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Mangroves of the Java Transitional VU

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Abstract

Mangroves of the Java Transitional is a regional ecosystem subgroup (level 4 unit of the IUCN Global Ecosystem Typology). It includes the marine ecoregions of Southern Java and Cocos-Keeling/Christmas Island. The Java Transitional mangrove province mapped extent in 2020 was 159.9 km^2, representing 0.1% of the global mangrove area. The biota is characterized by 34 species of true mangroves. Java Transitional mangroves are mostly distributed in Lampung Bay and the southern coast of Java, including the lagoonal mangroves in Central and East Java and mangrove forests in the UNESCO World Heritage Site of Ujung Kulon. The main threats to mangroves are anthropogenic activities, such as mangrove conversion aquaculture ponds and human settlement. Invasive species is also reported as threat in this region.

Today the Java Transitional mangroves cover ~65% less than our broad estimation for 1970. However, the mangrove net area change has been 3.7% since 1996. If this trend continues an overall change of 13.1% is projected over the next 50 years. Furthermore, under a high sea level rise scenario (IPCC RCP8.5) ≈-19% of the Java Transitional mangroves would be submerged by 2060. Moreover, 1.4 % of the province's mangrove ecosystem is undergoing degradation, with the potential to increase to 4.1% within a 50-year period, based on a vegetation index decay analysis. Overall, the Java Transitional mangrove ecosystem is assessed as **Vulnerable (VU)**.

Citation:
Sidik, F., Saputra, D., Ulumuddin, Y.I. & Suárez, E. L., (2025). '*IUCN Red List of Ecosystems, Mangroves of the Java Transitional*'. EcoEvoRxiv.

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Keywords:
Mangroves; Red List of ecosystems; ecosystem collapse; threats.

Ecosystem classification:
MFT1.2 Intertidal forests and shrublands
Assessment's distribution:
Java Transitional province
Summary of the assessment:

Criterion	A	B	C	D	E	Overall
Subcriterion 1	**VU**	**LC**	**DD**	**DD**		
Subcriterion 2	**LC**	**LC**	**LC**	**LC**	**NE**	**VU**
Subcriterion 3	**DD**	**LC**	**DD**	**DD**		

VU: Vulnerable, LC: Least Concern, DD Data Deficient, NE: Not Evaluated

Mangroves of The Java Transitional VU

1. Ecosystem Classification

IUCN Global Ecosystem Typology (version 2.1, Keith *et al.* 2022):

Transitional Marine-Freshwater-Terrestrial realm

MFT1 Brackish tidal biome

MFT1.2 Intertidal forests and shrublands

MFT1.2_4_MP_27 Mangroves of the Java Transitional

IUCN Habitats Classification Scheme (version 3.1, IUCN, 2012):

1 Forest

1.7 Forest – Subtropical/tropical mangrove vegetation above high tide level *below water level*[1]

12 Marine Intertidal

12.7 Mangrove Submerged Roots

Typical open coast mangroves facing the Indian Ocean, southern coast of Jember Regency, East Java (Photo credit: Dhira Saputra)

[1]Note on the original classification scheme. This habitat should include mangrove vegetation below water level. Mangroves have spread into warm temperate regions to a limited extent and may occasionally occur in supratidal areas. However, the vast majority of the world's mangroves are found in tropical/subtropical intertidal areas.

2. Ecosystem Description

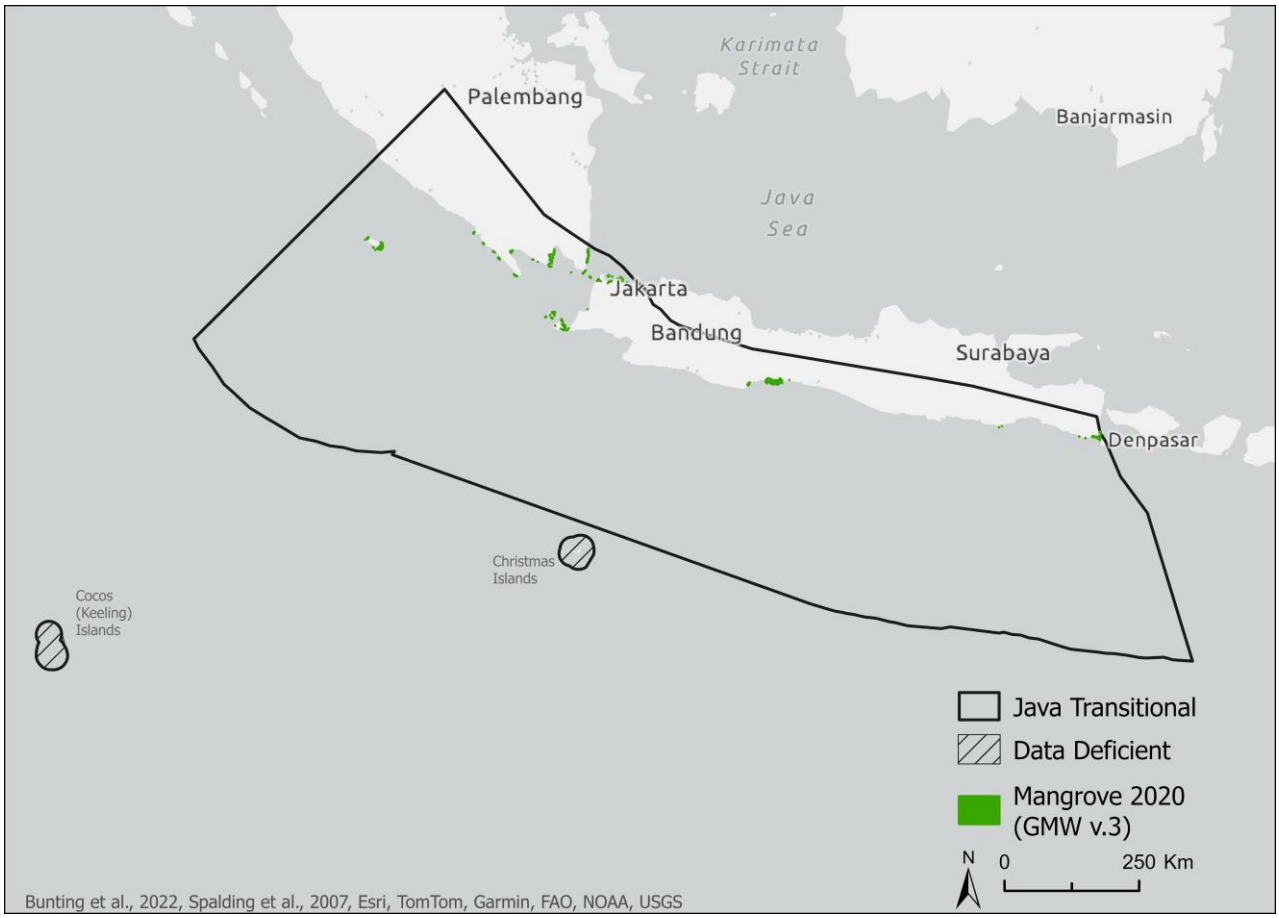

Figure 1. The mangroves of Java Transitional. Some experts have reported the presence of mangroves in the Cocos and Christmas Islands (diagonal dashed polygons), but these occurrences are not detected at the GMW v.3 mapping resolution. The islands are included here in case future reassessments allow for improvements to the base map.

Spatial distribution

The Mangroves of the Java Transitional province include intertidal forests and shrublands of the marine ecoregions of southern Java and Cocos-Keeling/Christmas Island, that extend across southern Sumatera and southern Java, Indonesia and Christmas Island, Australia. In Indonesia, mangroves are sparsely distributed from southern Sumatera, Enggano Island, the most western coast of Java and southern Java. In the coast of southern Java, mangrove forests are mostly found at the tip of the western and eastern part of the island, where two National Parks are located: Ujung Kulon and Alas Purwo, respectively. The estimated extent of mangroves in this region is 159.9 km2 (in 2020), representing about 0.1% of the global mangrove area. There has been a 3.7 % net area change since 1996 (Bunting *et al.*, 2022). Based on the typology of Worthington *et al*. (2020), the mangroves in the Java Transitional province can be classified as mainly estuarine and open coast fringing formations, but they include some lagoonal mangroves.

A mangrove lagoon in Alas Purwo, Banyuwangi, East Java (Photo credit: Yaya Ihya Ulumuddin)

Biotic components of the ecosystem (characteristic native biota)

Despite their relatively limited extent, mangroves of the Java Transitional province are biologically diverse with 34 recorded true mangrove plant species. This diversity can be attributed to the protection afforded to mangroves within the National Parks located within this ecoregion: Ujung Kulon National Park and Alas Purwo National Park. There are three threatened mangrove tree species in the IUCN Red List of Threatened Species (RTLS) database (IUCN, 2022): *Bruguiera hainesii* (Critically Endangered, CR) *Aegiceras floridum* (Near Threatened, NT) and *Sonneratia ovata* (NT). There are several other mangrove-associated plant species e.g. *Merope angulata* and *Cynometra* and *Acanthus* species. Beach forests are also common along the southern coast of Java, including plantations of *Casuarina equisetifolia*, as well as mangroves intermixed with beach forest.

Planted mangroves together with Casuarina equisetifolia, coast of Yogyakarta, south-central Java (Photo credit: Yaya Ihya Ulumuddin)

Various animals inhabit the forested areas including eight mammal species listed in the IUCN Red List of Threatened Species (IUCN, 2022), such as the dhole, *Cuon alpinus* (Endangered, EN), leopard, *Panthera pardus* (Critically Endangered, CR), large flying fox, *Pteropus vampyrus* (EN), crab-eating macaque, *Macaca fascicularis* (EN), and the Javan warty pig, *Sus verrucosus* (EN). The iconic but Critically Endangered Javan rhinoceros, *Rhinoceros sondaicus,* with a global population of only 18 animals (IUCN, 2022), is found in Ujung Kulon National Park, but has not been reported specifically to be associated with mangrove habitat.

