CAMDEN HAVEN RIVER ESTUARINE SHORELINE HABITAT CONDITION REPORT CARD 2023

Author: Jock Mackenzie
Earthwatch Institute

earthwatch AUSTRALIA

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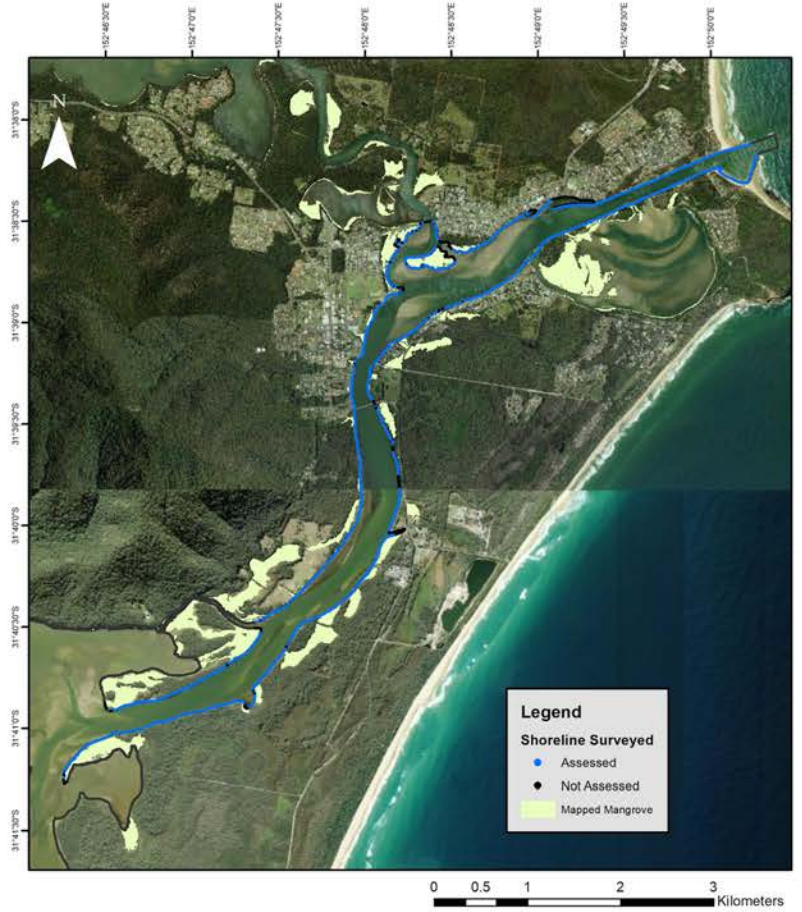
MangroveWatch

Data Collection

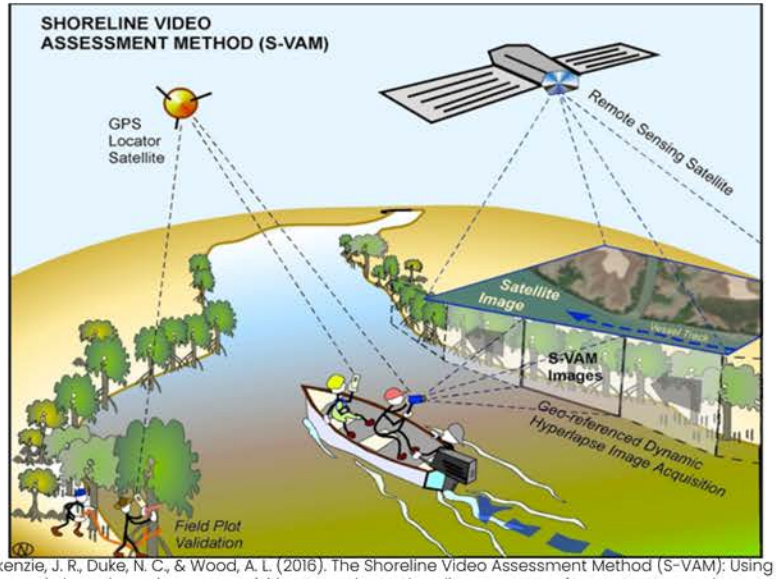
Lower Camden Haven River Estuary Shoreline Assessed
= 85% (~12 km upstream)

Survey Date: 15th August 2023.



