.

Cultural order concerns the compatibility of landscape components—particularly built ones—with what might be considered the ‘normal’, ‘right’, or ‘prevailing’ way of organizing space into place. Structures that depart dramatically in style from what is around them (e.g., avant-garde or modernist annexes built onto classical heritage buildings); overwhelm their surroundings through sheer scale of intervention (e.g., a very tall building in an area with only low-rise development); or seem out of character (e.g., a ‘big box’ retail outlet building in a mixed commercial-residential district in which small family-run shops have traditionally predominated) typically are controversial. Zoning bylaws and aesthetic guidelines are often put in place specifically to prevent such breaches of the cultural order.

Cohesiveness refers to a proposed project and its spatial and functional integration with existing uses and flows in the landscape, including other infrastructure. Transportation projects that seem to stand alone, with poorly articulated linkages to other infrastructure or accommodation for anything other than the traffic they carry (e.g., urban expressways and interurban highways that effectively bisect the landscapes they cross, for lack of user-friendly rights-of-way to enable crossing from one side to the other) are unlikely to be considered attractive by viewers in the community. Also, projects that attempt to honor and nurture their host landscapes (e.g., highway projects that incorporate native plantings and public greenways linking natural areas along their rights-of-way are likely to be considered visually appealing.

To gauge the expectations of people in the project area regarding the visual impacts of the BCIB project, questions pertaining to aesthetics and visual impact were incorporated into a broader perception survey administered as one of the key stakeholder engagement tools used during preparation of the updated project EIA. The perception survey was administered in person in various venues around the project area during two field periods (February 2022 and May–July 2022) and was also made available in an online format from February–July 2022. In all, 650 people participated in the perception survey, with 350 from Mariveles and 300 from Naic; most respondents (621) participated in person rather than online. Respondents were 57% female and 43% male in Mariveles, and 46% female and 54% male in Naic. The median age of respondents was 32 in both Mariveles and Naic. In both Mariveles and Naic, 86% of respondents indicated that their highest level of educational attainment was either secondary school, college diploma or university degree.

Three survey questions pertaining directly to aesthetics and visual impact were included in the perception survey. Respondents were asked to look through a series of artistic renderings of the BCIB infrastructure before talking the survey, and to base their responses to the three aesthetics questions on the renderings. The renderings shown can be seen in Appendix 1.

The first question regarding aesthetic matters was as follows: *Based on the drawings in the handout, please rate your impression regarding the likely attractiveness of the bridge on a scale of 1 to 5, where 1 is "not very aesthetically pleasing" and 5 is "very aesthetically pleasing".* The survey results for this question are shown in Exhibit 31. The respondents expressed an unfavorable impression overall, but a marked contrast can be noted between perceptions of respondents in Mariveles and Naic. In the Mariveles results, the two most unfavorable rating categories together account for over 80% of responses, and 'not very aesthetically pleasing' is the leading category. Only 12% of Naic respondents, on the other hand, rated the BCIB infrastructure as 'not very aesthetically pleasing', and the two least favorable rating categories collectively accounted for just under 40% of overall responses there. Responses on the positive end of the scale were more prevalent in Naic than in Mariveles.

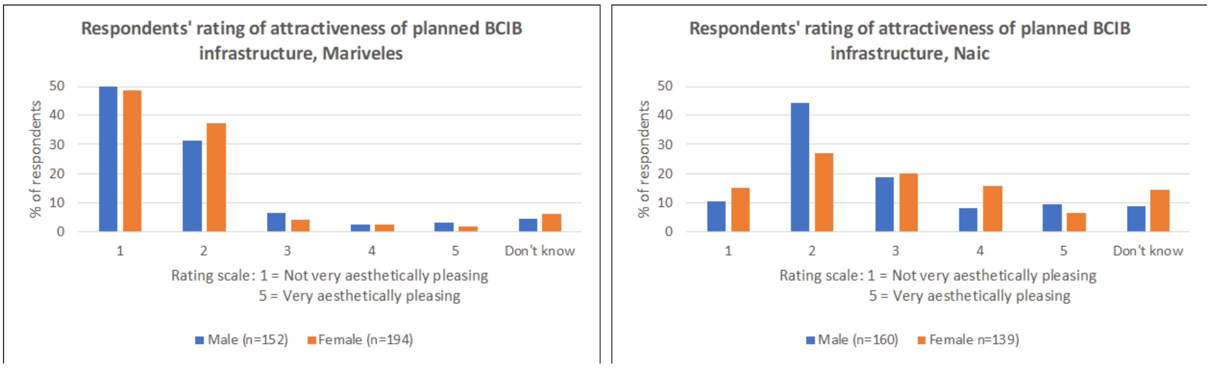


Exhibit 31: Perceptions of Likely Attractiveness of BCIB Infrastructure, Mariveles and Naic

A second survey question concerned respondents' expectations regarding the visual impacts the BCIB infrastructure will have on the host landscape, including on people's views: *Based on the drawings, please rate your impression of the likely visual effect of the bridge on the landscape and/or the view, on a scale of 1 to 5, where 1 is "not very aesthetically pleasing" and 5 is "very aesthetically pleasing"*. The survey results for this question are shown in Exhibit 32. In a pattern nearly identical to that revealed in relation to the first question, responses skewed negative in general, but markedly less so in Naic than in Mariveles.

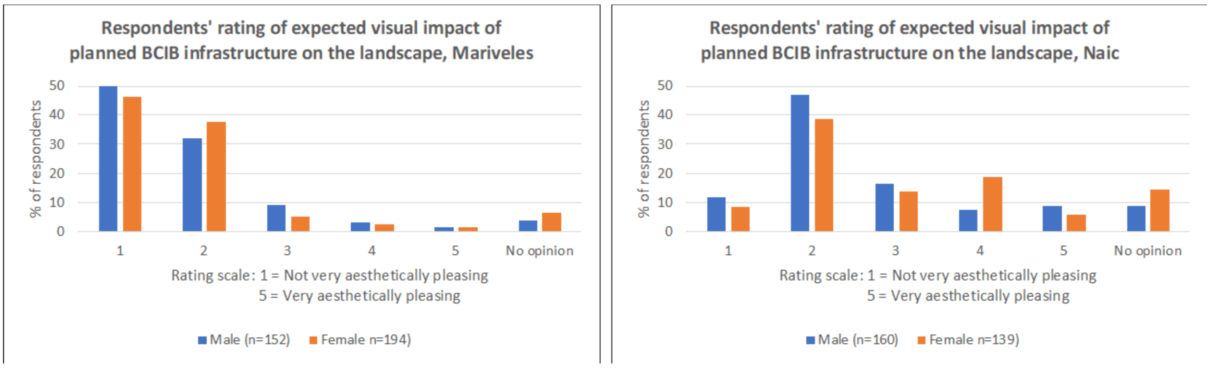
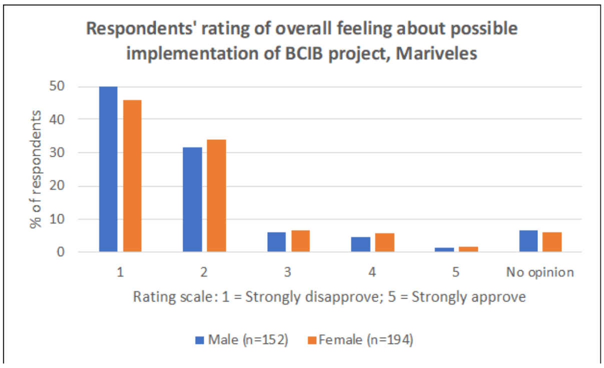


Exhibit 32: Perceptions of Likely Visual Impact of BCIB Project on Landscape, Mariveles and Naic

A third survey question attempted to identify specific concerns respondents might have regarding the possible aesthetic dimensions about the BCIB infrastructure: *Do you have any specific concerns about the appearance of the bridge or its visual effect on the landscape, and if so, what?* This survey question did not yield any significant insights, in either Mariveles or Naic, due to apparent misinterpretation by respondents; most responses were either non-responses such as 'None' or positive commentary not indicative of any concern. The few concerns noted by respondents were not relevant to visual impacts or aesthetics.

Absent any meaningful insights from responses to the third aesthetics question, there is not a strong basis for reflection regarding the underlying reasons for the generally negative ratings assigned, or the observed differences in perceptions between Mariveles and Naic respondents. It is possible that respondents on the Naic side of the project area are less strongly averse because the most visible project infrastructure will be quite far removed from the Naic shore. Greater proximity of the major bridges to Mariveles may be reflective of a more prevalent association of the project with a sense of disruption or imposition. Regardless, it seems likely that the respondents' opinions regarding aesthetics are influenced by broader views on the project as a whole; indeed, the pattern of stronger expression of favorability in Naic on the aesthetics questions mirrors survey results regarding respondents' overall feeling about the BCIB project. For the capstone survey question *On a scale of 1 to 5, where 1 is "strongly disapprove" and 5 is "strongly approve", how would you rate your overall feeling about the possible implementation of this project?*, the two least favorable rating categories accounted for 78% of responses in Mariveles, but only 35% of responses in Naic. Respondents indicating that they had no opinion were far more numerous in Naic than in Mariveles (see Exhibit 33).



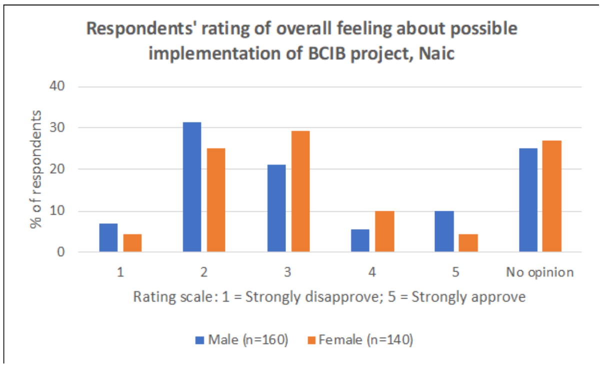


Exhibit 33: Overall Feelings About Implementation of BCIB Project, Mariveles and Naic

6.5 Anticipated Visual Impacts

6.5.1 Impacts on Existing Visual Resources in the Project Environment

Development of the BCIB project can be considered unlikely to severely affect existing visual resources, except for those closest to the Cavite land-side embankment. No significant visual feature or scenic visual corridor will be removed or degraded. The marine components will supplant an 'open sea' aesthetic along its path, but there is nothing about this aesthetic that is particular to the areas along the alignment, and there are many other nearby portions of Manila Bay where it will still prevail after the project has been developed. The BCIB itself will be a significant feature, worthy of admiration for its size and vivid design features. Around the world, bridges of the scale and stature of the BCIB draw attention and are commonly featured in tourist attraction brochures. The BCIB is likely to be a new draw of attention to both Cavite and Bataan for more viewing opportunities. This is a different aesthetic than the current low-key beachfront that currently prevails on the Cavite shore. The landside embankment in Cavite is anticipated to result in a sense of barrier or visual dominance over the otherwise low-profile buildings. This will result in a visual change to the character and experience of the community. Construction will affect local community areas mostly in Cavite, because the BCIB will result in displacement of homes and small businesses, and there will be years of construction equipment and lighting and dust associated with construction nearby residential areas. The potential for this is not as great in Bataan because the alignment is sparsely populated, the terrain is undulating, and the tree cover is more extensive. Viewers affected in Bataan are those who already experience the Roman Highway traffic, and can expected to be more accustomed to higher levels of activity.