Abiotic Components of the Ecosystem

Coastal areas of the Java Transitional ecoregion are mostly exposed to the Indian Ocean, which is characterised by strong currents. This physical environment influences mangrove formation, creating open coast and lagoonal mangrove typologies. Many coastal areas in southern Java are characterised by uplifted sandy beaches, which are often exposed to wave action and strong currents. They have less sediment accumulation in comparison to low-lying coastal areas and may have limited freshwater sources, resulting in an environment too saline for mangroves too survive**.** Mangroves are located primarily within small coastal embayments, particularly at river mouths and on intertidal flats. These areas are distinguished by their limited expanse of mangrove extent and are typically surrounded by hilly terrain. These sheltered locations where mangroves develop along the southern coast of Java mitigate the influence of tidal surges, causing them to have limited significant impact on mangroves. Naturally occurring pressures on mangroves are primarily from herbivory by insects and competition for space with adjacent terrestrial vegetation adjacent to the mangrove areas. This issue is attributed to the lack of available space to enable landward migration.

Mangroves are also located along the coastlines sheltered from oceanic forces, which provides favourable condition for mangrove to thrive, such as in Segara Anakan Cilacap, southern coast of Central Java. This area represents an estuarine system with a lagoon cover of 7037 ha and receives inputs from the Citanduy watershed with a discharge of 78-300 $m^3 s^{-1}$ (average value of 140 $m^3 s^{-1}$) (Ardli *et al*, 2022). These conditions provide a substantial sediment input, which is ideal for mangroves. The Ujung Kulon and Alas Purwo National Park encompass mangrove ecosystems composed of natural riverine and lagoonal mangrove stands, respectively, and are relatively stable and undisturbed. This can be attributed to the protective measures provided by their designated conservation status within these National Parks.

Pristine mangrove forest in Ujung Kulon National Park, Southwest Java (Photo credit: Terry Kepel)

Key processes and interactions

Mangroves act as structural engineers possessing traits such as pneumatophores, salt excretion glands, vivipary, and propagule buoyancy that promote survival and recruitment in poorly aerated, saline, mobile, and tidally inundated substrata. They exhibit high efficiency in nitrogen use and nutrient resorption. Mangroves produce large amounts of detritus (e.g., leaves, twigs, and bark), which is either buried in waterlogged sediments, or consumed by crabs and gastropods, then decomposed further by smaller invertebrates, fungi and bacteria, to produce detritus, which provides a protein- and nutrient-rich food source for other consumers in the mangrove and coastal food web. These ecosystems also serve as major blue carbon sinks, incorporating organic matter into sediments and living biomass. Large quantities of freshwater and alluvial sediments are brought to the coast by these riverine systems, where the nutrient-rich alluvium accumulates and settles to form mud banks and mudflats providing an ideal substratum for mangroves to colonise and grow on.

Mangroves colonising the muddy coastline of Karangantu, Banten in West Java (Photo credit: Yaya Ihya Ulumuddin)

The accumulation of organic matter in mangrove sediment sequesters large amounts of carbonand contributes to climate change mitigation. Blue carbon studies in Segara Anakan Cilacap have revealed a large variation in carbon stocks (167-593 Mg C ha^{-1}) and sequestration rates (194-658 g C m^{-2} yr^{-1}) due to differences in hydro-geomorphological settings and forest structure (Murdiyarso *et al.*, 2015; Kusumaningtyas *et al.*, 2019). For example, the restored mangroves in Panimbang, on the western coast of Java, have approximately half the carbon sequestration rate when compared to natural mangrove forest in the Ujung Julon National Park due to hydrological factors (Kusumaningtyas *et al.*, 2022).

3. Ecosystem Threats and vulnerabilities

Main threatening processes and pathways to degradation

The location of mangrove forests within intertidal areas renders them vulnerable to predicted sea-level rise because of climate change. Tsunamis threaten mangroves in this region and have previously destroyed the coast of Banyuwangi, southern Java, in 1994 and the Java-Sumatra coast around the island of Krakatoa in 1883. Tropical storms can damage mangrove forests through direct defoliation and destruction of trees, as well as through the mass mortality of animal communities within the ecosystems. Limited space for expansion, including the lack of suitable muddy substrata, also restricts the extent of the mangroves. In addition, mangroves face deforestation for aquaculture, urbanization, and associated coastal development, are vulnerable to unsustainable harvesting practises, and are polluted from domestic, industrial and agricultural land use practises. These anthropogenic drivers exacerbate the impacts of natural processes on mangrove growth and create multiple threats resulting in greater impact.

Mangroves cleared by local people for water channel development, Purworejo, southern coast of Central Java (Photo credit: Sapto Pamungkas)

Mangrove logging and land conversion to agriculture in Tamban, southern coast of Malang, East Java (Photo credit: Dhira Saputra)

Since the 1980's, mangroves have been converted for alternative land-use practises, such as along the Lampung coast, where the conversion of mangroves for shrimp pond farming has caused widespread degradation (Zieren *et al.*, 1999); and in Segara Anakan Cilacap, the largest mangrove area in Java (Ardli and Wollf, 2005), where conversion of mangroves for aquaculture and agriculture has resulted in a significant decline in mangrove cover from 17,090 ha in 1978 to 8,828 ha in 2019 (Ardli and Wollf, 2005, Ardli *et al.*, 2022).

Mangroves converted into a traditional aquaculture pond in Segara Anakan Cilacap (Photo credit: Bayu Prayudha)

Ongoing deforestation in Segara Anakan Cilacap continues to cause environmental change that favours the spreading of understorey plants and *Nypa fruticans* (Nordhaus *et al.*, 2019) and high sedimentation build-up that squeezes the lagoon area and transforms it into terrestrial land (Setyawan *et al.*, 2003). The invasive vine,

Derris trifoliata, can be detrimental to mangroves (Zhang *et al.*, 2021). *Derris* twines around mangrove trees resulting in rapid overgrowth. Uncontrolled spread of *Derris trifoliata*, coupled with an increase in *Nypa fruticans,* is characteristic of deforestation in this area and results in significant change in mangrove community composition, including a decrease in species number (Nordhaus *et al.*, 2019). In addition to deforestation, mangroves in Segara Anakan Cilacap are threatened by pollution as several oil spills caused by accidents to ships were reported around Cilacap (Setyawan *et al*., 2003).

Derris trifoliata strangling a Bruguiera gymnorhiza tree (Photo credit: Yaya Ihya Ulumuddin)

Massive invasion of Derris trifoliata and Nypa fruticans in lagoon mangroves, Segara Anakan, Cilacap, Central Java (Photo credit: Yaya Ihya Ulumuddin)

Definition of the collapsed state of the ecosystem

Mangroves, acting as structural engineers, possess specialised traits that facilitate high nitrogen use efficiency and nutrient resorption, influencing critical processes and functions within their ecosystem. Ecosystem collapse is recognized when the tree cover of diagnostic true mangrove species declines to zero, indicating complete loss. These ecosystems exhibit remarkable dynamism, with species distributions adapting to local

shifts in sediment distribution, tidal patterns, and variations in local inundation and salinity gradients. Disruptive processes, such as increasingly extreme, climate change driven mechanisms, can trigger shifts in this dynamism, potentially leading to ecosystem collapse. Ecosystem collapse may manifest through the following mechanisms: a) restricted recruitment and survival of diagnostic true mangroves due to adverse climatic conditions (e.g., low temperatures); b) alterations in rainfall, river inputs, waves, and tidal currents that destabilize and erode soft sediments thereby hindering recruitment and growth; c) shifts in rainfall patterns and tidal flushing altering salinity stress and nutrient loadings, impacting overall survival; d) land use change that leads to changes in salinity, sediment inputs and tidal inundation.

Natural regeneration of Sonneratia alba after local shift in sediment distribution in Clungup Beach, East Java. This geomorphological process results in mangrove degradation due to erosion (left) while high sedimentation occurs in other part of the site (right) (Photo credit: Frida Sidik)

Marine aquaculture inside mangrove conservation area in South Malang coast, East Java (Photo credit: Frida Sidik)

Threat Classification

IUCN Threat Classification (version 3.3, IUCN-CMP, 2022) relevant to mangroves of the Java Transitional province:

1. Residential & commercial development
- Housing & urban areas
- Commercial & industrial areas
- Tourism & recreation areas

2. Agriculture & aquaculture
- 2.1 Annual & perennial non-timber crops
- 2.4 Marine & freshwater aquaculture

3. Energy production & mining
- 3.1 Oil & gas drilling

4. Transportation & service corridors
- 4.1 Roads & railroads
- 4.2 Utility & service lines

5. Biological resource use
- 5.1 Hunting & collecting terrestrial animals
- 5.2 Gathering terrestrial plants
- 5.3 Logging & wood harvesting
- 5.4 Fishing & harvesting aquatic resources

6. Human intrusions & disturbance
- 6.1 Recreational activities
- 6.3 Work & other activities

7. Natural system modifications
- 7.3 Other ecosystem modifications

8. Invasive & other problematic species, genes & diseases
- 8.1 Invasive non-native/alien species/diseases
- 8.2 Problematic native species/diseases

9. Pollution
- 9.1 Domestic & urban waste water
- 9.2. Industrial and military effluents
- 9.3 Agricultural & forestry effluents
- 9.4 Garbage & solid waste

10. Geological events
- 10.2 Earthquakes/tsunamis

11. Climate change & severe weather
- 11.1 Habitat shifting & alteration
- 11.4 Storms & flooding
- 11.5 Other impacts (sedimentation)

4. Ecosystem Assessment

Criterion A: Reduction in Geographic Distribution

Subcriterion A1 measures the trend in ecosystem extent during the last 50-year time window. Unfortunately, there is currently no common regional dataset that provides information for the entire target area in 1970. However, we compiled reliable published sources (see appendix 3) that contain information on mangrove area

estimates close to 1970 (both before and after) for South Java coast, which currently account for 71.7% (114.6 km^2) of the Java Transitional mangroves (159.9 km^2). These estimates were then used to extrapolate the trend in mangrove existence in 1970 in the province, therefore the estimated values for 1970 should be considered only indicative (see appendix 3 for further details of the methods and limitations).

In contrast, to estimate the Java Transitional mangrove area from 1996 to 2020, we used the most recent version of the Global Mangrove Watch (GMW v3.0) spatial dataset. The mangrove area in the province (and in the corresponding countries) was corrected for both omission and commission errors, utilizing the equations in Bunting *et al.* (2022).