The Shoreline Video Assessment Method (S-VAM)

S-VAM surveys were conducted to capture the main estuary channel shorelines from the mouth to upstream estuary limits for a permanent visual record of shoreline habitat. A boat traveled along the Camden Haven River shoreline at a speed of 6-10 kts, with observers recording continuous video footage at a distance of up to 200m from shore. The camera was held at a 90-degree angle to the boat's direction. GPS tracking was recorded, and special points of interest were geotagged. In-field observations were also recorded via voice. Data was collected at Low to mid tide during a neap tide period ensure clear shoreline visibility while maintaining safe navigation.



Mackenzie, J. R., Duke, N. C., & Wood, A. L. (2016). The Shoreline Video Assessment Method (S-VAM): Using dynamic hyperlapse image acquisition to evaluate shoreline mangrove forest structure, values, degradation and threats. Marine Pollution Bulletin.

Data Processing & Analysis

This section describes the methodology used to process data streams collected from shoreline surveys. The data was processed to enable criteria-based visual assessment of habitat attributes. The estuary video streams were converted to time-stamped 1-second still image frames, and shoreline shapefiles were generated in ArcMap 10.8. A point-shapefile was generated for each estuary shoreline, representing 10-meter shoreline intervals. R-studio was used to match video and still image video to 10 m shoreline points along the surveyed shoreline using the perpendicular GPS bearing. Each surveyed shoreline point has an associated still frame image.

Data streams sent to MangroveWatch for processing → Video converted to 1-second still image frames → Data input into R to match video images & GPS to shoreline points

Generating Shoreline Habitat Scores and Metrics

Features visible in still-frame imagery associated with shoreline points were scored using a criteria-based image analysis. The scoring system used is based on experience and knowledge of tropical and sub-tropical shoreline estuary habitats. The assessment was done on images associated with 10-meter interval shoreline points. Mangrove presence, shoreline naturalness, flood damage and point features (e.g. litter) were scored every 10 m, whereas habitat features (density, maturity, connectivity and condition) and shoreline process were scored every 50 m. The shoreline and mangrove habitat features were grouped into different habitat metrics: habitat structure, condition, shoreline process and shoreline naturalness, each reflecting ecosystem service provision potential, resilience and risk. An additional measure of mangrove forest stand size (length along shoreline) and determination of high value stand based on structural attributes was calculated. Features were scored from the middle of images. Further details on the scoring and grading calculations are provided here: https://wettropicswaterways.org.au/wp-content/uploads/2023/07/Methods-2021-22-V4.0.pdf

Shoreline Mangrove Cover

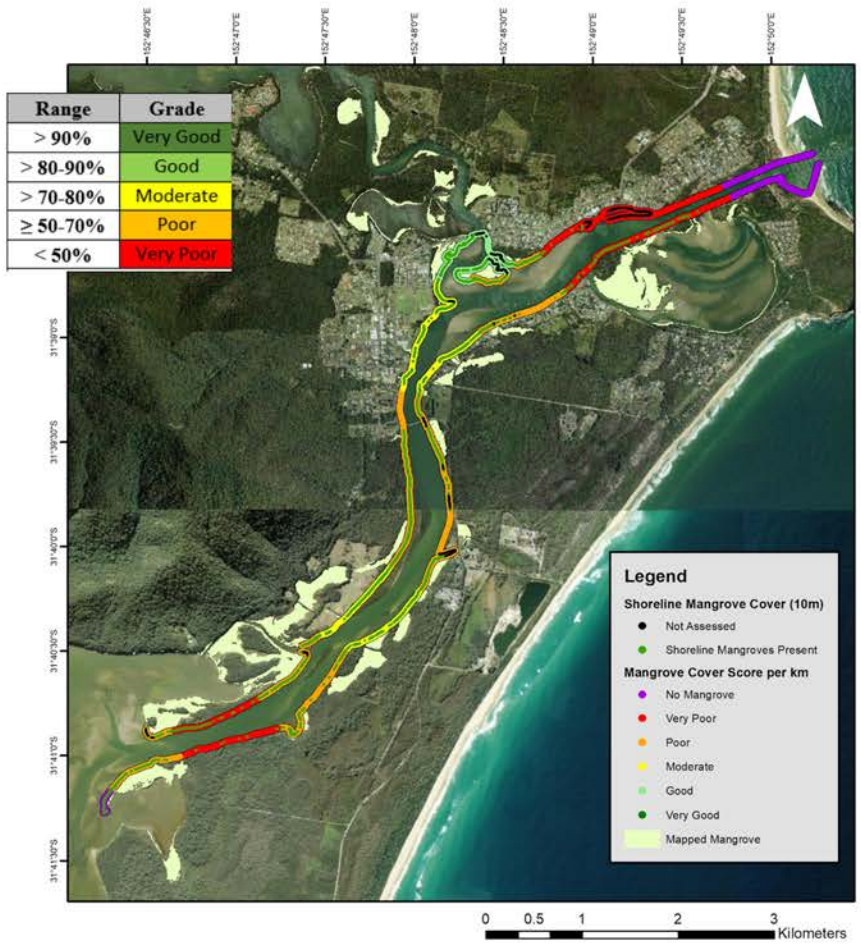
Descriptor: The proportion of shoreline with mangroves present