6.5.2 Impacts on Viewers

The significance of anticipated impacts on viewers will vary by viewer group and location. The analysis that follows draws out the main affected viewer groups and reflects on the importance of location in shaping impacts within those groups.

6.5.2.1 Viewers on Land

Views of on-land infrastructure from the direct vicinity

Based on the visual characteristics and visibility of the project's on-land components, impacts on ground-level viewers in the near vicinity of the roadways can be expected to arise during the construction phase, as there will be no feasible way to shield the under-construction embankments and crossing structures from view. However, this impact will be temporary.

Regarding the operation phase, design elements and vegetation can be incorporated to soften the infrastructure's appearance and integrate it favorably with the residential character of community areas nearby , especially at underpasses. The BCIB will not interfere with scenic view corridors or block culturally significant features. The anticipated visual impact for people living and working along the roadways can be classified as 'adverse' (temporary and minor) for the construction phase, and with mitigation, 'beneficial to neutral' for the operation phase.

Seaward views from Mariveles

For on-land viewers in a position to regularly view the nearshore segments of the marine viaducts, the visual impact is likely to be mixed. Some people living at favorable higher-elevation vantage points on the Mariveles side (mostly in and around Alas Asin village) will be able to see the crossing curving away towards Corregidor Island and the distant Cavite shore, and this distant view is likely to be considered a pleasing one, as the infrastructure will add a relatively unobtrusive and complementary element of interest to the generally attractive visual landscape centered on the North Channel and Corregidor Island. It is to be noted that few people have clear views out over the bay, and those that do will see the bridges and viaducts at a distance of at least 5 km, so the infrastructure will occupy a small proportion of the viewshed. The anticipated visual impact of the proposed project for people in these upslope locations can be classified as 'beneficial', though of minor magnitude due to the distance factor. Also, visual impacts on these viewers' visual experience during construction will be negligible, and accordingly classified as neutral.

As has been noted previously, the shoreline in southern Mariveles is sparsely inhabited, and this lessens the potential for visual impact, whether positive or negative. The primary inhabited shore-level vantage points are in Cabcaben, 2 km northeast of the project alignment landing point, and the small fishing village at the base of Kamaya Point Road, 2.2 km southwest of the landing point.

From Cabcaben, the west- and southwest-facing viewshed is dominated by Corregidor Island (see Exhibit 34). The nearest part of the island is 6 km from Cabcaben, but the island is nevertheless a dominant landscape feature (more than the photograph in Exhibit 34 suggests). The BCIB project will be positioned between Cabcaben and Corregidor Island, and thus will alter residents' view of the island. The North Channel Bridge will have a fairly limited obscuring effect on the view to the islands, as it will occupy a narrow slice of the viewshed (see sight lines 1 and 2 in Exhibit 35), but the overall view to the islands will be screened by the supports of the bridge and the high viaducts. For perspective, it may be noted that the towers of the North Channel Bridge are to be 150 m tall, the same height as the highest part of Corregidor Island but will be approximately 50% closer to Cabcaben-positioned viewers, and so will appear to stand about twice as tall. The rugged Hooker's Point at the tip of Corregidor Island's Tail End, despite being several kilometers distant, is visually interesting as seen from the Cabcaben area, but most of the land here stands barely higher than the designed height of the viaduct and turnaround and will be mostly hidden behind them (sight line 3). These screening and blocking effects will represent a permanent impairment of residents' view of the island. This negative effect will be balanced, however, against the visual interest provided after dark by the North Channel Bridge's decorative lighting, a middle-distance feature that most viewers are likely to find pleasing. On balance, the visual impact of the BCIB project for residents of the Cabcaben waterfront can be considered neutral for the operation phase. Visual impacts at Cabcaben derived from construction activity are unlikely to be significant, given that all work sites will be at least 2 km away.

Exhibit 34: Corregidor Island from Cabcaben Waterfront

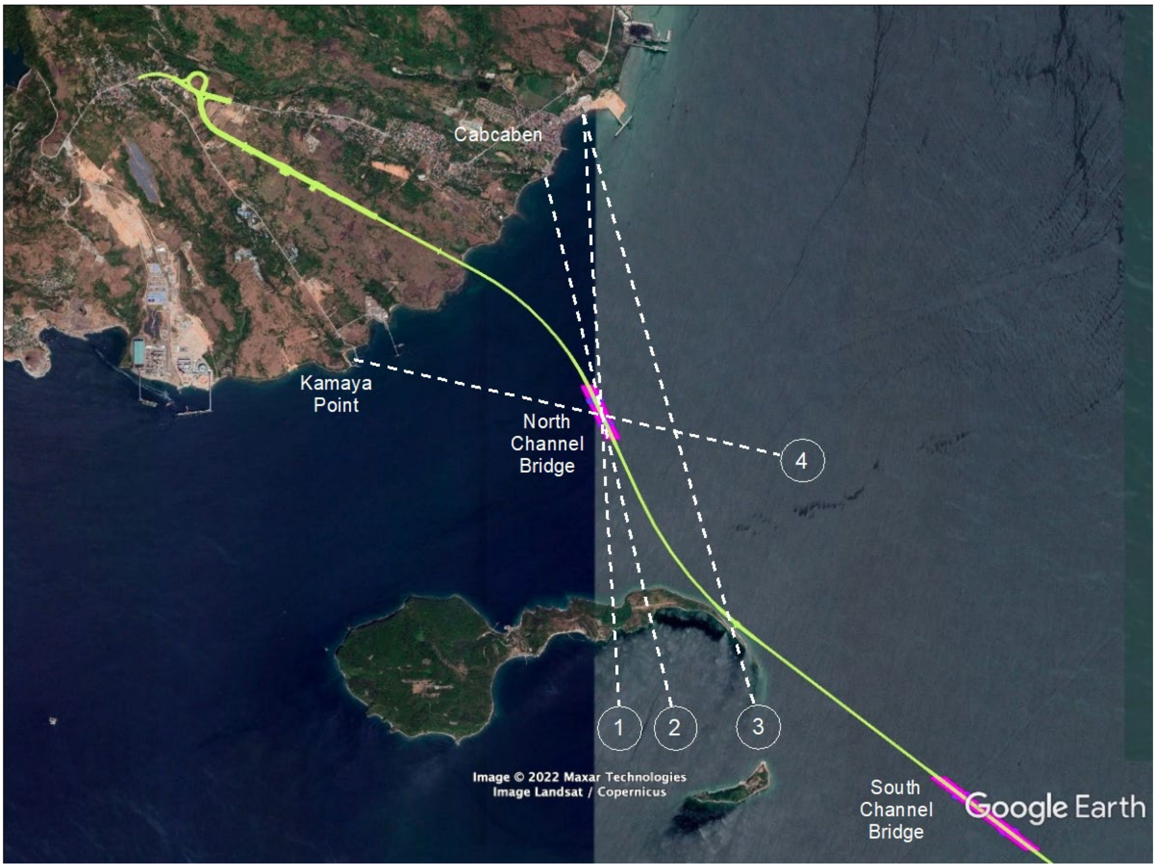


Exhibit 35: Sight Lines to Corregidor and Caballo Islands from Cabcaben Beachfront

For the residents of the small community at Kamaya Point, the BCIB project will not block any part of the view to Corregidor Island, which is closer than it is to Cabcaben, and therefore has even greater prominence in the south-facing viewshed. From this vantage point, the North Channel Bridge will be viewed from a less oblique angle, and it will be possible to see both towers and cable sprays distinctly (see sight line 4 in Exhibit 35). The bridge will be about 4 km from this location, about the same as the width of the North Channel, so the 150 m-bridge towers will appear to the viewer in proportions roughly commensurate with the height of the island (also about 150 m), and therefore should not be visually overwhelming (see Exhibit 36). In daylight hours, the substantial mass of the island is likely to remain the center of visual interest, balanced only partially by the visually permeable bridge and viaduct infrastructure. At night, the bridge lighting should provide a pleasing—and again not overwhelming—spectacle in the middle distance and will draw the eye to a much greater extent than will the mostly unlit island, effectively re-centering the viewshed. The bridge and viaduct will impair eastward views of the expanse of Manila Bay from this location, but this is not a particularly interesting seascape, so this negative effect can be considered negligible. On balance, the visual impact of the BCIB project for viewers in the Kamaya Point community is likely to be moderately beneficial for the operation phase. Construction-derived visual impacts for people at this location are expected to be minimal, given the distance of at least 2 km to the marine construction sites. The primary visual impact during construction will be derived from the substantial construction vessel traffic through the viewshed, transiting between the alignment and the drydock and casting yard, which will be located about 1 km west of Kamaya Point (those facilities themselves will be mostly or entirely outside the viewshed of the Kamaya Point community); this temporary visual impact is not likely to be significant, and may be considered to add visual interest for many viewers for the time it lasts.

Exhibit 36: North Channel and Corregidor Island from Kamaya Point Community

Seaward views from Corregidor Island

The potential for project impacts on views from Corregidor Island is limited by the island's highly varied topography, thick vegetation, and the locations of visitor facilities. There are currently few opportunities for close-range views of the nearshore and offshore areas through which the alignment will pass. Most tourist sites are located around former military installations in the western half of the island. Much of the island's Tail End has been a restricted military zone for decades, and no visitor access points have been established to the north or east of the airstrip, where direct, close range views would be possible. However, there are a number of vantage points from which the BCIB infrastructure will be visible; these are shown in Exhibit 37, and discussed individually below. All viewsheds discussed are static ones; although there are numerous roads winding around the island, thick roadside vegetation affords little more than the occasional fleeting seaward glimpse, thus dynamic viewsheds are not of any significance. There are no facilities for visitors on Caballo Island, which still houses significant stores of WWII-era munitions and is a restricted zone, so the view from there is not considered.