Mangroves of the Java Transitional	Area 2020* (Km^2)	Area 1970* (Km^2)	Net area Change (Km^2)	% Net Area Change	Rate of change (%/year)
	159.9	452.3	147.5	- 65%	- 1.3%

** Details on the methods and references used to estimate the mangrove area in 1970 are listed in appendix 3. Total mangrove area in 2020 is based on the Global Mangrove Watch Version 3 (GMW v3.0) dataset.*

The analysis of subcriterion A1 (Annex 3) reveals an estimated ~65%loss of mangroves in the Java Transitional province over the last 50 years (1970-2020). The estimate was derived from extrapolation of net change in large stretches of mangroves along the river mouth in south Java coastline during 1964-2002 (-65%) (Setyawan *et al.*, 2002) and Segara Anakan Cilacap during 1978-2019 (-48%) (Ardli and Wollf, 2005, Ardli *et al.*, 2022). Given that the rate of change in geographic distribution is within 48-65% risk threshold, the ecosystem is assessed as **Vulnerable (VU**) with a plausible range between Vulnerable and Endangered (VU-EN) under subcriterion A1.

Subcriterion A2 measures the change in ecosystem extent in any 50-year period, including from the present to the future: The Java Transitional province mangroves show a net area change of 3.7% (1996-2020) based on the Global Mangrove Watch time series (Bunting *et al.*, 2022). This value reflects the offset between areas gained (+ 0.5%/year) and lost (- 0.3%/year). The largest decrease in mangrove area in this time series occurred between 1996 and 2007, but then the area estimates increased, indicating a positive trend up until 2019. Applying a linear regression to the area estimations between 1996 and 2020 we obtained a rate of change of 0.2%/year (Figure 2). Assuming this trend continues in the future, it is predicted that the extent of mangroves in the Java Transitional province may increase in the future (11.0% from 1996 to 2046; 17.3% from 1996 to 2070; 13.1% from 2020 to 2070). Given that these predicted changes in mangrove extent are below the 30% risk threshold, the Java Transitional mangrove ecosystem is assessed as **Least Concern** (**LC**) under subcriterion A2.

Subcriterion A3 measures changes in mangrove area since 1750. Unfortunately, no reliable data is available on the mangrove extent for the entire province during this period, and therefore the Java Transitional mangrove ecosystem is classified as **Data Deficient** (**DD**) for this subcriterion.

Overall, the ecosystem is assessed as **Vulnerable** (**VU**) under criterion A.

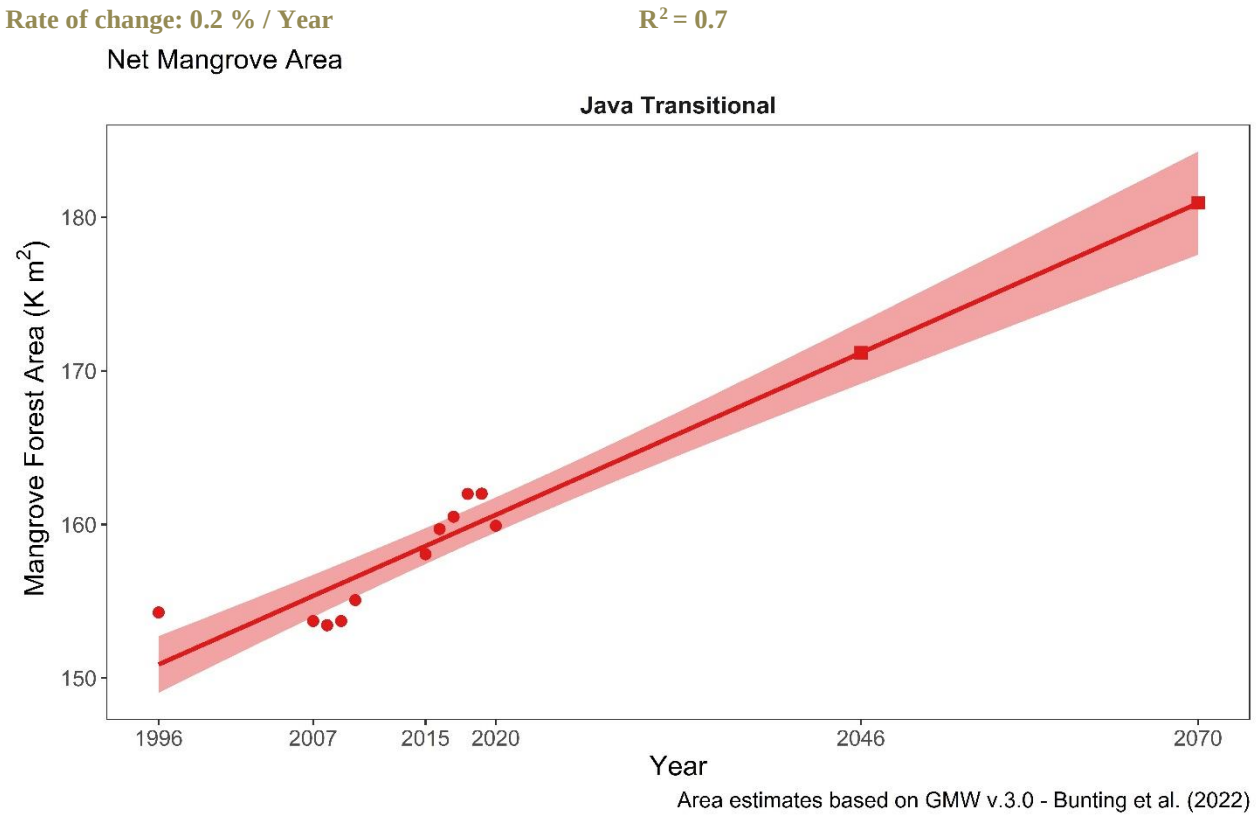

Figure 2. Projected extent of the Java Transitional mangrove ecosystem to 2070. Circles represent the province mangrove area between 1996 and 2020 based on the GMW v3.0 dataset and equations in Bunting *et al.*, (2022). The solid line and shaded area are the linear regression and 95% confidence intervals. Squares show the Java Transitional province predicted mangrove area for 2046 and 2070.

Criterion B: Restricted Geographic Distribution

Criterion B measures the risk of ecosystem collapse associated with restricted geographical distribution, based on standard metrics (Extent of Occurrence EOO, Area of Occupancy AOO, and Threat-defined locations). These parameters were calculated based on the 2020 Java Transitional province mangrove extent (GMW v.3).

Province	Extent of Occurrence EOO (Km^2)	Area of Occupancy (AOO)	Criterion B
The Java Transitional	141,294.0	54	**Least Concern (LC)**

For 2020, the AOO and EOO were measured as 87 grid cells of 10 x 10 km and 141,294.0 km^2, respectively (Figure 3). The extent of occurrence (EOO) exceeds the thresholds for classification under the threat threshold for criterion B1 and is therefore assessed as **Least Concern** (**LC**).

For criterion B2, we excluded those grid cells that collectively contain small patches covering less than 1% of the total mapped area of the ecosystem. Therefore, the AOO was estimated as 54 grid cells (10 x 10 km) (Figure 3, red grids). As the AOO is above the threat threshold for classification under criterion B2 the ecosystem is considered **Least Concern** (**LC**) under sub-criterion B2

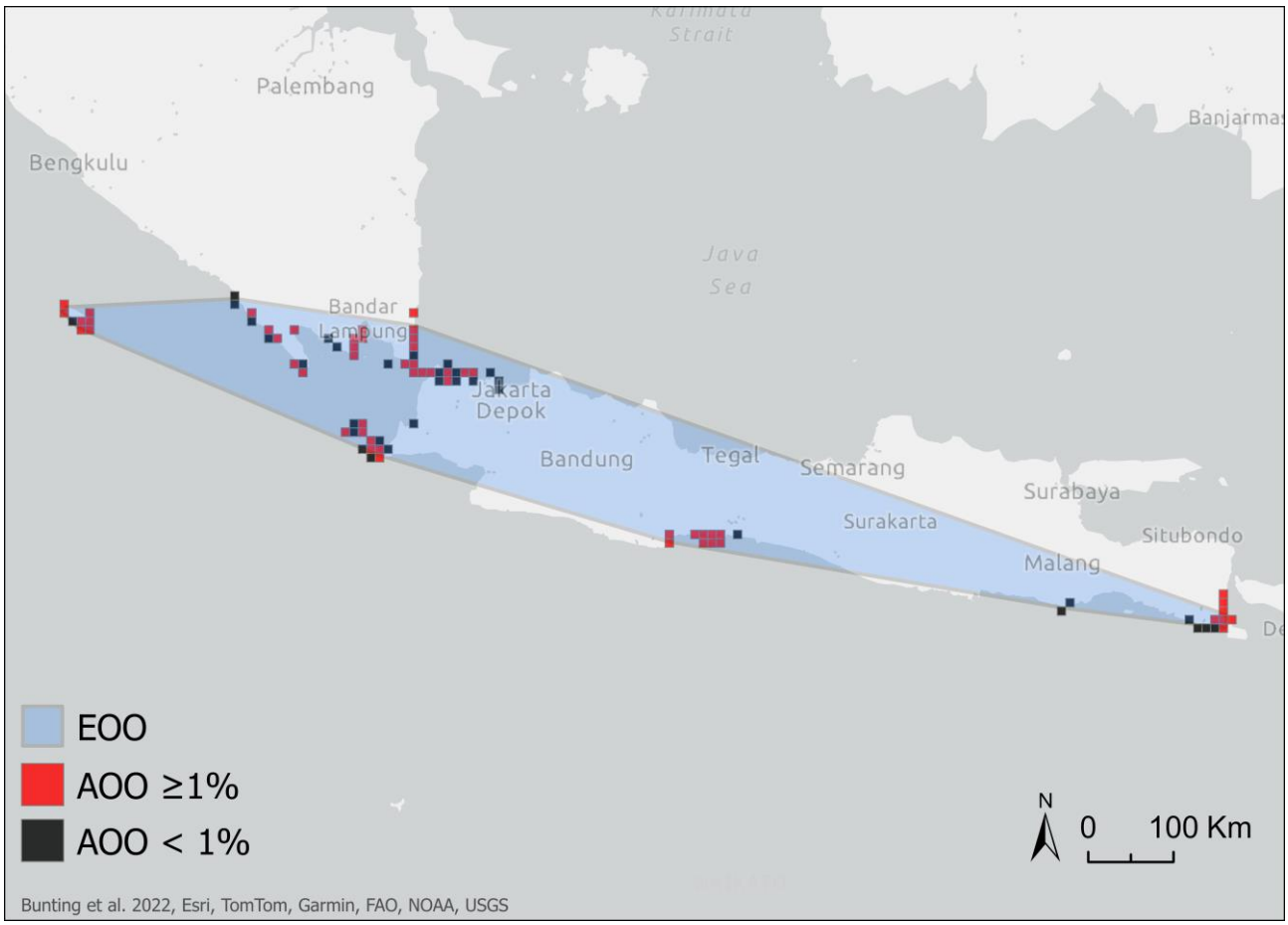

Figure 3. The Extent Of Occurrence (EOO) and Area Of Occupancy (AOO) of mangroves within the Java Transitional province in 2020. Estimates based on 2020 GMW v3.0 spatial layer (Bunting *et al.*, 2022). The red (10 x 10 km) grids (n = 54) cover 99% of the ecosystem accumulated area and the black grids 0 - 1% (n = 33).