Overall Shoreline Mangrove Cover = 51.4 %

Overall Mangrove Cover Score = Poor

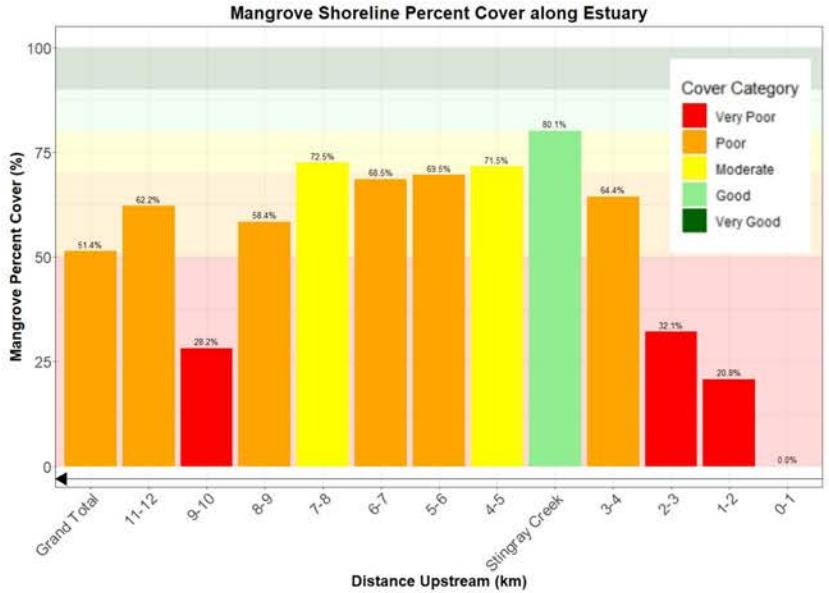
Method Summary

Mangrove presence/absence was scored at 10m intervals along the shoreline to generate a percentage cover score. A percent cover score was generated for each 1km of estuary channel along the surveyed shoreline based on standard MangroveWatch report card values.



Mangrove cover along the lower Camden Haven River estuary is 'Moderate' compared to other surveyed estuaries. There are no mangroves present in the lower 1km of the estuary at the mouth with very low cover 3km upstream of the estuary mouth. Shoreline mangrove cover is highest at the confluence of the Camden Haven River and Stingray Creek. Extensive shoreline modification throughout the estuary, combined with increased estuary flow rates associated with hydrodynamic modification reduces mangrove establishment potential.

The absence of mangroves in the lower estuary limits natural climate risk mitigation, natural water quality improvement, fish habitat complexity and biodiversity refugia provided by shoreline mangroves. With increasing sea level rise and coastal hazard risks associated with climate change it is important that shoreline mangrove cover is improved in the lower estuary. To improve shoreline mangrove cover and associated ecosystem service values, it will be necessary to adopt ecological engineering approaches, such as living shoreline construction.