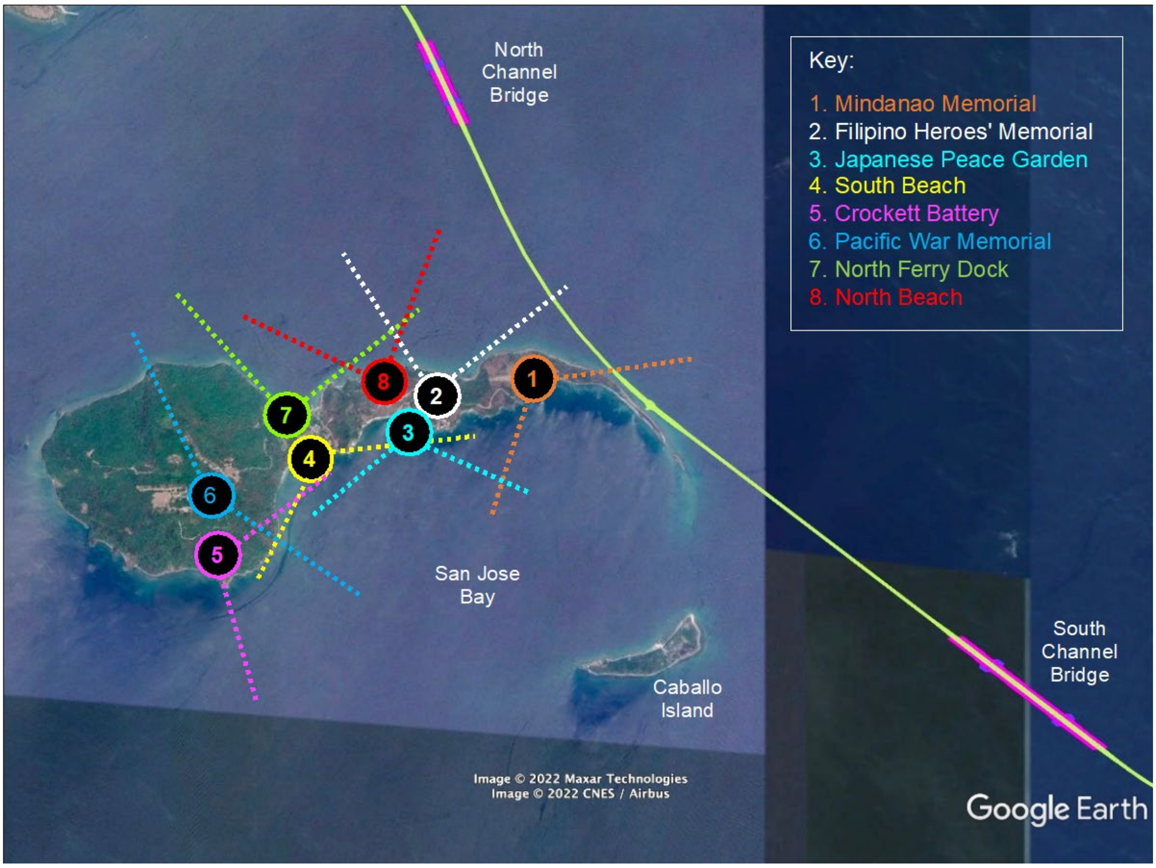


Exhibit 37: Vantage Points and Viewsheds on Corregidor Island

Mindanao Memorial

This memorial site (No.1 in Exhibit 37) is just south of the airstrip in the Tail End and has an overlook (30 masl) with open views over San Jose Bay to the southwest, south and southeast. The southeastwards view is along the rugged forested spine of Hooker's Point, and at present offers a strong 'unspoiled nature' aesthetic (see Exhibit 38). The viaduct and turnaround will impinge upon this nature-dominant scene, with the turnaround visible at a range of just 1.2 km across Hooker's Point, and the viaduct occupying the horizon across the visual gap between Hooker's Point and Caballo Island. It is likely that the addition of a four-lane elevated highway to the view here will be considered an unfavorable visual intrusion to many or most visitors.[4] The South Channel Bridge will be visible at a range of 5.3 km, and given the 305-m height of the bridge towers, will be a prominent new feature of the visual landscape. However, the bridge is unlikely to detract from the more locally scaled wild nature aesthetic to the same extent that the viaduct and turnaround will, as it will serve more as a backdrop than an intrusion. Many or most visitors to this viewpoint may well find the South Channel Bridge awe-inspiring and pleasant to behold, even at a range of 5.3 km. From this vantage point, the bridge will be seen almots end-on, so it will occupy a smaller slice of the viewshed than it would in the case of a full side view but may also be less visually interesting from this perspective. Considering the likely moderate to strong adverse impact on the near-range view and likely mild beneficial impact on the longer-range view, the probable visual impact of the BCIB infrastructure on views from this vantage point can, on balance, be considered mildly adverse for the operation phase. During

[4] This effect will be substantially worsened if a spur connection to the island from the turnaround involves an elevated roadway across San Jose Bay, as has been hypothetically postulated as one possibility by the BCIB design team. From a visual impact perspective, it would be preferable to find a land route for the access link. This is a matter for a separate EIA study of possible future development plans involving a link from the BCIB turnaround.

construction, the view from the Mindanao Memorial will be moderately degraded by the marine works; this adverse visual impact will be temporary, although of significant duration (more than two years for the components in the near distance).

Exhibit 38: Southeasterly View from Mindanao Memorial

Filipino Heroes' Memorial

This major memorial site (No. 2 in Exhibit 37) offers views to the north and southwest; the primary exposure to the BCIB infrastructure concerns the north-facing vantage point. The North Channel Bridge will be visible at a distance of 2.8 km and will figure prominently in the viewshed. As the viewpoint sits at about 50 masl, the view of the bridge and its high approaches will be mostly horizontal rather than upwards, which should make the structure seem less imposing than it would appear from a position at sea level. The North Channel Bridge will be seen from a deep oblique perspective and will not block sight lines to any significant visual resources (only the view of distant industrial facilities will be directly affected). A limited portion of the lower viaduct closer to the island will be visible at a range of 1.5–2.0 km, in a downward view. The visual impact of the BCIB infrastructure on the north-facing viewshed from the Filipino Heroes' Memorial seems unlikely to be considered strongly or even moderately negative by many visitors, and, at the same time, can be expected to elicit at least moderately positive reactions from viewers who find cable-stayed bridges interesting to behold. On balance, the probable visual impact from this vantage point is mildly beneficial for the operation phase. A moderate adverse visual impact can be expected during the construction phase, lasting for a period of three years or more.

Japanese Peace Garden

This commemorative site on a low headland beside San Jose Bay (No. 3 in Exhibit 37) is oriented more to contemplation than outward-looking visual experience, but does offer limited views over San Jose Bay, primarily in a southwesterly direction. A view to the southeast and the future location of the BCIB is possible from one part of the site for those who seek it out (see Exhibit 39), but the proportion of visitors who will do this is probably quite low. The South Channel Bridge will stand 5.6 km from the Japanese Peace Garden (approximately where the ship can be seen in Exhibit 39) and the high towers will be visible and even prominent, but given that they will not be 'front and center' in the viewshed, the effect on the vast majority of site visitors will be quite minimal. The visual impact of the BCIB infrastructure at this site can therefore be considered neutral.

Exhibit 39 Southeasterly View from Japanese Peace Garden

The same can be said for the beach recreation area to the immediate west of the Japanese Peace Garden, as southwesterly views from the beach are blocked by the headland on which the garden is situated. Given the distance from both sites to the marine construction works, the potential for visual impacts during the construction phase is expected to be negligible.

South Beach

South Beach is a mixed sandy/cobbly beach across a narrow saddle from the main ferry dock on the island's north side and is the most accessible beach on the island. There is a secondary ferry dock extending from the beach, which is used when wind conditions are unfavorable at the main dock. From South Beach, the BCIB viaduct will be visible on the horizon at a range of 4 km, where it will be seen to emerge from behind Hooker's Point and remain a horizon feature all the way to the South Channel Bridge. Although there are some visitor sites on the shore between South Beach and Hooker's Point, including the Japanese Peace Garden and adjacent beach area, these are out of view due to intervening forested headlands, and the southeastward view has a natural aesthetic. This natural aesthetic will be degraded by the addition of the marine viaduct to the horizon, particularly as the viaduct will, from this perspective, pass directly behind the picturesque cliff-bound islet that stands off the end of Hooker's Point. The 4-km distance will render the degradation less severe from the viewer's perspective than it will be at closer range, e.g., from the Minadanao Memorial. The South Channel Bridge will be quite noticeable to the left of the Caballo Island silhouette, but as the towers will stand 7 and 8 km, respectively, from the South Beach-positioned viewer and the structure will be seen from an oblique perspective, the visual effect is unlikely to be especially powerful.

Exhibit 40: Southeasterly View from South Beach

Neither appreciators of the wild nature aesthetic nor admirers of bridge architecture are likely to experience strong emotion upon viewing the BCIB infrastructure from the South Beach, and the overall operation-phase visual impact in relation to this vantage point can be considered effectively neutral on balance. No special additional visual impact is expected from construction activity, given the distance to the works sites.

Crockett Battery

From the roof of this ruined gun battery perched at 140 masl on the southeast side of the main body of Corregidor Island (No. 5 in Exhibit 37), a commanding view can be had eastwards over the Tail End, Caballo Island and the intervening waters of San Jose Bay, and also southwards to the hills of western Cavite and northern Batangas. The South Channel Bridge will be visible at a range of 8 km and will appear to rise out of the north side of Caballo Island, which lies between the battery and the bridge site. Although quite distant from the South Channel Bridge, this site will offer the least oblique view of the structure of any on-land vantage point on Corregidor Island, and viewers should be able to make out both towers and cable sprays with ease. Given the distance between the viewpoint and the bridge, the visual impact of the project at this location is unlikely to elicit any significant negative response from visitors, and positive response may also not be particularly strong. It is also worth mentioning here that many visitors to the Crockett Battery will not actually climb to the roof to take in the view. Taking account of all factors mentioned, the expected visual impact for the operation phase is appropriately classified as 'mildly beneficial'. It is not expected that construction activity will present any special visual impact, beyond the fact that the distant, partially completed infrastructure is unlikely to be visually pleasing. Given the substantial distance from this vantage point to the alignment, this adverse impact will be a mild one.

Pacific War Memorial

From the end of the open grassy area extending eastward from the Pacific War Memorial (elevation 160 masl), a wide vista can be enjoyed, taking in Mt. Mariveles, all of the North Channel, the long tail of the island winding its way off to the south, and Caballo Island. This vantage point has the most comprehensive visual exposure to the BCIB infrastructure of any point on the island. The North Channel Bridge will be seen 4.5 km away to the northeast, from an oblique perspective, and the South Channel Bridge, also an oblique view, 8 km to the southeast. Given their relative sizes and distances off, the two bridges are likely to make a similar impression on viewers from this location. Unlike all other vantage points, the Pacific War Memorial viewpoint will give the viewer a sense of the BCIB as a coherent infrastructural entity, as it will be possible to take in approximately 13 km of the project's overall length, from the Mariveles shore to the South Channel Bridge. Many viewers are likely to find this grand sweeping view of the bridges and viaducts linked together across the middle distance, together with the elegant curvature of the island's Tail End portion, impressive and pleasing. The visual impact of the BCIB project, as perceived from this location, can be considered moderately to strongly beneficial. In the construction phase, the same comprehensive view will be of partially completed infrastructure and will not be as impressive; this less attractive phase will result in a mildly adverse visual impact for a period of 4–5 years.