There is no evidence of plausible threats that could lead to the collapse of the entire ecosystem and therefore it is not possible to define the number of "threat defined locations". The ecosystem is assessed as **Least Concern** (**LC**) under sub-criterion B3. As a result, the Java transitional mangrove ecosystem is assessed as **Least Concern** (**LC**) under criterion B.

Criterion C: Environmental Degradation

Criterion C measures the environmental degradation of abiotic variables necessary to support the ecosystem.

Subcriterion C1 measures environmental degradation over the past 50 years. Many studies have reported conversion of mangroves for other land use practises in Segara Anakan, Cilacap and the southern coast of Java since the 1970s, which indicate high environmental degradation in this province. However, given the lack of quantitative data, the ecosystem is classified as Data Deficient (DD) for subcriterion C1.

Subcriterion C2 measures environmental degradation in the future, or over any 50-year period, including from the present. In this context, the impact of future sea level rise (SLR) on mangrove ecosystems was assessed by adopting the methodology presented in Schuerch *et al.* (2018). The published model was designed to calculate both absolute and relative change in the extent of wetland ecosystems under various regional SLR scenarios (i.e. medium: RCP 4.5 and high: RCP 8.5), with consideration for sediment accretion. The Schuerch *et al*. (2018) model was applied to the Java Transitional mangrove ecosystem boundary, using the spatial extent

from Giri *et al.* (2011) and assuming mangrove landward migration was not possible. According to the results, under an extreme 1.1 m sea-level rise scenario by 2100, the projected submerged area is ~-18.7% by 2060, which remains below the 30% risk threshold. Therefore, as no mangrove recruitment can occur in a submerged system (100% relative severity), ~-18.7% of the ecosystem extent is projected to be affected by SLR.

In addition of SLR, the assessment was also conducted for other abiotic variables. From direct observation and previous studies (Zieren *et al.,* 2019, Ardli *et al.,* 2022), several environmental degradations of abiotic variables occur in the Java Transitional mangrove ecosystem, such as erosion, extensive siltation and change in hydrology. However, no dataset is available to quantify the extent and severity of those changes. Currently, considering projected SLR impact on this province, the Java Transitional mangrove is considered **Least Concern** (**LC**) for subcriterion C2, with strong recommendations for future assessments to look at changes in hydrology and erosion.

Subcriterion C3 measures change in abiotic variables since 1750. There is a lack of reliable historic data on environmental degradation covering the entire province, and therefore the Java Transitional province is classified as **Data Deficient** (**DD**) for this subcriterion.

Overall, the ecosystem is assessed as **Least Concern** (**LC**) under criterion C.

Criterion D: Disruption of biotic processes or interactions

The global mangrove degradation map developed by Worthington and Spalding (2018) was used to assess the level of biotic degradation in the Java Transitional province. This map is based on degradation metrics calculated from vegetation indices (NDVI, EVI, SAVI, NDMI) using Landsat time series (from ~2000-2017). These indices represent vegetation greenness and moisture condition.

Mangrove degradation was calculated at a pixel scale (30m resolution), on areas intersecting with the 2017 mangrove extent map (GMW v2). Mangrove pixels were classified as degraded if two conditions were met: 1) at least 10 out of 12 degradation indices showed a decrease of more than 40% compared to the previous period; and 2) all twelve indices did not recover to within 20% of their pre-2000 value (detailed methods and data are available at: maps.oceanwealth.org/mangrove-restoration/). The decay in vegetation indices has been used to identify mangrove degradation and abrupt changes, including mangrove die-back events, clear-cutting, fire damage, and logging; as well as to track mangrove regeneration (Lovelock *et al.*, 2017; Santana, 2018; Murray *et al.,* 2020; Aljahdali *et al.,* 2021; Lee *et al.,* 2021). However, it is important to consider that changes observed in the vegetation indices can also be influenced by data artifacts (Akbar *et al.,* 2020). Therefore, a relative severity level of more than 50%, but less than 80%, was assumed.

The results from this analysis show that over a period of 17 years (~2000 to 2017), 1.4% of the Java Transitional mangrove area is classified as degraded, resulting in an average annual rate of degradation of 0.1%. Assuming this trend remains constant, +4.1% of the Java Transitional mangrove area will be classified as degraded over a 50-year period. Since less than 30% of the ecosystem will meet the category thresholds for criterion D, the Java Transitional mangrove province is assessed as **Least Concern (LC)** under subcriterion D2b.

No data were found to assess the disruption of biotic processes and degradation over the past 50 years (subcriterion D1) or since 1750 (subcriterion D3). Thus, both subcriteria are classified as **Data Deficient (DD).**

Overall, the Java Transitional ecosystem remains **Least Concern (LC)** under criterion D.

Criterion E: Quantitative Risk

No model was used to quantitatively assess the risk of ecosystem collapse for this ecosystem; hence criterion E was **Not Evaluated (NE)**.

5. Summary of the Assessment

CRITERION			
A. Reduction in Geographic Distribution	**A1** Past 50 years	**A2** Future or any 50 years period	**A3** Historical (1750)
	VU	**LC**	**DD**
B. Restricted Geo. Distribution	**B1** Extent of Occurrence	**B2** Area of Occupancy	**B3** # Threat-defined Locations < 5?
	LC	**LC**	**LC**
C. Environmental Degradation	**C1** Past 50 years (1970)	**C2** Future or any 50 years period	**C3** Historical (1750)
	DD	**LC**	**DD**
D. Disruption of biotic processes	**D1** Past 50 years (1970)	**D2** Future or Any 50 years period	**D3** Historical (1750)
	DD	**LC**	**DD**
E. Quantitative Risk analysis		**NE**	
OVERALL RISK CATEGORY		**VU**	

DD = Data Deficient; LC = Least Concern; NE = Not Evaluated

Overall, the status of the Java Transitional mangrove ecosystem is assessed as **Vulnerable (VU).**

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Acknowledgments
The development of the Java Transitional Mangrove Red List of Ecosystems was made possible through the collaboration and dedication of the Asia Mangrove Specialists group. Their valuable contributions throughout the development process have been integral to the accuracy and quality of the final product.

We would also like to thank the IUCN SSC Mangrove Specialist Group and the Global Mangrove Alliance Science Working group, for their support in the delineation of the level 4 mangrove units that were the basis for this analysis. Special thanks to José Rafael Ferrer-Paris for his contribution to the production of the general ecosystem description template for the RLE mangrove assessments. We also wish to acknowledge Thomas Worthington for kindly providing the spatial data on mangrove degradation. We extend our thank to mangrove experts who provided valuable inputs and photos for the completion of this ecosystem description: Frida Sidik, Dhira Saputra, Yaya Ihya Ulumuddin, Anthon Andrimida, Terry Kepel, Bayu Prayudha, and Sapto Pamungkas.

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7. Appendices

1. List of Key Mangrove Species

List of plant species considered true mangroves according to Red List of Threatened Species (RLTS) spatial data (IUCN, 2022). We included species whose range maps intersected with the boundary of the marine provinces/ecoregions described in the distribution section.

Class	Order	Family	Scientific name	RLTS category
Liliopsida	Arecales	Arecaceae	*Nypa fruticans*	LC
Magnoliopsida	Ericales	Primulaceae	*Aegiceras corniculatum*	LC
Magnoliopsida	Ericales	Primulaceae	*Aegiceras floridum*	NT
Magnoliopsida	Gentianales	Rubiaceae	*Scyphiphora hydrophylacea*	LC
Magnoliopsida	Lamiales	Acanthaceae	*Avicennia alba*	LC
Magnoliopsida	Lamiales	Acanthaceae	*Avicennia marina*	LC
Magnoliopsida	Lamiales	Acanthaceae	*Avicennia officinalis*	LC
Magnoliopsida	Lamiales	Bignoniaceae	*Dolichandrone spathacea*	LC
Magnoliopsida	Malpighiales	Euphorbiaceae	*Excoecaria agallocha*	LC
Magnoliopsida	Malpighiales	Euphorbiaceae	*Excoecaria indica*	DD
Magnoliopsida	Malpighiales	Rhizophoraceae	*Bruguiera cylindrica*	LC
Magnoliopsida	Malpighiales	Rhizophoraceae	*Bruguiera exaristata*	LC
Magnoliopsida	Malpighiales	Rhizophoraceae	*Bruguiera gymnorhiza*	LC
Magnoliopsida	Malpighiales	Rhizophoraceae	*Bruguiera hainesii*	CR
Magnoliopsida	Malpighiales	Rhizophoraceae	*Bruguiera parviflora*	LC
Magnoliopsida	Malpighiales	Rhizophoraceae	*Bruguiera sexangula*	LC
Magnoliopsida	Malpighiales	Rhizophoraceae	*Ceriops decandra*	NT
Magnoliopsida	Malpighiales	Rhizophoraceae	*Ceriops tagal*	LC
Magnoliopsida	Malpighiales	Rhizophoraceae	*Ceriops zippeliana*	LC
Magnoliopsida	Malvales	Malvaceae	*Heritiera littoralis*	LC
Magnoliopsida	Malvales	Malvaceae	*Camptostemon schultzii*	LC
Magnoliopsida	Myrtales	Combretaceae	*Lumnitzera littorea*	LC
Magnoliopsida	Myrtales	Combretaceae	*Lumnitzera racemosa*	LC
Magnoliopsida	Myrtales	Lythraceae	*Pemphis acidula*	LC
Magnoliopsida	Myrtales	Lythraceae	*Sonneratia alba*	LC
Magnoliopsida	Myrtales	Lythraceae	*Sonneratia caseolaris*	LC
Magnoliopsida	Myrtales	Lythraceae	*Sonneratia ovata*	NT
Magnoliopsida	Rhizophorales	Rhizophoraceae	*Rhizophora apiculata*	LC
Magnoliopsida	Rhizophorales	Rhizophoraceae	*Rhizophora mucronata*	LC
Magnoliopsida	Rhizophorales	Rhizophoraceae	*Rhizophora stylosa*	LC
Magnoliopsida	Sapindales	Meliaceae	*Xylocarpus granatum*	LC
Magnoliopsida	Sapindales	Meliaceae	*Xylocarpus moluccensis*	LC
Polypodiopsida	Polypodiales	Pteridaceae	*Acrostichum aureum*	LC
Polypodiopsida	Polypodiales	Pteridaceae	*Acrostichum speciosum*	LC

2. List of Associated Species

List of taxa that are associated with mangrove habitats in the Red List of Threatened Species (RLTS) database (IUCN, 2022). We included only species with entries for Habitat 1.7: “Forest - Subtropical/Tropical Mangrove Vegetation Above High Tide Level” or Habitat 12.7 for “Marine Intertidal - Mangrove Submerged Roots”, and with suitability recorded as “Suitable”, with “Major Importance” recorded as “Yes”, and any value of

seasonality except “Passage”. The common names are those shown in the RLTS, except common names in brackets, which are from other sources.

Class	Order	Family	Scientific name	RLTS category	Common name
Liliopsida	Arecales	Arecaceae	*Phoenix paludosa*	Near Threatened	
Magnoliopsida	Fabales	Fabaceae	*Cynometra iripa*	Least Concern	
Magnoliopsida	Fabales	Fabaceae	*Cynometra ramiflora*	Least Concern	Katong
Magnoliopsida	Lamiales	Acanthaceae	*Acanthus ebracteatus*	Least Concern	
Magnoliopsida	Lamiales	Acanthaceae	*Acanthus volubilis*	Least Concern	
Magnoliopsida	Malpighiales	Euphorbiaceae	*Excoecaria indica*	Data Deficient	
Magnoliopsida	Sapindales	Meliaceae	*Aglaia cucullata*	Data Deficient	
Actinopterygii	Anguilliformes	Muraenidae	*Gymnothorax monochrous*	Least Concern	
Actinopterygii	Anguilliformes	Muraenidae	*Uropterygius concolor*	Least Concern	Brown Moray Eel
Actinopterygii	Anguilliformes	Ophichthidae	*Scolecenchelys macroptera*	Least Concern	
Actinopterygii	Atheriniformes	Atherinidae	*Atherinomorus lacunosus*	Least Concern	Hardyhead Silverside
Actinopterygii	Atheriniformes	Phallostethidae	*Phenacostethus posthon*	Least Concern	
Actinopterygii	Aulopiformes	Synodontidae	*Saurida nebulosa*	Least Concern	Clouded Lizardfish
Actinopterygii	Beloniformes	Zenarchopteridae	*Dermogenys sumatrana*	Least Concern	
Actinopterygii	Beloniformes	Zenarchopteridae	*Zenarchopterus dispar*	Least Concern	Feathered River-garfish
Actinopterygii	Beloniformes	Zenarchopteridae	*Zenarchopterus ectuntio*	Least Concern	
Actinopterygii	Beloniformes	Zenarchopteridae	*Zenarchopterus gilli*	Least Concern	Shortnose River Garfish
Actinopterygii	Beloniformes	Zenarchopteridae	*Zenarchopterus pappenheimi*	Least Concern	
Actinopterygii	Clupeiformes	Clupeidae	*Anodontostoma selangkat*	Least Concern	Indonesian Gizzard Shad
Actinopterygii	Clupeiformes	Clupeidae	*Sardinella albella*	Least Concern	White Sardinella
Actinopterygii	Clupeiformes	Engraulidae	*Encrasicholina punctifer*	Least Concern	Buccaneer anchovy
Actinopterygii	Clupeiformes	Engraulidae	*Setipinna breviceps*	Least Concern	
Actinopterygii	Clupeiformes	Engraulidae	*Thryssa kammalensis*	Data Deficient	
Actinopterygii	Clupeiformes	Engraulidae	*Thryssa mystax*	Least Concern	Moustached Thryssa
Actinopterygii	Cypriniformes	Cobitidae	*Pangio kuhlii*	Least Concern	
Actinopterygii	Cypriniformes	Nemacheilidae	*Nemacheilus chrysolaimos*	Least Concern	

Actinopterygii	Elopiformes	Elopidae	*Elops hawaiensis*	Data Deficient	Giant Herring
Actinopterygii	Elopiformes	Elopidae	*Elops machnata*	Least Concern	
Actinopterygii	Elopiformes	Megalopidae	*Megalops cyprinoides*	Data Deficient	Indo-Pacific Tarpon
Actinopterygii	Gobiiformes	Eleotridae	*Bostrychus sinensis*	Least Concern	Four-eyed Sleeper
Actinopterygii	Gobiiformes	Eleotridae	*Butis amboinensis*	Least Concern	Ambon Gudgeon
Actinopterygii	Gobiiformes	Eleotridae	*Butis butis*	Least Concern	Crimson-tipped Gudgeon
Actinopterygii	Gobiiformes	Eleotridae	*Butis gymnopomus*	Least Concern	Striped Crazy Fish
Actinopterygii	Gobiiformes	Eleotridae	*Butis koilomatodon*	Least Concern	Marblecheek Sleeper
Actinopterygii	Gobiiformes	Eleotridae	*Eleotris fusca*	Least Concern	Brown Spinecheek Gudgeon
Actinopterygii	Gobiiformes	Eleotridae	*Eleotris melanosoma*	Least Concern	Broadhead Sleeper
Actinopterygii	Gobiiformes	Eleotridae	*Ophiocara porocephala*	Least Concern	Spangled Gudgeon
Actinopterygii	Gobiiformes	Eleotridae	*Oxyeleotris urophthalmoides*	Data Deficient	Throat-spine Sinuous Gudgeon
Actinopterygii	Gobiiformes	Eleotridae	*Oxyeleotris urophthalmus*	Data Deficient	
Actinopterygii	Gobiiformes	Gobiidae	*Amblygobius esakiae*	Least Concern	Snout-spot Goby
Actinopterygii	Gobiiformes	Gobiidae	*Amblygobius stethophthalmus*	Least Concern	Freckled Goby
Actinopterygii	Gobiiformes	Gobiidae	*Asterropteryx semipunctata*	Least Concern	
Actinopterygii	Gobiiformes	Gobiidae	*Aulopareia unicolor*	Least Concern	
Actinopterygii	Gobiiformes	Gobiidae	*Boleophthalmus boddarti*	Least Concern	Boddart's Goggle-eyed Goby
Actinopterygii	Gobiiformes	Gobiidae	*Brachygobius xanthozonus*	Data Deficient	Bumblebee Fish
Actinopterygii	Gobiiformes	Gobiidae	*Caragobius urolepis*	Least Concern	Scaleless Worm Goby
Actinopterygii	Gobiiformes	Gobiidae	*Cryptocentrus leptocephalus*	Least Concern	Pink-speckled Shrimpgoby
Actinopterygii	Gobiiformes	Gobiidae	*Drombus triangularis*	Least Concern	Brown Drombus
Actinopterygii	Gobiiformes	Gobiidae	*Glossogobius circumspectus*	Least Concern	Circumspect Goby
Actinopterygii	Gobiiformes	Gobiidae	*Gnatholepis ophthalmotaenia*	Least Concern	
Actinopterygii	Gobiiformes	Gobiidae	*Gobiopterus brachypterus*	Data Deficient	
Actinopterygii	Gobiiformes	Gobiidae	*Mahidolia mystacina*	Least Concern	Flagfin Prawn Goby

Actinopterygii	Gobiiformes	Gobiidae	*Oligolepis acutipennis*	Least Concern	Paintedfin Goby
Actinopterygii	Gobiiformes	Gobiidae	*Oxyurichthys ophthalmonema*	Least Concern	Eyebrow Goby
Actinopterygii	Gobiiformes	Gobiidae	*Paratrypauchen microcephalus*	Least Concern	Comb Goby
Actinopterygii	Gobiiformes	Gobiidae	*Psammogobius biocellatus*	Least Concern	Sleepy Goby
Actinopterygii	Gobiiformes	Gobiidae	*Taenioides cirratus*	Data Deficient	Whiskered Eel Goby
Actinopterygii	Gobiiformes	Gobiidae	*Trypauchen vagina*	Least Concern	Burrowing Goby
Actinopterygii	Gobiiformes	Gobiidae	*Trypauchenopsis intermedia*	Least Concern	Bearded Eel Goby
Actinopterygii	Mugiliformes	Mugilidae	*Planiliza subviridis*	Least Concern	Greenback Mullet
Actinopterygii	Ophidiiformes	Carapidae	*Encheliophis homei*	Least Concern	Silver Pearlfish
Actinopterygii	Perciformes	Ambassidae	*Ambassis macracanthus*	Data Deficient	Estuarine Glass Perchlet
Actinopterygii	Perciformes	Ambassidae	*Ambassis nalua*	Least Concern	Scalloped Perchlet
Actinopterygii	Perciformes	Ambassidae	*Ambassis vachellii*	Least Concern	Vachell's Glassfish
Actinopterygii	Perciformes	Apogonidae	*Apogonichthyoides melas*	Least Concern	Black Cardinalfish
Actinopterygii	Perciformes	Apogonidae	*Fowleria variegata*	Least Concern	Variegated Cardinalfish
Actinopterygii	Perciformes	Apogonidae	*Pseudamia amblyuroptera*	Least Concern	White-jawed Cardinalfish
Actinopterygii	Perciformes	Apogonidae	*Sphaeramia orbicularis*	Least Concern	Orbiculate Cardinalfish
Actinopterygii	Perciformes	Apogonidae	*Yarica hyalosoma*	Least Concern	Mangrove Cardinalfish
Actinopterygii	Perciformes	Caesionidae	*Caesio cuning*	Least Concern	Redbelly yellowtail fusilier
Actinopterygii	Perciformes	Carangidae	*Atule mate*	Least Concern	Yellowtail Scad
Actinopterygii	Perciformes	Datnioididae	*Datnioides polota*	Least Concern	Silver Tiger Fish
Actinopterygii	Perciformes	Ephippidae	*Platax orbicularis*	Least Concern	Orbiculate Batfish
Actinopterygii	Perciformes	Epinephelidae	*Epinephelus coeruleopunctatus*	Least Concern	Whitespotted Grouper
Actinopterygii	Perciformes	Epinephelidae	*Epinephelus coioides*	Least Concern	Orange-spotted Grouper
Actinopterygii	Perciformes	Epinephelidae	*Epinephelus malabaricus*	Least Concern	(Malabar Grouper)
Actinopterygii	Perciformes	Epinephelidae	*Epinephelus tauvina*	Data Deficient	Greasy Grouper
Actinopterygii	Perciformes	Gerreidae	*Gerres erythrourus*	Least Concern	Deep-bodied Mojarra
Actinopterygii	Perciformes	Haemulidae	*Diagramma labiosum*	Least Concern	Painted Sweetlips