Exhibit 41: Easterly View (Composite Panorama) from Nearby Pacific War Memorial

North Ferry Dock

The main arrival and departure point for visitors to Corregidor Island, the north ferry dock offers a fairly broad view across most of the North Channel, including the North Channel Bridge site. The bridge will be 3.5 km from the dock area and will be visible from a perspective that is only moderately oblique, meaning that the full breadth of the bridge's cable sprays will be visible. As the vantage point is at sea level, the bridge will occupy a substantial space in the northeastward portion of the viewshed, despite being over 3 km away. Unlike many of the viewpoints on the island, the ferry dock may actually be frequented to some extent into the evening, giving visitors a full view of the bridge's night lighting. The BCIB infrastructure will not block views of Mt. Mariveles or any especially attractive view to the northeast, and it is quite likely that most viewers will find it a pleasing addition to the visual landscape of the North Channel.

Exhibit 42: Northeasterly View Over North Channel from North Ferry Dock

The visual impact of the finished project as perceived at this location is considered likely to be moderately to strongly beneficial. During the construction phase, which may endure for 3–4 years at this location, a moderately adverse visual impact is expected, on the assumption that few viewers will find partially completed infrastructure particularly attractive.

North Beach

An undeveloped beach separated from the north ferry dock by three headlands, North Beach is currently accessible only by walking trail and so is not heavily frequented, but there are plans to build a minor spur road down to the beach in the near term. This vantage point has views similar to those from the ferry dock, although the North Channel Bridge will be somewhat closer (2.8 km) and will be visible from a more oblique angle. Because of a prominent headland to the east of this beach, most of the viaduct south of the bridge will be out of sight for beach users. To the extent that individual viewers may enjoy looking at large bridges, the presence of the North Channel Bridge at medium range will offer an enjoyable visual experience, but otherwise it is not likely to invoke strong positive or negative reactions. Overall, the expected visual impact of the BCIB project at this location is classified as mildly beneficial. During the construction phase, a partially completed North Channel Bridge will stand in direct view for a period of 3–4 years, and this can be expected to constitute a moderately adverse visual impact.

Seaward views from Naic beachfronts

For viewers on the Naic shore, of which there will be many in the fishing communities and resorts lining the beaches, the visibility of the BCIB project will be high, even though the two most visually prominent project features will be far away. Here, the viaduct will extend out from the beach along a gentle arc from the landing site westwards to a point about 6.5 km linear distance, from where it will bend away to the northwest. This alignment places the viaduct directly in front of beach-positioned viewers, at distances ranging from 0–3,000 m (see Exhibit 43).

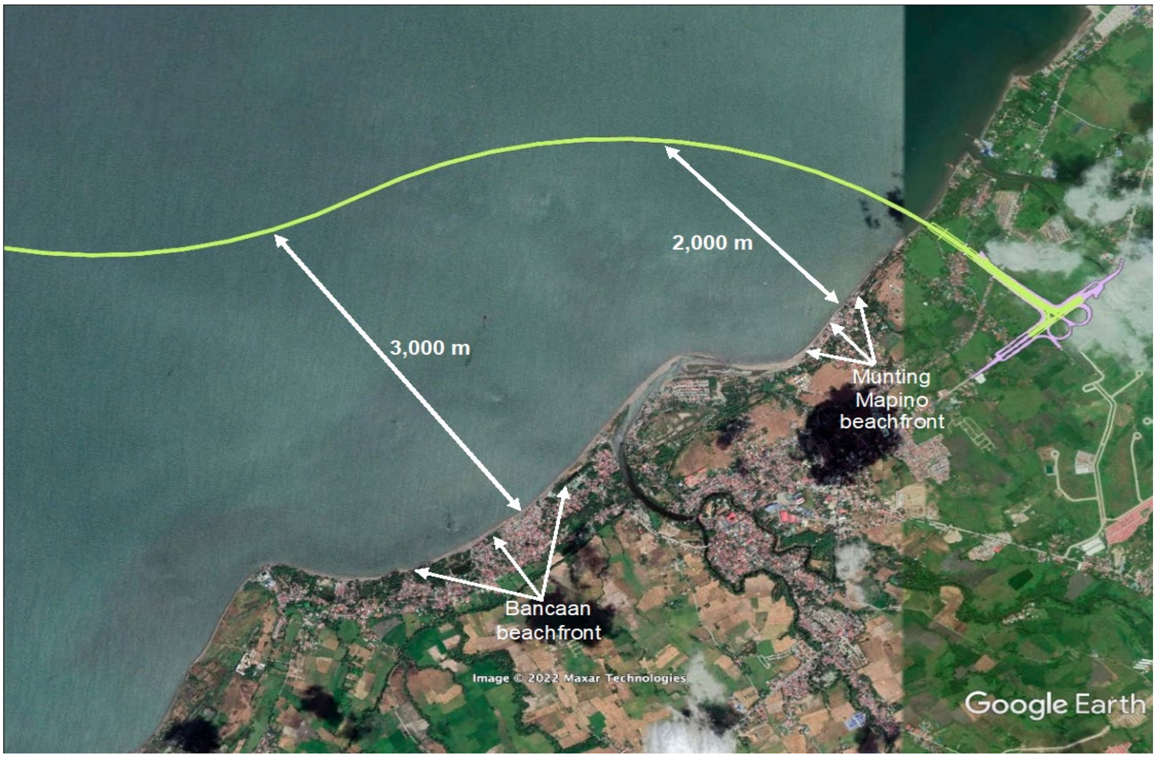


Exhibit 43: BCIB Alignment Near Naic Beachfronts

Nearest the landing point, where the viaduct will stand higher than the eye, the viewer will be required to look through the gaps between support piers to observe the open bay and the slopes of Mt. Mariveles in the distance, and the viaduct deck will obscure part of the normal view.

Further to the southwest, the viaduct will run parallel to the shore, 2.5–3 km from the beach; from vantage points on this part of the shore (mainly Barangay Bancaan), the viaduct structure will appear on the horizon as a thick whitish line on stilts. While this shore-parallel segment will not block the view of Mt. Mariveles from the shore, it will obscure views of the natural sea horizon, and modify the view of Corregidor and Caballo Islands. The South Channel Bridge will block views of Corregidor and Caballo Islands from Munting Mapino and Bancaan (see Exhibit 44), and this may be disappointing to some. It has to be acknowledged here that the view to Corregidor and Caballo Islands from the Naic beachfronts is a distant one (14–20 km, depending on the combination of vantage point and feature viewed) and is sometimes substantially obscured by haze, so the blockage may not be considered a severe loss by many people. For some, the addition of the 300 m-tall towers and cable sprays of the South Channel Bridge (especially when lit at night) may be a favorable substitution for the impaired views to the islands.

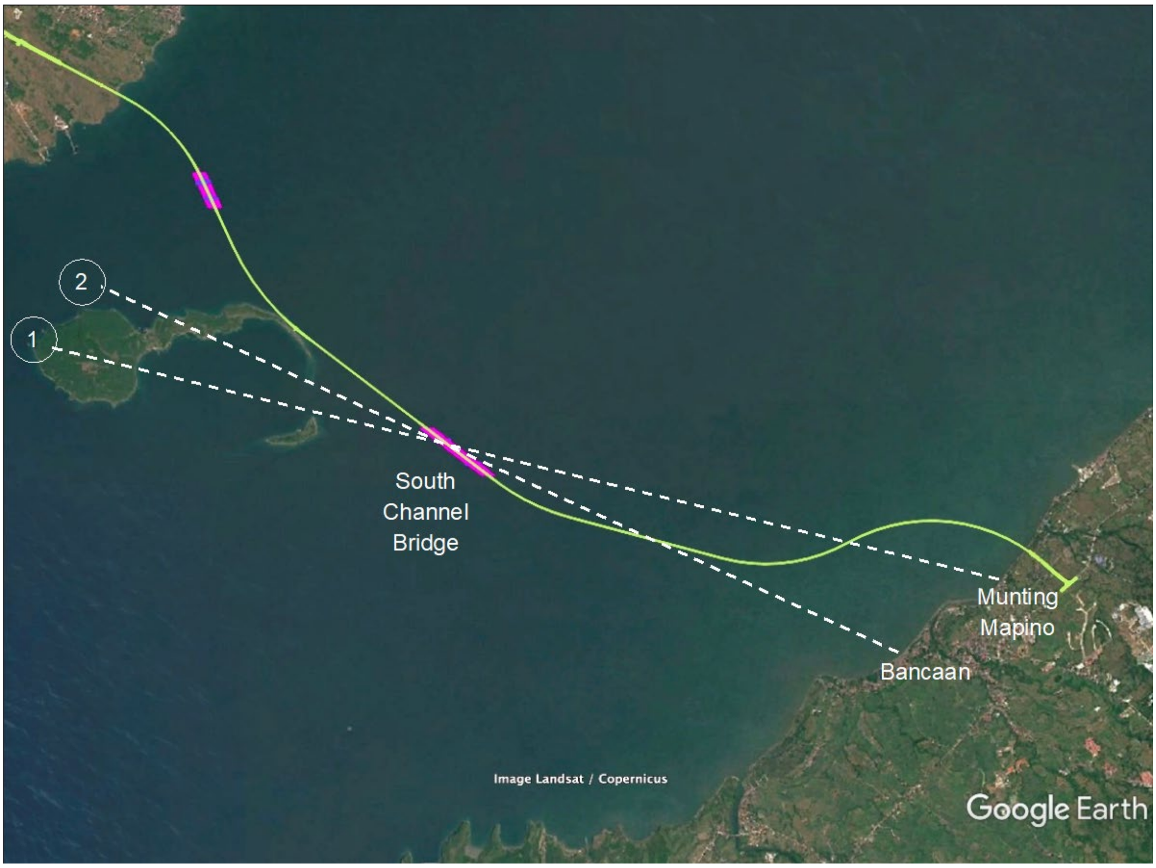


Exhibit 44: Sight Lines from Naic Beachfronts to Corregidor and Caballo Islands

The viaduct's nearshore presence will not noticeably alter the sea state or affect the sea breeze, but a subtle transformation in the aesthetic of the seascape is likely to take place in the beachfront areas of Naic, with the sense of wide-open sea being supplanted by a feeling of being within a more narrowly scaled protected embayment. At night, the running lights of vehicles moving along the roadway will be partially visible flickering through the barred railings. The addition of this feature to the visual landscape seems likely to be considered a mild annoyance by some amenity-seeking beach users, but others may find the viaduct visually enhancing to the sea view, in that it curves and will lead the eye to Corregidor Island as a far destination. Given the viaduct's distance from shore, neither adverse nor positive reactions are likely to be strongly felt.