Actinopterygii	Perciformes	Haemulidae	*Plectorhinchus gibbosus*	Least Concern	Brown Sweetlips
Actinopterygii	Perciformes	Haemulidae	*Pomadasys argenteus*	Least Concern	Silver Javelin
Actinopterygii	Perciformes	Haemulidae	*Pomadasys kaakan*	Least Concern	Javelin Grunter
Actinopterygii	Perciformes	Leiognathidae	*Gazza minuta*	Least Concern	Toothed Ponyfish
Actinopterygii	Perciformes	Leiognathidae	*Leiognathus equulus*	Least Concern	Common Ponyfish
Actinopterygii	Perciformes	Lethrinidae	*Lethrinus harak*	Least Concern	Thumbprint Emperor
Actinopterygii	Perciformes	Lethrinidae	*Lethrinus nebulosus*	Least Concern	Spangled Emperor
Actinopterygii	Perciformes	Lethrinidae	*Lethrinus ornatus*	Least Concern	Ornate Emperor
Actinopterygii	Perciformes	Lethrinidae	*Lethrinus semicinctus*	Least Concern	Black-Spot Emperor
Actinopterygii	Perciformes	Lutjanidae	*Lutjanus fulviflamma*	Least Concern	Dory Snapper
Actinopterygii	Perciformes	Lutjanidae	*Lutjanus fulvus*	Least Concern	Blacktail Snapper
Actinopterygii	Perciformes	Mullidae	*Parupeneus barberinus*	Least Concern	Dash-and-dot goatfish
Actinopterygii	Perciformes	Nemipteridae	*Pentapodus setosus*	Least Concern	Butterfly Whiptail
Actinopterygii	Perciformes	Nemipteridae	*Scolopsis ciliata*	Least Concern	Saw-jawed Monocle Bream
Actinopterygii	Perciformes	Pomacentridae	*Dascyllus trimaculatus*	Least Concern	Threespot Damselfish
Actinopterygii	Perciformes	Pomacentridae	*Dischistodus perspicillatus*	Least Concern	White Damsel
Actinopterygii	Perciformes	Pomacentridae	*Neopomacentrus azysron*	Least Concern	Yellowtail Damsel
Actinopterygii	Perciformes	Pomacentridae	*Neopomacentrus taeniurus*	Data Deficient	Freshwater Damsel
Actinopterygii	Perciformes	Sciaenidae	*Aspericorvina jubata*	Least Concern	Prickly Croaker
Actinopterygii	Perciformes	Sciaenidae	*Johnius belangerii*	Least Concern	Belanger's Croaker
Actinopterygii	Perciformes	Sciaenidae	*Johnius borneensis*	Least Concern	Hammer Croaker
Actinopterygii	Perciformes	Sciaenidae	*Johnius carouna*	Least Concern	Caroun Croaker
Actinopterygii	Perciformes	Sciaenidae	*Johnius latifrons*	Data Deficient	(Broad-head Croaker)
Actinopterygii	Perciformes	Sciaenidae	*Johnius plagiostoma*	Least Concern	
Actinopterygii	Perciformes	Sciaenidae	*Johnius weberi*	Least Concern	
Actinopterygii	Perciformes	Sciaenidae	*Nibea coibor*	Data Deficient	
Actinopterygii	Perciformes	Sciaenidae	*Panna microdon*	Least Concern	
Actinopterygii	Perciformes	Sciaenidae	*Pennahia anea*	Least Concern	

Actinopterygii	Perciformes	Siganidae	*Siganus guttatus*	Least Concern	Golden Rabbitfish
Actinopterygii	Perciformes	Siganidae	*Siganus vermiculatus*	Least Concern	Vermiculated Spinefoot
Actinopterygii	Perciformes	Terapontidae	*Mesopristes argenteus*	Least Concern	Silver Grunter
Actinopterygii	Perciformes	Terapontidae	*Mesopristes cancellatus*	Least Concern	Tapiroid Grunter
Actinopterygii	Pleuronectiformes	Cynoglossidae	*Cynoglossus puncticeps*	Least Concern	
Actinopterygii	Pleuronectiformes	Cynoglossidae	*Cynoglossus sibogae*	Data Deficient	
Actinopterygii	Pleuronectiformes	Paralichthyidae	*Pseudorhombus arsius*	Least Concern	Largetooth Flounder
Actinopterygii	Pleuronectiformes	Soleidae	*Brachirus aspilos*	Least Concern	Dusky Sole
Actinopterygii	Scorpaeniformes	Platycephalidae	*Cymbacephalus beauforti*	Least Concern	Crocodile Fish
Actinopterygii	Siluriformes	Bagridae	*Mystus abbreviatus*	Least Concern	
Actinopterygii	Syngnathiformes	Syngnathidae	*Hippichthys penicillus*	Least Concern	Beady Pipefish
Actinopterygii	Tetraodontiformes	Tetraodontidae	*Arothron reticularis*	Least Concern	Reticulated Pufferfish
Actinopterygii	Tetraodontiformes	Tetraodontidae	*Arothron stellatus*	Least Concern	Stellate Puffer
Amphibia	Anura	Dicroglossidae	*Fejervarya cancrivora*	Least Concern	Java Wart Frog
Aves	Caprimulgiformes	Podargidae	*Batrachostomus javensis*	Least Concern	Horsfield's Frogmouth
Aves	Charadriiformes	Charadriidae	*Charadrius mongolus*	Least Concern	Lesser Sandplover
Aves	Charadriiformes	Charadriidae	*Pluvialis fulva*	Least Concern	Pacific Golden Plover
Aves	Charadriiformes	Scolopacidae	*Actitis hypoleucos*	Least Concern	Common Sandpiper
Aves	Charadriiformes	Scolopacidae	*Numenius arquata*	Near Threatened	Eurasian Curlew
Aves	Charadriiformes	Scolopacidae	*Xenus cinereus*	Least Concern	Terek Sandpiper
Aves	Ciconiiformes	Ciconiidae	*Ciconia episcopus*	Near Threatened	Asian Woollyneck
Aves	Ciconiiformes	Ciconiidae	*Leptoptilos javanicus*	Vulnerable	Lesser Adjutant
Aves	Ciconiiformes	Ciconiidae	*Mycteria cinerea*	Endangered	Milky Stork
Aves	Columbiformes	Columbidae	*Ducula badia*	Least Concern	Mountain Imperial-pigeon
Aves	Columbiformes	Columbidae	*Ducula bicolor*	Least Concern	Pied Imperial-pigeon
Aves	Columbiformes	Columbidae	*Ramphiculus jambu*	Near Threatened	Jambu Fruit-dove
Aves	Coraciiformes	Alcedinidae	*Alcedo atthis*	Least Concern	Common Kingfisher
Aves	Coraciiformes	Alcedinidae	*Alcedo coerulescens*	Least Concern	Cerulean Kingfisher

Aves	Coraciiformes	Alcedinidae	*Alcedo euryzona*	Critically Endangered	Javan Blue-banded Kingfisher
Aves	Coraciiformes	Alcedinidae	*Alcedo meninting*	Least Concern	Blue-eared Kingfisher
Aves	Coraciiformes	Alcedinidae	*Alcedo peninsulae*	Near Threatened	Malay Blue-banded Kingfisher
Aves	Coraciiformes	Alcedinidae	*Ceyx erithaca*	Least Concern	Oriental Dwarf-kingfisher
Aves	Coraciiformes	Alcedinidae	*Halcyon coromanda*	Least Concern	Ruddy Kingfisher
Aves	Coraciiformes	Alcedinidae	*Halcyon pileata*	Vulnerable	Black-capped Kingfisher
Aves	Coraciiformes	Alcedinidae	*Todiramphus chloris*	Least Concern	Collared Kingfisher
Aves	Coraciiformes	Alcedinidae	*Todiramphus sanctus*	Least Concern	Sacred Kingfisher
Aves	Cuculiformes	Cuculidae	*Centropus nigrorufus*	Vulnerable	Javan Coucal
Aves	Cuculiformes	Cuculidae	*Phaenicophaeus diardi*	Near Threatened	Black-bellied Malkoha
Aves	Cuculiformes	Cuculidae	*Phaenicophaeus sumatranus*	Near Threatened	Chestnut-bellied Malkoha
Aves	Falconiformes	Falconidae	*Falco severus*	Least Concern	Oriental Hobby
Aves	Passeriformes	Acanthizidae	*Gerygone sulphurea*	Least Concern	Golden-bellied Gerygone
Aves	Passeriformes	Aegithinidae	*Aegithina tiphia*	Least Concern	Common Iora
Aves	Passeriformes	Aegithinidae	*Aegithina viridissima*	Near Threatened	Green Iora
Aves	Passeriformes	Campephagidae	*Coracina striata*	Least Concern	Bar-bellied Cuckooshrike
Aves	Passeriformes	Campephagidae	*Lalage nigra*	Least Concern	Pied Triller
Aves	Passeriformes	Campephagidae	*Pericrocotus cinnamomeus*	Least Concern	Small Minivet
Aves	Passeriformes	Campephagidae	*Pericrocotus divaricatus*	Least Concern	Ashy Minivet
Aves	Passeriformes	Chloropseidae	*Chloropsis sonnerati*	Endangered	Greater Green Leafbird
Aves	Passeriformes	Cisticolidae	*Orthotomus atrogularis*	Least Concern	Dark-necked Tailorbird
Aves	Passeriformes	Cisticolidae	*Orthotomus ruficeps*	Least Concern	Ashy Tailorbird
Aves	Passeriformes	Cisticolidae	*Orthotomus sericeus*	Least Concern	Rufous-tailed Tailorbird
Aves	Passeriformes	Cisticolidae	*Prinia familiaris*	Near Threatened	Bar-winged Prinia
Aves	Passeriformes	Cisticolidae	*Prinia flaviventris*	Least Concern	Yellow-bellied Prinia