During the construction phase, the daytime view of the works will include a series of structures in various stages of assembly. It is expected that construction lighting will be used to support around-the-clock work and materials transit in this area during at least part of the construction phase. These visual impacts can be considered broadly incompatible with the aesthetic values underpinning beach tourism, although they will be minimized by distance for most locations. The anticipated visual impact of the BCIB for residents and tourists on the Naic shore can be classified as adverse during the construction phase, with the severity of the impact being greatest in the first 1 km southwest of the alignment landing point, where the works will be closest to the beach. The mildly to moderately adverse construction phase visual impacts will be temporary and will diminish as the viaduct works proceed from the first works in the nearshore zone to locations further offshore.

6.5.2.2 Viewers on the Water

For on-water viewers, the proposed project will add an object of considerable visual interest to the landscape. People on vessels will have excellent side and oblique views of the cable-stayed bridges from multiple ranges, and when approaching or passing beneath the bridges and viaducts, a close look at the attractive styling of the piers and towers. Passing beneath the cable-stayed bridges will likely be a stimulating visual experience for passengers and crews alike. At night, the decorative lighting on the towers, cables and piers will enhance the experience significantly. The anticipated visual impact of the project for on-water viewers can be classified as ‘strongly beneficial’ for the operation phase.

The visual appearance of the project for on-water viewers during the construction phase can be expected to range from unpleasant to mildly interesting, depending on the personal interests of the viewer. At this stage, which will last for 4–5 years, the project will lack the visual cohesiveness of the finished product and will be unlikely to elicit strongly positive visual impressions from most viewers. At the same time, those who find the construction process interesting or inspiring to observe, passing near the area during the construction phase is likely to offer an enjoyable viewing experience. Taking these considerations together, the anticipated visual impact of the project for on-water viewers during construction can be classified as more or less neutral.

6.5.2.3 Viewers Using the BCIB Infrastructure

The visual impacts for users of the BCIB will be broadly positive. The project will open up an entirely new visual experience for the traveling public. A crossing of the bridge will give drivers and passengers evolving attractive views of Mt. Mariveles, Corregidor and Caballo Islands, and shipping in the north and south navigation channels. Passing between the cable sprays of the two navigation bridges will be a visual highlight, likely to be universally enjoyed. The anticipated visual impact for BCIB users can be classified as strongly beneficial. Visual impacts during construction are not applicable to this viewer group.

6.6 Mitigation of Visual Impacts

The visibility of a project as large and spread out as the proposed BCIB is difficult to modify in order to reduce adverse visual impacts, and it is fortunate that beneficial visual impacts are anticipated to be more numerous than adverse ones. In addition, for several affected locations, mild to moderate adverse visual impacts are appropriately balanced against beneficial ones at the same location. Operation-phase adverse impacts not fully offset by a corresponding beneficial effect have been identified above for viewers at one site on Corregidor Island (the Mindanao Memorial) and for viewers along the Naic beachfront (particularly the barangays of Munting Mapino and Bancaan). Adverse impacts derived from construction activity have been found for several sites, with the most severely affected being the Naic beachfronts. The scope for mitigation of the adverse impacts identified is discussed below in relation to each affected site or group of sites.

6.6.1 Operation Phase Impacts

6.6.1.1 Mindanao Memorial, Corregidor Island

The mildly adverse overall visual impact of the BCIB project on the views experienced by visitors to the Mindanao Memorial will be impossible to prevent or minimize, short of not building the infrastructure, and are not amenable to any form of compensation. In view of this, the impact is most appropriately accepted as a minor residual impact, to be balanced against positive visual impacts in other locations and factored into the overall weighing of risks and benefits associated with the project.

6.6.1.2 Naic Beachfronts and Nearby Community

While people in the resort communities may have mixed impressions of the BCIB, it is designed to be a signature bridge, including aesthetic design details to signify gateway to the Philippine capital of Manila. This scale of infrastructure warrants tourists' attention and may bring new visitors to the area. There may be some viewers who desire to maintain the low-key ambience of the beachfront, which may change under the influence of this significant infrastructure investment. The moderately adverse visual impacts for these viewers along the Naic beachfronts as a result of the BCIB project's development are largely unavoidable. The night-time views of the BCIB cable-stay bridges include decorative lighting design but BCIB roadway lighting will indicate luminaries configured with appropriate directionality and shielding to ensure that lateral light emissions are substantially which preserves the night sky views. BCIB designers have eliminated decorative undercarriage lighting, once considered an option for the viaducts. This will prevent unpleasant glare for people on the beach at night or staying in beachfront accommodations and limit the potential for the viaduct to appear as a line of lights across the horizon.

The more substantial visual impact will be experienced by inland residents and travelers on the local roadways progressing perpendicular to the BCIB, as the roadway will be approximately 6.5m above existing grade. The scale and visual barrier of roadway embankment will be a substantial visual change to the character of the community for nearby viewers. Mitigation elements integrated into the overall design to address this will include the following:

1. All hardscapes (MSE retaining walls, sound walls, and fences along the right-of-way) shall include patterns, colors and/or motifs that are congruent with the culture and heritage of the fishing and tourist community of Cavite and incorporate surfaces unfavorable for grafitti. Fencing should be durable and include full screening and thorny plantings to deter entry by grafitti artists.

2. Soil embankments will be vegetated to include native shrub species, compatible with maintenance and safety considerations. Where such plantings are not acceptable for drainage or maintenance reasons, columnar trees shall line the base of the embankment to the exterior of the drainage ditches to reduce the visual dominance of the embankment slope. Tall columnar and drought resistant trees shall be identified that can also mitigate residual lateral light leakage from the roadway. Native species selected shall not be ones known to have aggressive root systems, and careful planting details will restrict roots from intruding on adjacent property.

3. The facades of the underpasses shall be designed to connote a gateway, with night lighting and features to allow easy passage by pedestrians and cyclists in addition to vehicles, to reduce the sense of the BCIB embankment as a community barrier.

Mitigation through lighting design notwithstanding, some residual adverse visual impact associated with the project may continue to serve as a visual annoyance to some residents and resort operators along the Naic beachfront. This residual impact can probably be considered relatively minor for most locations, but may rise to the level of moderate for resort areas closest to the BCIB landing point, in Timalan Concepcion and Munting Mapino;

these residuals will have to be acknowledged in the overall balancing of benefits and risks for the project, which will also include possible increases in business for local tourism operators due to the crossing's development.

6.6.2 Construction Phase Impacts

6.6.2.1 Naic beachfront

In order to minimize degradation of touristic values on the Naic beachfront from construction activity, modifications could be made to the works lighting to reduce visibility and visual intrusion. The lighting arrays could be oriented to light the works from a landward direction, so no direct bright light would reach the shore. Shielding could also be used on the lighting to prevent leakage towards the beach. These measures would significantly reduce glare. Working hours could also be altered, at least for the works nearest to shore, to reduce the need for construction lighting.

With regards to the visual distraction derived from the incompatibility of close- to moderate-range, long-duration construction with beach tourism, contractors may be encouraged to prioritize local resorts in selecting accommodations for personnel, to offset any possible financial loss due to construction distractions to tourism. It is difficult to predict how significant the residual, if kept to relatively low nuisance level, would be for local tourism operators, and it may be more appropriate to address the matter through the grievance redress mechanism than through an *a priori* compensation scheme.

7 SYNTHESIS

The primary visual impacts of the BCIB project will be on static and dynamic viewsheds; no existing visual resources will themselves be degraded by the project's construction or operation. The visual impacts foreseen and discussed in the VIA are collected together in one place in Exhibit 45.

It will be noted from Exhibit 45 that the visual impact profile for the project is quite moderate, with few significant adverse visual impacts , and even fewer that are not balanced by beneficial impacts for viewers from the same location. Residual adverse impacts are foreseen for two locations in the operation phase: the Mindanao Memorial on Corregidor Island, and beachfront locations nearby the BCIB landing site in Naic. Significant residual adverse impacts are foreseen for the same two locations during construction, although these will be temporary.

Exhibit 45: Summary of Visual Impacts Associated With BCIB Project

Affected Viewshed	Construction Phase	Operation Phase
STATIC VIEWSHEDS		
Views of inland infrastructure from direct vicinity (Mariveles)	• Minor and temporary adverse impact on unremarkable visual landscape due to visual disturbance at works sites and staging areas	• No significant impact
Views of inland infrastructure from direct vicinity (Naic)	• Temporary adverse impact on beach-front community due to visual disturbance at works sites and staging areas	• Beneficial impact: A signature bridge of international magnitude, including aesthetic design details to signify gateway to the Philippine capital of Manila. • Adverse impact: The scale and visual barrier of roadway embankment is a substantial visual change to the character of the community from nearby views.
Seaward views from Mariveles	• No significant impact, due to distance of works sites from populated areas	• Beneficial but minor impact (upslope locations in Alas Asin) • Mix of mild to moderate beneficial and adverse impacts, thus neutral overall (Cabcaben waterfront) • Mildly beneficial due to added visual interest (Kamaya Point waterfront)
Seaward views from Corregidor Island	• Temporary mild to moderate adverse impact from all sites with views to works sites, substantially mitigated by distance	• Mix of beneficial and adverse impacts, on balance mildly adverse residual impact (Mindanao Memorial) • Neutral impact (South Beach, Japanese Peace Garden) • Mildly beneficial impact (Filipino Heroes' Memorial, Crocket Battery, North Beach) • Moderately to strongly positive impact (Pacific War Memorial, North Ferry Dock)
Seaward views from Naic beachfronts	• Minor to insignificant temporary adverse impact for most beachfront areas • Moderately adverse temporary impact for beachfront areas in Timalan Concepcion and Munting Mapino (closest to BCIB landing)	• Minor to insignificant adverse impact for most beachfront areas • Moderately adverse residual impact for beachfront areas in Timalan Concepcion and Munting Mapino (closest to BCIB landing)
DYNAMIC VIEWSHEDS		
Views for viewers using the infrastructure	• Not applicable	• Strongly beneficial impact
Views for on-the-water viewers	• Mix of mild to moderate beneficial and adverse impacts, thus neutral overall	• Strongly beneficial impact

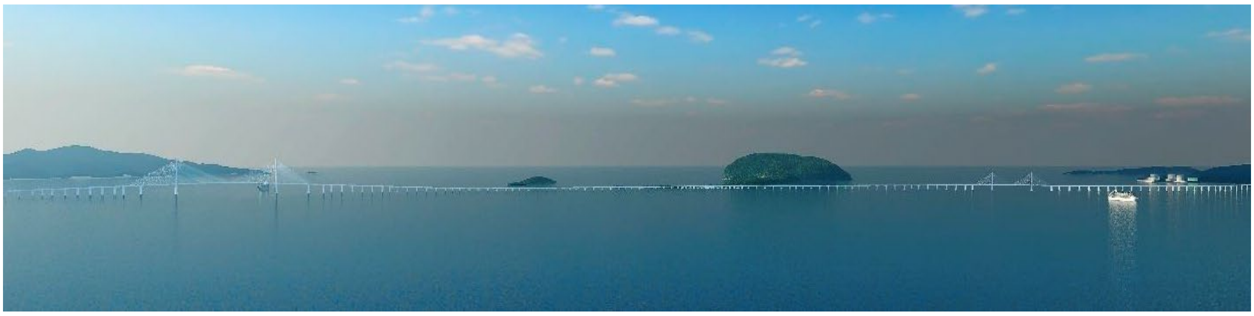
APPENDIX: VISUAL RENDERINGS USED IN PERCEPTION SURVEY

PROPOSED BATAAN–CAVITE INTERLINK BRIDGE

(PRELIMINARY VISUAL RENDERINGS – 2021)

The proposed Bataan–Cavite Interlink Bridge (BCIB) is under consideration by the Government of the Philippines and the Asian Development Bank. The bridge would provide a four-lane highway link between the provinces of Bataan and Cavite. The proposed bridge link would connect to the Roman Highway at Brgys. Alas-Asin/Mountain View in Mariveles, Bataan, and to the Antero Soriano Highway at Brgys. Timalan Balsahan/Timalan Concepcion in Naic, Cavite. The bridge link would include two high-clearance cable-stayed bridges over the shipping lanes, and smaller local boats would be able to pass under the viaducts without any problem in other areas. This handout has been prepared to support a perception survey carried out as part of the Environmental Impact Assessment of the proposed project, and provides a basis for discussion of potential visual impact. ***Details of the project infrastructure are subject to change during the design process, so the 3D renderings shown below should be considered preliminary.***

Proposed alignment of Bataan–Cavite Interlink Bridge



Proposed Bataan–Cavite Interlink Bridge with Corregidor and Caballo Islands (looking out to sea)

Looking northwest from near Naic shore towards Corregidor Island and Bataan

Proposed South Channel Bridge over ship navigation channel between Naic and Corregidor Island

Proposed mid-span turnaround, with possibility of connection to Corregidor Island in future

Proposed North Channel Bridge between Corregidor Island (left) and Mariveles (right)

Document No.: 481714-BCIB-DJV-LTR-0286 March 16, 2022

Sharif Madsmo H. Hasim
Project Director
Roads Management Cluster II
Unified Project Management Office
Department of Public Works and Highways
2nd Street, Port Area, Manila

Attention: Ms. Teresita V. Bauzon
Project Manager

RE: Consulting Services for the Detailed Engineering Design of Bataan-Cavite Interlink Bridge Project under Infrastructure Preparation and Innovation Facility (IPIF)- Additional Financing ADB Loan No. 3886-PHI

Subject: Through-Deck Drainage on Marine Structures - 481714-BCIB-DJV-DQ-0033

Dear Director Hasim,

This letter responds to the request by DPWH to provide a discussion of environmental impacts and recommendations by the DJV environmental specialists regarding the use of through-deck drainage as presented in DQ-0033.

To address this, we include Attachment A "Environmental Brief on Bridge Deck Runoff Concerns" which examines the ecological risks and discusses recommended mitigative options to be considered with the use of through-deck drainage.

We note that many recent examples of major marine bridge crossings use through-deck drainage over environmentally sensitive waters, including: the San Francisco Oakland Bay Bridge (Skyway), the Hong Kong-Zhuhai-Macau Bridge (at 55km HZMB is the longest open-sea fixed link in the world), and the Panama Puente Centenario (see Attachment B).

Based on the this, the TYLI/PEC JV recommends the use of through-deck scuppers in the design of the Marine Viaducts, High-level Approaches, and Cable-Stayed bridges for the BCIB Project. We welcome a meeting with DPWH to further discuss these recommendations with our specialists.

Sincerely yours,

____

Marwan Nader, PhD, PE
Senior Vice President
Project Manager/Team Leader, Chief Bridge Engineer

ATTACHMENT A

BATAAN–CAVITE INTERLINK BRIDGE PROJECT

Environmental Brief on Bridge Deck Runoff Concerns

March 14, 2022

By: Jodi Ketelsen, BCIB Senior Environment Specialist
Gavin S. Stairs, PhD, BCIB Senior Environment Specialist

1. CONTEXT AND OBJECTIVES

Road runoff contains contaminants derived from pavement wear, vehicle wear, fluid leaks, exhaust, cargo leakage and spills, material tracked from off-road areas, and atmospheric deposition. Typical runoff contaminants include various heavy metals, volatile and semi-volatile organic compounds including PCBs and PAH, oil and grease, soil particles, fecal coliform, and the nutrients nitrogen and phosphorus. Bridge decks pose special challenges compared to on-land roads because of their position directly over water, which entails a direct pathway for contamination of aquatic or marine biota.

Structural options for managing bridge deck runoff are constrained by space, weight, strength, aesthetic and cost concerns. For short bridges, channeling deck runoff to land for remediation is the preferred solution, but this becomes less feasible as bridge length increases. As a very long bridge with multiple grade reversals and high clearance requirements at navigation channels, the BCIB presents limited potential for on-land remediation, and direct drainage of deck runoff has been proposed. The objectives of this brief are to scope the ecological concerns associated with direct drainage of bridge deck runoff to Manila Bay, and to identify potentially feasible mitigative options.

2. SCOPING OF ECOLOGICAL RISK

Bridge deck runoff presents four ecological risks: (i) siltation and sedimentation; (ii) chemical contaminant loading; (iii) nutrient loading; and (iv) bacteriological pollution. Three input scenarios also enter into the risk equation: (i) chronic low-level loading; (ii) short-duration elevated loading in storm events following prolonged rain-free periods; and (iii) sudden concentrated discharges from accidents involving trucks carrying large quantities of fluid material. Generally speaking, risk is a function of exposure and vulnerability.

2.1 Exposure

Exposure in this context is defined by the amount of contaminants that would be introduced to the environment in bridge deck runoff. Contaminant loading in road surface runoff may be positively correlated with traffic volume for some constituents, and the US Federal Highways Administration formulated a general benchmark in the 1990s on this basis. AADT of 30,000 vehicles per day was taken as a lower threshold, below which no effects of runoff would be discernible, and above which effects would begin to be expected, at least for freshwater environments. An upper threshold of 180,000 vehicles per day, above which severe impacts would begin to be expected, was also defined. [1,4] By this general metric, the projected traffic volume on the BCIB (AADT 37,000 passenger car units by the tenth year of operation) is suggestive of relatively low potential exposure. However, many factors contribute to concentration of contaminants in road surface runoff in addition to traffic volume (e.g., traffic composition, fleet condition, congestion factor, road surface material, road surface age and condition, location relative to regional air pollution sources, and precipitation patterns), so use of traffic volume as the sole indicator of exposure requires caution. Numerous studies have documented toxic levels of contaminants in runoff from road and bridge surfaces, and measurable elevations of a range of contaminants in aquatic environments credibly traced to runoff from nearby bridges, in both high-traffic and low-traffic contexts. [source 2,3,4] Direct drainage from the BCIB is thus characterized as a potentially new source of contaminants in the marine environment.

2.2 Vulnerability

Vulnerability in the BCIB context is defined by the sensitivity of the Manila Bay marine ecosystem to inputs of bridge deck contaminants. Inputs of particulates may elevate turbidity and reduce photosynthesis, limit respiration efficiency in fish and invertebrates, interfere with prey-finding, and in extreme cases, lead to burial of fish eggs and smothering of sessile benthic organisms. Elevated levels of heavy metals, PCBs, PAH and hydrocarbons in the water column and in bottom sediments may have harmful effects on bodily functions and reproductive success in marine animals, whether through direct contact and ingestion, or ingestion of other organisms in which bioaccumulation has occurred. The nutrients nitrogen and phosphorus play important roles in algal blooms and bacterial consumption of dissolved oxygen, and elevated levels affect the suitability of water as habitat for fish and invertebrates; proliferation of cyanobacteria linked to development of toxic compounds in certain fish and shellfish consumed by local people is also enabled by nutrient enrichment. High levels of fecal coliform put swimmers and consumers of shellfish at greater risk of gastro-intestinal illness.

Traffic volume and bridge runoff composition are weak predictors of ecological effects from bridge deck runoff, because the probability of effects is strongly determined by the characteristics of the receiving waters, e.g., volume, turbulence, dispersive capacity, background contamination, and presence of sensitive species and human uses. Water bodies with robust circulation, e.g., oceanic bays, estuaries and large, fast-moving rivers, are less vulnerable to toxicity effects than are small and enclosed ones with weak circulation, e.g., ponds and swamps. A 2002 study of the San Francisco–Oakland Bay Bridge provides an instructive example in this regard; despite traffic volume of 250,000 vehicles per day, and runoff shown through laboratory bioassays to have toxic effects for some local species, no bridge-associated elevation of heavy metal content was found in sampled sediments, and no ecological effect could be discerned based on habitat assessment or analysis of infaunal assemblages. The dynamism of the estuarine environment had prevented ecological effects that persistent inputs of significantly contaminated bridge runoff might have been expected to produce.[1] A comprehensive study involving upstream-downstream comparisons with respect to various ecological parameters at a series of 10 river bridges in North Carolina similarly failed to turn up compelling evidence of ecological effects from bridge runoff in aquatic environments, despite documented elevation of some contaminants in runoff samples and in the water column.[5] The large volume of Manila Bay and presence of tidal and wind-driven currents in the BCIB project area are likely indicative of low vulnerability to contaminated bridge deck runoff.

Dilutive and dispersive capacity notwithstanding, the BCIB alignment will pass through waters known to contain sensitive marine habitats such as coral reefs, some of which are included in a marine protected area (Corregidor Islands Marine Park). Several endangered marine species protected under national law have been documented in the project area. Local fisherfolk harvest fish and shellfish in waters close to the BCIB alignment, and this indicates potential human health vulnerability linked to bioaccumulated contaminants. In addition, analysis of water samples collected along the alignment indicates that national marine water quality standards are sometimes violated, including for parameters implicated in bridge deck runoff. Additional inputs of contaminants from the BCIB would tend to increase the frequency of standards violation, which is suggestive of increasing vulnerability to ecological change.