Aves	Passeriformes	Cisticolidae	*Prinia inornata*	Least Concern	Plain Prinia
Aves	Passeriformes	Corvidae	*Corvus enca*	Least Concern	Slender-billed Crow
Aves	Passeriformes	Corvidae	*Corvus macrorhynchos*	Least Concern	Large-billed Crow
Aves	Passeriformes	Corvidae	*Crypsirina temia*	Least Concern	Racquet-tailed Treepie
Aves	Passeriformes	Dicruridae	*Dicrurus annectens*	Least Concern	Crow-billed Drongo
Aves	Passeriformes	Dicruridae	*Dicrurus paradiseus*	Least Concern	Greater Racquet-tailed Drongo
Aves	Passeriformes	Eurylaimidae	*Cymbirhynchus macrorhynchos*	Least Concern	Black-and-red Broadbill
Aves	Passeriformes	Laniidae	*Lanius tigrinus*	Least Concern	Tiger Shrike
Aves	Passeriformes	Monarchidae	*Terpsiphone affinis*	Least Concern	Oriental Paradise-flycatcher
Aves	Passeriformes	Monarchidae	*Terpsiphone atrocaudata*	Near Threatened	Japanese Paradise-flycatcher
Aves	Passeriformes	Monarchidae	*Terpsiphone incei*	Least Concern	Chinese Paradise-flycatcher
Aves	Passeriformes	Muscicapidae	*Copsychus malabaricus*	Least Concern	White-rumped Shama
Aves	Passeriformes	Muscicapidae	*Cyornis rufigastra*	Least Concern	Mangrove Blue-flycatcher
Aves	Passeriformes	Muscicapidae	*Ficedula mugimaki*	Least Concern	Mugimaki Flycatcher
Aves	Passeriformes	Muscicapidae	*Ficedula zanthopygia*	Least Concern	Yellow-rumped Flycatcher
Aves	Passeriformes	Muscicapidae	*Myophonus caeruleus*	Least Concern	Blue Whistling-thrush
Aves	Passeriformes	Nectariniidae	*Arachnothera chrysogenys*	Least Concern	Yellow-eared Spiderhunter
Aves	Passeriformes	Oriolidae	*Oriolus chinensis*	Least Concern	Black-naped Oriole
Aves	Passeriformes	Pachycephalidae	*Pachycephala cinerea*	Least Concern	Mangrove Whistler
Aves	Passeriformes	Pachycephalidae	*Pachycephala fulvotincta*	Least Concern	Rusty-breasted Whistler
Aves	Passeriformes	Paridae	*Parus major*	Least Concern	Great Tit
Aves	Passeriformes	Phylloscopidae	*Phylloscopus borealis*	Least Concern	Arctic Warbler
Aves	Passeriformes	Phylloscopidae	*Phylloscopus coronatus*	Least Concern	Eastern Crowned Warbler
Aves	Passeriformes	Phylloscopidae	*Phylloscopus examinandus*	Least Concern	Kamchatka Leaf-warbler

Aves	Passeriformes	Phylloscopidae	*Phylloscopus xanthodryas*	Least Concern	Japanese Leaf-warbler
Aves	Passeriformes	Pittidae	*Pitta moluccensis*	Least Concern	Blue-winged Pitta
Aves	Passeriformes	Pittidae	*Pitta sordida*	Least Concern	Western Hooded Pitta
Aves	Passeriformes	Ploceidae	*Ploceus philippinus*	Least Concern	Baya Weaver
Aves	Passeriformes	Pycnonotidae	*Brachypodius atriceps*	Least Concern	Black-headed Bulbul
Aves	Passeriformes	Pycnonotidae	*Ixidia erythropthalmos*	Least Concern	Spectacled Bulbul
Aves	Passeriformes	Pycnonotidae	*Pycnonotus goiavier*	Least Concern	Yellow-vented Bulbul
Aves	Passeriformes	Sittidae	*Sitta frontalis*	Least Concern	Velvet-fronted Nuthatch
Aves	Passeriformes	Sturnidae	*Aplonis panayensis*	Least Concern	Asian Glossy Starling
Aves	Passeriformes	Sturnidae	*Gracula religiosa*	Least Concern	Common Hill Myna
Aves	Passeriformes	Timaliidae	*Macronus ptilosus*	Near Threatened	Fluffy-backed Tit-babbler
Aves	Passeriformes	Timaliidae	*Mixornis bornensis*	Least Concern	Bold-striped Tit-babbler
Aves	Passeriformes	Turdidae	*Turdus obscurus*	Least Concern	Eyebrowed Thrush
Aves	Passeriformes	Vangidae	*Hemipus hirundinaceus*	Least Concern	Black-winged Flycatcher-shrike
Aves	Passeriformes	Zosteropidae	*Zosterops melanurus*	Vulnerable	Sangkar White-eye
Aves	Passeriformes	Zosteropidae	*Zosterops simplex*	Least Concern	Swinhoe's White-eye
Aves	Pelecaniformes	Ardeidae	*Ardea purpurea*	Least Concern	Purple Heron
Aves	Pelecaniformes	Ardeidae	*Butorides striata*	Least Concern	Green-backed Heron
Aves	Pelecaniformes	Ardeidae	*Egretta garzetta*	Least Concern	Little Egret
Aves	Pelecaniformes	Ardeidae	*Egretta sacra*	Least Concern	Pacific Reef-egret
Aves	Pelecaniformes	Ardeidae	*Ixobrychus cinnamomeus*	Least Concern	Cinnamon Bittern
Aves	Pelecaniformes	Ardeidae	*Ixobrychus sinensis*	Least Concern	Yellow Bittern
Aves	Piciformes	Megalaimidae	*Psilopogon haemacephalus*	Least Concern	Coppersmith Barbet
Aves	Piciformes	Picidae	*Chloropicoides rafflesii*	Near Threatened	Olive-backed Woodpecker
Aves	Piciformes	Picidae	*Chrysocolaptes guttacristatus*	Least Concern	Greater Flameback

Aves	Piciformes	Picidae	*Chrysophlegma humii*	Near Threatened	Chequer-throated Yellownape
Aves	Piciformes	Picidae	*Chrysophlegma mentale*	Near Threatened	Javan Yellownape
Aves	Piciformes	Picidae	*Chrysophlegma miniaceum*	Least Concern	Banded Woodpecker
Aves	Piciformes	Picidae	*Dinopium javanense*	Least Concern	Common Flameback
Aves	Piciformes	Picidae	*Micropternus brachyurus*	Least Concern	Rufous Woodpecker
Aves	Piciformes	Picidae	*Mulleripicus pulverulentus*	Vulnerable	Great Slaty Woodpecker
Aves	Piciformes	Picidae	*Picoides canicapillus*	Least Concern	Grey-capped Woodpecker
Aves	Piciformes	Picidae	*Picoides moluccensis*	Least Concern	Sunda Pygmy Woodpecker
Aves	Piciformes	Picidae	*Picus vittatus*	Least Concern	Laced Woodpecker
Aves	Psittaciformes	Psittacidae	*Belocercus longicaudus*	Vulnerable	Long-tailed Parakeet
Aves	Psittaciformes	Psittacidae	*Psittacula alexandri*	Near Threatened	Red-breasted Parakeet
Aves	Suliformes	Anhingidae	*Anhinga melanogaster*	Near Threatened	Oriental Darter
Aves	Suliformes	Fregatidae	*Fregata ariel*	Least Concern	Lesser Frigatebird
Aves	Suliformes	Fregatidae	*Fregata minor*	Least Concern	Great Frigatebird
Aves	Trogoniformes	Trogonidae	*Harpactes duvaucelii*	Near Threatened	Scarlet-rumped Trogon
Chondrichthyes	Carcharhiniformes	Carcharhinidae	*Carcharhinus amblyrhynchoides*	Vulnerable	Graceful Shark
Chondrichthyes	Carcharhiniformes	Carcharhinidae	*Carcharhinus amboinensis*	Vulnerable	Pigeye Shark
Chondrichthyes	Carcharhiniformes	Carcharhinidae	*Carcharhinus melanopterus*	Vulnerable	Blacktip Reef Shark
Chondrichthyes	Carcharhiniformes	Carcharhinidae	*Negaprion acutidens*	Endangered	Sharptooth Lemon Shark
Chondrichthyes	Myliobatiformes	Dasyatidae	*Brevitrygon javaensis*	Endangered	Javan Whipray
Chondrichthyes	Myliobatiformes	Dasyatidae	*Himantura leoparda*	Vulnerable	Leopard Whipray
Chondrichthyes	Myliobatiformes	Dasyatidae	*Himantura uarnak*	Endangered	Coach Whipray
Chondrichthyes	Myliobatiformes	Dasyatidae	*Himantura undulata*	Endangered	Honeycomb Whipray
Chondrichthyes	Myliobatiformes	Dasyatidae	*Maculabatis gerrardi*	Endangered	Whitespotted Whipray
Chondrichthyes	Myliobatiformes	Dasyatidae	*Maculabatis macrura*	Endangered	Sharpnose Whipray
Chondrichthyes	Myliobatiformes	Dasyatidae	*Maculabatis pastinacoides*	Endangered	Round Whipray
Chondrichthyes	Myliobatiformes	Dasyatidae	*Pastinachus ater*	Vulnerable	Broad Cowtail Ray

Chondrichthyes	Myliobatiformes	Dasyatidae	*Pastinachus gracilicaudus*	Endangered	Narrow Cowtail Ray
Chondrichthyes	Myliobatiformes	Dasyatidae	*Pastinachus solocirostris*	Endangered	Roughnose Cowtail Ray
Chondrichthyes	Myliobatiformes	Dasyatidae	*Pateobatis uarnacoides*	Endangered	Whitenose Whipray
Chondrichthyes	Myliobatiformes	Dasyatidae	*Taeniura lymma*	Least Concern	Bluespotted Lagoon Ray
Chondrichthyes	Rhinopristiformes	Pristidae	*Anoxypristis cuspidata*	Endangered	Narrow Sawfish
Chondrichthyes	Rhinopristiformes	Pristidae	*Pristis clavata*	Critically Endangered	Dwarf Sawfish
Chondrichthyes	Rhinopristiformes	Pristidae	*Pristis pristis*	Critically Endangered	Largetooth Sawfish
Chondrichthyes	Rhinopristiformes	Pristidae	*Pristis zijsron*	Critically Endangered	Green Sawfish
Gastropoda	Cycloneritida	Neritidae	*Clithon faba*	Least Concern	Kanokogai
Gastropoda	Cycloneritida	Neritidae	*Neritodryas subsulcata*	Data Deficient	Weakly Cut Nerite
Gastropoda	Ellobiida	Ellobiidae	*Auriculastra subula*	Least Concern	
Gastropoda	Ellobiida	Ellobiidae	*Cylindrotis quadrasi*	Least Concern	
Gastropoda	Ellobiida	Ellobiidae	*Ellobium aurisjudae*	Least Concern	Judas Ear Cassidula
Gastropoda	Ellobiida	Ellobiidae	*Ellobium aurismidae*	Least Concern	Midas Ear Cassidula
Gastropoda	Ellobiida	Ellobiidae	*Laemodonta bella*	Least Concern	
Gastropoda	Ellobiida	Ellobiidae	*Laemodonta punctigera*	Least Concern	
Gastropoda	Littorinimorpha	Clenchiellidae	*Clenchiella microscopica*	Least Concern	
Gastropoda	Littorinimorpha	Littorinidae	*Littoraria undulata*	Least Concern	
Gastropoda	Neogastropoda	Conidae	*Conus frigidus*	Least Concern	Frigid Cone
Gastropoda	Neogastropoda	Conidae	*Conus varius*	Least Concern	"Freckled Cone"
Insecta	Odonata	Coenagrionidae	*Ceriagrion cerinorubellum*	Least Concern	
Insecta	Odonata	Libellulidae	*Aethriamanta aethra*	Least Concern	
Mammalia	Carnivora	Felidae	*Neofelis diardi*	Vulnerable	Sunda Clouded Leopard
Mammalia	Carnivora	Felidae	*Panthera pardus*	Vulnerable	Leopard
Mammalia	Carnivora	Felidae	*Panthera tigris*	Endangered	Tiger
Mammalia	Carnivora	Felidae	*Prionailurus planiceps*	Endangered	Flat-headed Cat
Mammalia	Carnivora	Herpestidae	*Herpestes brachyurus*	Near Threatened	Short-tailed Mongoose
Mammalia	Carnivora	Mustelidae	*Aonyx cinereus*	Vulnerable	Asian Small-clawed Otter
Mammalia	Carnivora	Mustelidae	*Lutra lutra*	Near Threatened	Eurasian Otter

Mammalia	Carnivora	Mustelidae	*Lutra sumatrana*	Endangered	Hairy-nosed Otter
Mammalia	Carnivora	Mustelidae	*Lutrogale perspicillata*	Vulnerable	Smooth-coated Otter
Mammalia	Carnivora	Viverridae	*Paradoxurus hermaphroditus*	Least Concern	Common Palm Civet
Mammalia	Carnivora	Viverridae	*Viverricula indica*	Least Concern	Small Indian Civet
Mammalia	Cetartiodactyla	Phocoenidae	*Neophocaena phocaenoides*	Vulnerable	Indo-Pacific Finless Porpoise
Mammalia	Cetartiodactyla	Suidae	*Sus scrofa*	Least Concern	Wild Boar
Mammalia	Cetartiodactyla	Suidae	*Sus verrucosus*	Endangered	Javan Warty Pig
Mammalia	Cetartiodactyla	Tragulidae	*Tragulus kanchil*	Least Concern	Lesser Oriental Chevrotain
Mammalia	Chiroptera	Hipposideridae	*Coelops frithii*	Near Threatened	Tail-less Leaf-nosed Bat
Mammalia	Chiroptera	Hipposideridae	*Hipposideros ater*	Least Concern	Dusky Leaf-nosed Bat
Mammalia	Chiroptera	Hipposideridae	*Hipposideros atrox*	Least Concern	Lesser Bicoloured Leafnosed Bat
Mammalia	Chiroptera	Hipposideridae	*Hipposideros galeritus*	Least Concern	Cantor's Leaf-nosed Bat
Mammalia	Chiroptera	Megadermatidae	*Megaderma spasma*	Least Concern	Lesser False Vampire
Mammalia	Chiroptera	Pteropodidae	*Macroglossus minimus*	Least Concern	Dagger-toothed Long-nosed Fruit Bat
Mammalia	Chiroptera	Pteropodidae	*Macroglossus sobrinus*	Least Concern	Hill Long-tongued Fruit Bat
Mammalia	Chiroptera	Pteropodidae	*Pteropus vampyrus*	Endangered	Large Flying-fox
Mammalia	Chiroptera	Vespertilionidae	*Myotis hasseltii*	Least Concern	Lesser Large-footed Myotis
Mammalia	Dermoptera	Cynocephalidae	*Galeopterus variegatus*	Least Concern	Sunda Flying Lemur
Mammalia	Eulipotyphla	Erinaceidae	*Echinosorex gymnura*	Least Concern	Moonrat
Mammalia	Pholidota	Manidae	*Manis javanica*	Critically Endangered	Sunda Pangolin
Mammalia	Primates	Cercopithecidae	*Macaca fascicularis*	Endangered	Long-tailed Macaque
Mammalia	Primates	Cercopithecidae	*Macaca nemestrina*	Endangered	Southern Pig-tailed Macaque
Mammalia	Primates	Cercopithecidae	*Trachypithecus auratus*	Vulnerable	Spangled Ebony Langur

Mammalia	Primates	Cercopithecidae	*Trachypithecus cristatus*	Vulnerable	Silvery Lutung
Mammalia	Primates	Cercopithecidae	*Trachypithecus mauritius*	Vulnerable	West Javan Ebony Langur
Mammalia	Sirenia	Dugongidae	*Dugong dugon*	Vulnerable	Dugong
Reptilia	Squamata	Agamidae	*Aphaniotis acutirostris*	Least Concern	Indonesia Earless Agama
Reptilia	Squamata	Elapidae	*Ophiophagus hannah*	Vulnerable	King Cobra
Reptilia	Squamata	Pythonidae	*Python bivittatus*	Vulnerable	Burmese Python
Reptilia	Squamata	Scincidae	*Emoia atrocostata*	Least Concern	Littoral Whiptail-skink
Reptilia	Squamata	Varanidae	*Varanus dumerilii*	Data Deficient	Dumeril Monitor
Reptilia	Squamata	Varanidae	*Varanus rudicollis*	Data Deficient	Roughneck Monitor
Reptilia	Squamata	Varanidae	*Varanus salvator*	Least Concern	Common Water Monitor
Reptilia	Testudines	Geoemydidae	*Batagur affinis*	Critically Endangered	Southern River Terrapin

3. National Estimates for subcriterion A1

To estimate the Java Transitional mangrove ecosystem extent in 1970, we gathered reliable information on the mangrove area for each country within the province around this period (Table b). With area estimates of South Java coast, which currently account for 71.7% (114.6 km^2) of the Java Transitional mangroves (159.9 km^2), we used the trend of mangrove change in South Java Coast in the period of 1964-2002 (Setyawan, 2002; Table b) and extrapolate it to estimate mangrove existence in 1970 in the province We assumed that a linear relationship between mangrove and time, and the percentage of mangrove extent by country within the province remained constant over time, as the percentages did not change between 1996 and 2020 (GMW v3.0 dataset). However, using mangrove area estimates from different sources can lead to uncertainty (Friess and Webb 2014)[2] and there were no regional statistics or global studies available for this time period. Thus, the estimates for 1970 should be considered only indicative.

Table a. Estimated mangrove area by country in 1970 and 2020 (in km^2). Estimates for 2020* mangrove area are based on the Global Mangrove Watch Version 3 (GMW v3.0) dataset. The references used to calculate mangrove area for each country in 1970 are listed below in Table b.**

Year	Country total 2020*	Within province 2020*	Country total 1970**	Within province 1970**
Java Transitional – Indonesia	29,534	159.9	46,608	452.3

[2]Friess, D. A. and Webb, E. L. (2014). Variability in mangrove change estimates and implications for the assessment of ecosystem service provision. *Global Ecology and Biogeography*, 23 (7). 715-725 doi:10.1111/geb.12140

Table b. List of selected studies considered to have reliable information on mangrove area for the period around 1970 in each country of the Java Transitional province.

Country	Year	Mangrove Area (Ha)	Reference
Indonesia	1982	4,251,011	FAO (2003). Status and trends in mangrove area extent worldwide. By Wilkie, M.L. and Fortuna, S. Forest Resources Assessment Working Paper No. 63. Forest Resources Division.
Indonesia	2020	2,953,398.4	Bunting, P., Rosenqvist, A., Hilarides, L., Lucas, R. M., Thomas, N., Tadono, T., Worthington, T. A., Spalding, M.D., Murray, N. J., & Rebelo, L.-M. (2022). Global Mangrove Extent Change 1996–2020: Global Mangrove Watch Version 3.0. Remote Sensing, 14(15), 3657. https://doi.org/10.3390/rs14153657
Indonesia	1964	4,950 (South Java coast rivermouth)	Setyawan, A.D., Susilowati A., Wiryanto (2002). Relics habitat of mangrove vegetation in south coast of Java. Biodiversitas 3 (2): 242-256
Indonesia	2002	1,750 (South Java coast rivermouth)	Setyawan, A.D., Susilowati A., Wiryanto (2002). Relics habitat of mangrove vegetation in south coast of Java. Biodiversitas 3 (2): 242-256
Indonesia	1978	17,090 (Segara Anakan Cilacap)	Ardli, E.R. and M. Wolff (2005). Spatial and temporal dynamics of mangrove conversion at the Segara Anakan Cilacap, Indonesia. Proceeding of the 10th ISSM International Conference, 30th September – 1st October 2005. Paris, France.
Indonesia	2019	8,828 (Segara Anakan Cilacap)	Ardli, E. R., Yuwono, E., & Purwanto, A. D. (2022). Land Cover Changes and Impacts of Massive Siltation on the Mangrove Segara Anakan Lagoon System, Cilacap Indonesia. Journal of Ecological Engineering, 23(7).