Regulators' interest in controlling bridge deck runoff in the United States and elsewhere is typically driven by the logical expectation that the runoff will contribute to the worsening of existing degradation or increase threats to natural resources considered particularly sensitive by stakeholders, rather than hard science indicating actual or predicted effects.[6] Manila Bay is perceived by many direct stakeholders, governmental agencies, non-governmental entities and the general public as an ecosystem under threat, and its cleanup has been a central concern of environmental policy in the Manila Bay region for at least three decades. The Continuing Writ of Mandamus issued in 2008 by the Supreme Court assigns responsibility for *improving* water quality in Manila Bay (i.e., not just preventing further degradation) to 14 government agencies.

2.3 Summary of Ecological Risk and Need for Mitigation

Modest expectations for overall contaminant production, coupled with large assimilative capacity, are suggestive of low direct ecological risk in relation to bridge deck runoff from the BCIB. However, the Manila Bay ecosystem is widely acknowledged to be impaired by existing stressors, and therefore vulnerable to addition of new sources of contamination. While direct drainage of BCIB runoff to the bay may not ultimately produce measurable ecological effects on its own, it would nevertheless contribute to the cumulative negative impact of development on a threatened marine ecosystem. In this context, it is appropriate for the project to reduce possible runoff impacts to the maximum extent practicable.

3. MITIGATIVE OPTIONS

Despite the challenges inherent in long bridge geometry, a number of structural and management options capable of reducing runoff contaminant releases to receiving waters are available, and some are potentially feasible in the BCIB context. Measures mentioned in the research literature are considered below.

3.1 Structural Options

3.1.1 On-land remediation (onsite)

On-land remediation in settling ponds and vegetated swales is the most widely adopted mitigation measure for bridge deck runoff, and some shore-proximate segments of the BCIB may be amenable to this. However, means of conveying water to shore over any significant distance (bridge deck gutters or enclosed piping) typically require significant modification of base designs to address needs related to space, extra weight, and routing, and therefore may add significantly to complexity and cost.[6] Additional land acquisition may be required near the landing sites to accommodate ponds and swales. As only a small portion of the BCIB deck runoff could feasibly be brought to shore, less costly mitigative options applicable to the entire bridge length are a more appropriate focus.

3.1.2 On-land remediation (offsite)

In terms of pollution reduction potential, it may be more effective to remediate runoff on an equivalent or longer length of road than to attempt remediation of runoff from a long bridge. A watershed approach is increasingly being adopted by road agencies in the United States, and remediation swaps—whereby remediation is pursued in one location where it is easy to implement, to compensate for remediation foregone at a more challenging location—have been formulated within that framework.[6] In the BCIB context, the applicability of the swapping approach is complicated by stakeholder concerns regarding specific marine resources in the direct vicinity of the BCIB alignment. Water quality gains realized elsewhere in the Manila Bay watershed as part of a remediation swap are unlikely to reassure stakeholders about the perceived direct threat from BCIB runoff to a marine protected area, endangered species or fishing ground from BCIB runoff. For this reason, offsite remediation is not recommended as a primary mitigation measure for the BCIB but should be applied to the project's on-land road segments as a supplemental measure.

3.1.3 Deck-integrated sediment traps

Many constituents of road runoff are either entrained solids or adsorbed onto such solids. Capturing particles in sediment traps at scuppers and inlets can be a practical means of limiting contamination in receiving waters, and this is often done for on-land roadways. Oil removal can be integrated by adding adsorptive inserts to the sediment trap design.[6] Prefabricated settling chambers set into bridge decks at scupper locations are thought to have some potential to capture solid contaminants before runoff is discharged, but this remains an untested approach. Potential interference with structural members and strengthening elements, increased construction cost, maintenance demands (regular cleanout of large numbers of traps), safety risks associated with maintenance activity carried out from an active bridge deck, and difficulty in sizing traps to handle a range of discharge volumes are seen as drawbacks of this concept.[7] Deck-integrated sediment traps are unlikely to be practical or cost-effective for the BCIB.

3.1.4 Pier-mounted treatment systems

Various natural filtration and remediation systems incorporating sand, biofiltering fibers, and wetland plants mounted at the base of bridge piers have been designed to treat bridge deck runoff but have not been widely tested or applied [6]. These may be substantial structures, and implementation in the BCIB context would likely require significant adaption of the pier designs. Crucially, maintenance of the treatment system has to be carried out from a vessel and would be a massive task in the BCIB context, given the number of bridge piers. These kinds of systems may have applications in protected waters but are likely to be subject to damage in the harsh open water marine environment and should not be considered for the BCIB.

3.1.5 Rumble strips

A portion of particulates present in bridge deck runoff is dropped from vehicle tires, undercarriages, bodies and cargoes, and one concept reportedly being explored by some road agencies in the United States is installation of rumble strips in the approach road segments to encourage loose particles to fall off before vehicles reach the bridge. It is suspected that drips of oil and other hydrocarbons from leaks in oil pans, gearboxes and exhaust pipes may also be amenable to such pre-emptive removal, as oil accumulation is often noted on road surfaces near expansion joints and frost humps [6]. It is not known how effective rumble strips are at reducing deposition on bridge decks, particularly as they target a limited range of deck contaminants, but they are inexpensive to install, and simple to maintain. This should be considered for the BCIB, as one measure amongst others.

3.2 Management Measures

3.2.1 Vacuum sweeping

Experiments conducted in the United States with street sweeping have established that regular removal of dry particulates (especially fine particulates) from the road surface can achieve very substantial reductions in contaminant loading of road runoff. Weekly removal of fine particles from the road surface using advanced vacuum-assisted sweepers and regenerative air sweepers (which loosen particulates from surfaces and crevices using air jets, and immediately vacuum them up) has been found to reduce total suspended solids concentration in runoff by up to 90% for residential streets and by up to 80% for major arterials.[1,4,6,7] A substantial reduction of dissolved metals also seems likely, since timely sweeping would prevent dissolution from occurring on the deck surface. A single sweeper unit (vacuum-assisted or air sweeper) would be sufficient to conduct a weekly sweep of all four lanes of the BCIB. Sweeping equipment would be necessary for maintenance of safe operating conditions anyway, so the incremental cost of more frequent sweeping should be modest. Weekly sweeping with a regenerative air sweeper is recommended as a priority mitigation measure for contaminants in BCIB deck runoff.

3.2.2 Accident prevention

The risk of spills occurring as a result of accidents involving vehicles with large fluid cargoes can be reduced by strict enforcement of limits on speed, tailgating and reckless driving. It may also be feasible to institute a safety inspection regime for heavy trucks at the pre-bridge weigh stations, to prevent potentially unsafe trucks from accessing the bridge. These kinds of measures should be adopted for the BCIB project for safety and transport efficiency reasons, in addition to pollution mitigation.

3.2.2 Spill response plans and crews

In the event of a spill somewhere on the bridge, the speed and effectiveness of cleanup would be major determinants of the extent to which marine contamination occurs. An appropriately equipped and trained spill response team should be considered an automatic requirement and will be stipulated as such in the EMP. Key elements of effective spill response include intensive monitoring via on-bridge cameras; at-the-ready personnel, vehicles and supplies; established protocols for cleanup of different classes of spilled material; and a clear chain of communication and command.

4. CONCLUSIONS

Bridge deck runoff presents non-negligible ecological risks to the marine ecosystem of Manila Bay, which already faces numerous other stressors. The BCIB alignment passes through ecologically sensitive marine environments, including a marine protected area. Runoff contaminants should not go unmitigated.

Five mitigation approaches are feasible in the BCIB context, and are recommended for implementation:

1. Weekly sweeping of all bridge deck surfaces with a regenerative air sweeper (weather permitting);
2. Active accident prevention, through monitoring, inspection and enforcement;
3. Well trained and equipped spill response crews, available around the clock;
4. Rumble strips placed across both incoming lanes of each approach road; and
5. Implementation of weekly sweeping and vegetated runoff infiltration swales on the full length of the on-land roadway segments to reduce the project's overall contribution of contaminants to Manila Bay (remediation swap approach).

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T.Y. Lin International

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Renardet Consulting Engineers

SOURCES CITED

1. Dupuis, T.V. 2002. Assessing the Impacts of Bridge Deck Runoff Contaminants in Receiving Waters – Volume 1: Final Report. National Cooperative Highway Research Program Report 474.

2. Bartlet-Hunt, S.L., E.G. Jones and R. Barrios. 2015. Characterization of Bridge Deck Runoff. Report on research sponsored by Nebraska Department of Roads.

3. Hart, T. 2017. Assessment of Water Quality Issues and Best Management Practices for Stormwater Management for the Interstate 95 Highway Bridge Over the Norwalk River in Norwalk, Connecticut. Technical Report to the Norwalk Harbor Management Commission.

4. Georgia Department of Transportation. 2021. Investigation on Water Quality Impacts of Bridge Stormwater Runoff from Scupper Drains on Receiving Waters. Georgia DOT Research Report 18-09, Final Report.

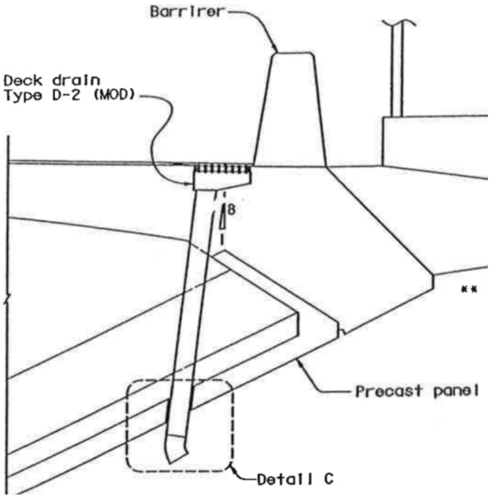
5. URS Corporation–North Carolina. 2012. Stormwater Runoff from Bridges: Final Report to Joint Legislation Transportation Oversight Committee, in Fulfillment of Session Law 2008-107. North Carolina Department of Transportation.

6. Taylor, S., M. Barrett, G. Ward, M. Leisenring, M. Venner and R. Kilgore. 2014. Bridge Stormwater Analysis and Treatment Options. National Cooperative Highway Research Program Report 778.

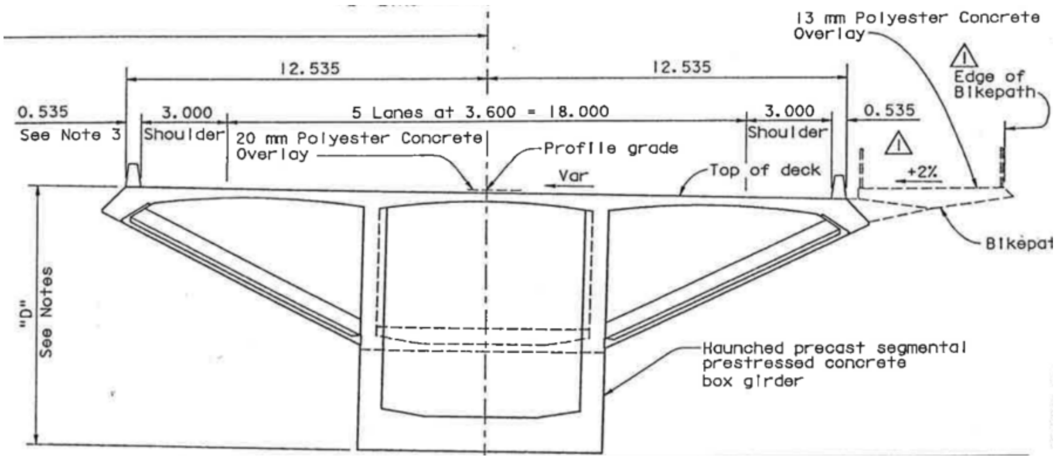
7. United States Environmental Protection Agency. 2005. National Management Measures to Control Nonpoint Source Pollution from Urban Areas. EPA-841-B-05-004. November 2005.

ATTACHMENT B

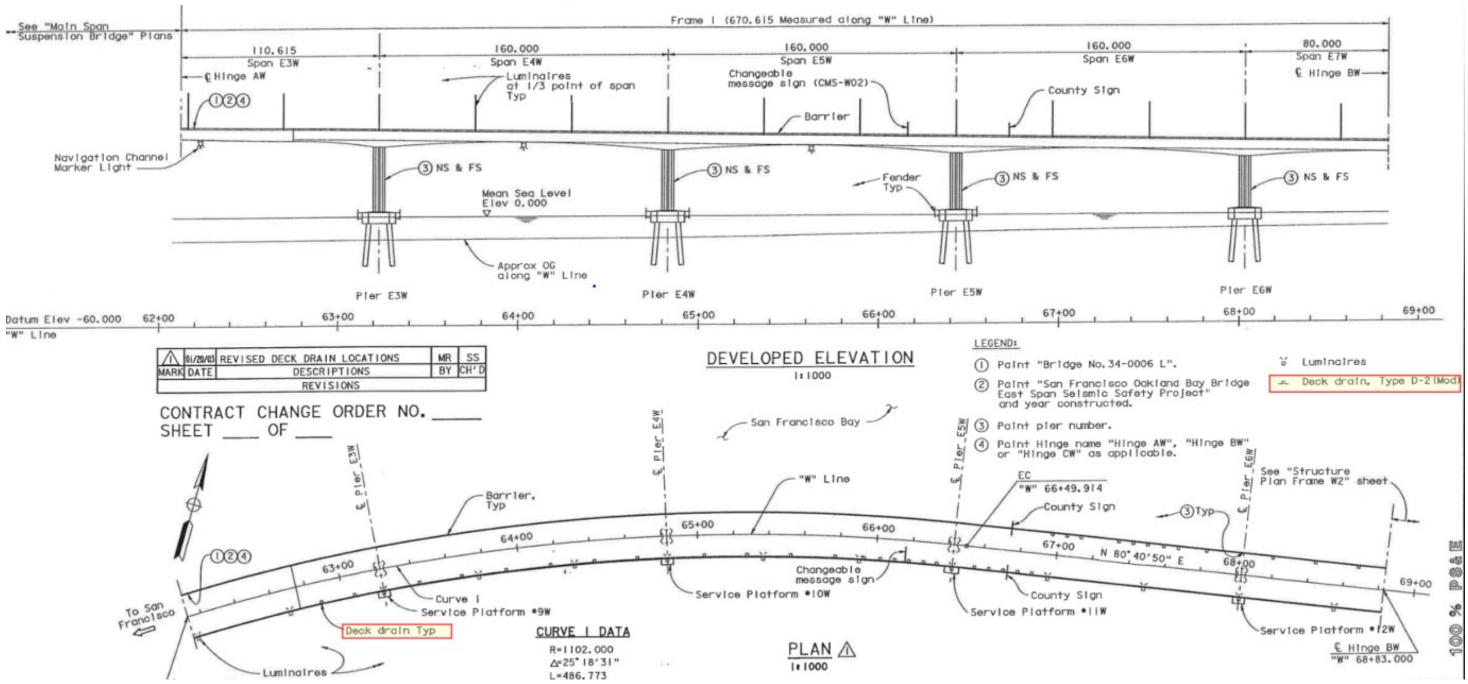
San Francisco Oakland Bay Bridge Deck Drain: Details/Cross Section/Plan & Elevation (Concrete box girder)



DETAIL

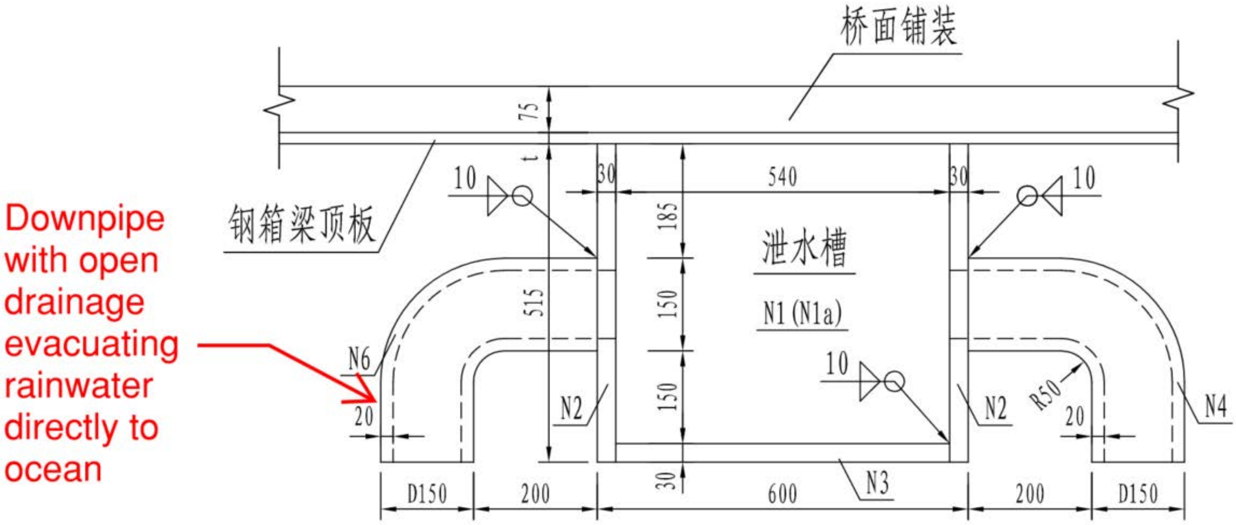


BRIDGE CROSS SECTION

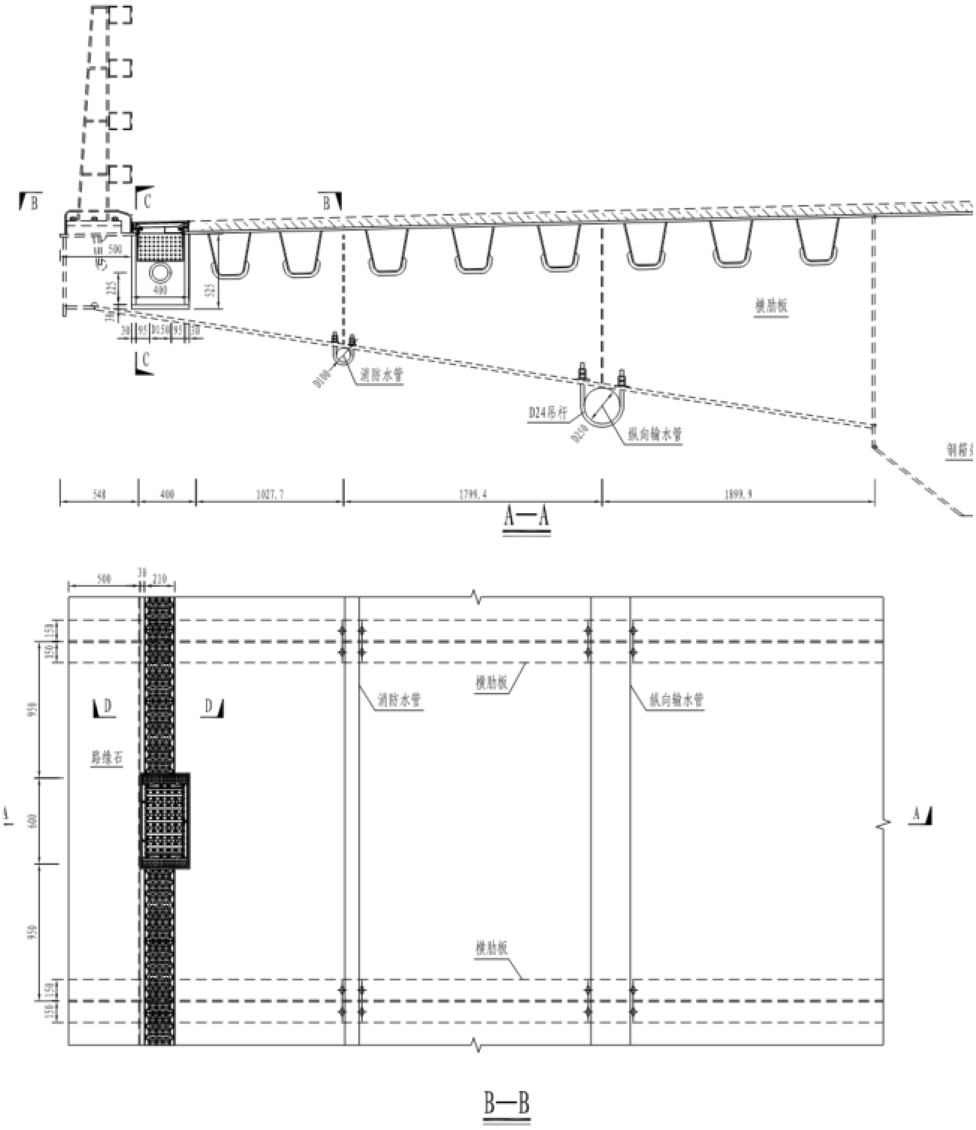


BRIDGE PLAN & ELEVATION

Hong Kong-Zhuhai-Macau Bridge Deck Drain: Detail and Plan & Section (Steel girder)



DETAIL



BRIDGE PLAN & SECTION