Shoreline Mangrove Habitat Structure

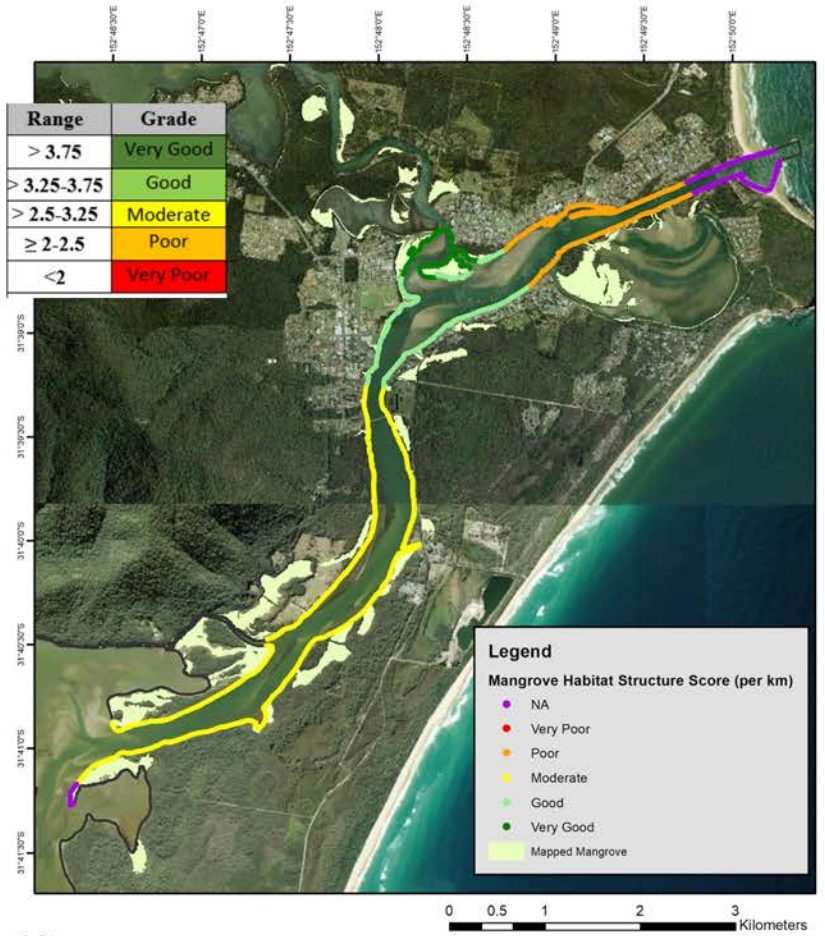
Descriptor: A combined score representing shoreline mangrove cover, mangrove stand density, stand maturity and tidal connectivity.

Mean Habitat Structure Score = 3.05

Overall Mangrove Cover Score = Moderate

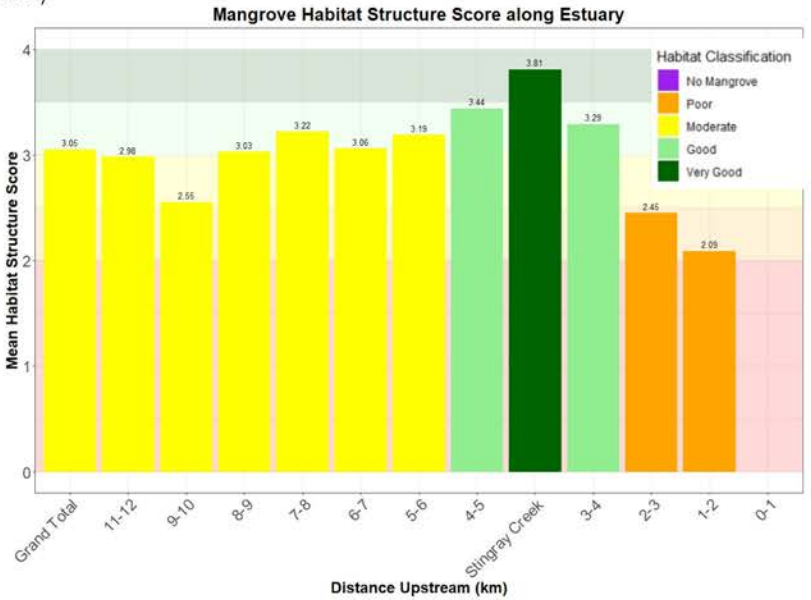
Method Summary

Mangrove structural attributes including stand density, age of trees and tidal connectivity were scored every 50m where mangroves were present. The average of these scores for each estuary reach was combined, standardised and factored relative to mangrove shoreline cover to provide a measure of mangrove habitat structure.



Mangrove Forest Density (MD): 1 = Isolated Individuals, 2 = Dense Patch, 3 = Open Continuous Forest, 4 = Closed Canopy
Mangrove Forest Maturity (Stand Age) (MM): 1 = Seedlings, 2 = Saplings, 3 = immature trees, 4 = mature trees, 5 = old growth
Mangrove Tidal Connectivity (TC): 1 = no connectivity, 2 = indirect connectivity, 3 = direct high tide connectivity 4 = low tide connectivity

Mangrove Forest Structure Score = (%Cover Score + MD + (MM/5)*4 + TC)/4



Shoreline mangrove forest structure is highest in the mid-estuary and lower Stingray Creek. These mangroves have high density, high connectivity and high stand maturity. These structural attributes relate to multiple mangrove ecosystem services including carbon storage, fish and wildlife habitat, coastal hazard risk reduction and water quality improvement. The lower estuary was scored 'Poor' for mangrove forest structure, with many shoreline mangrove stands disconnected from the main estuary channel. Efforts to conserve mangrove forest structure in the mid estuary and improve connectivity in the lower estuary will assist to protect and improve local estuary values.

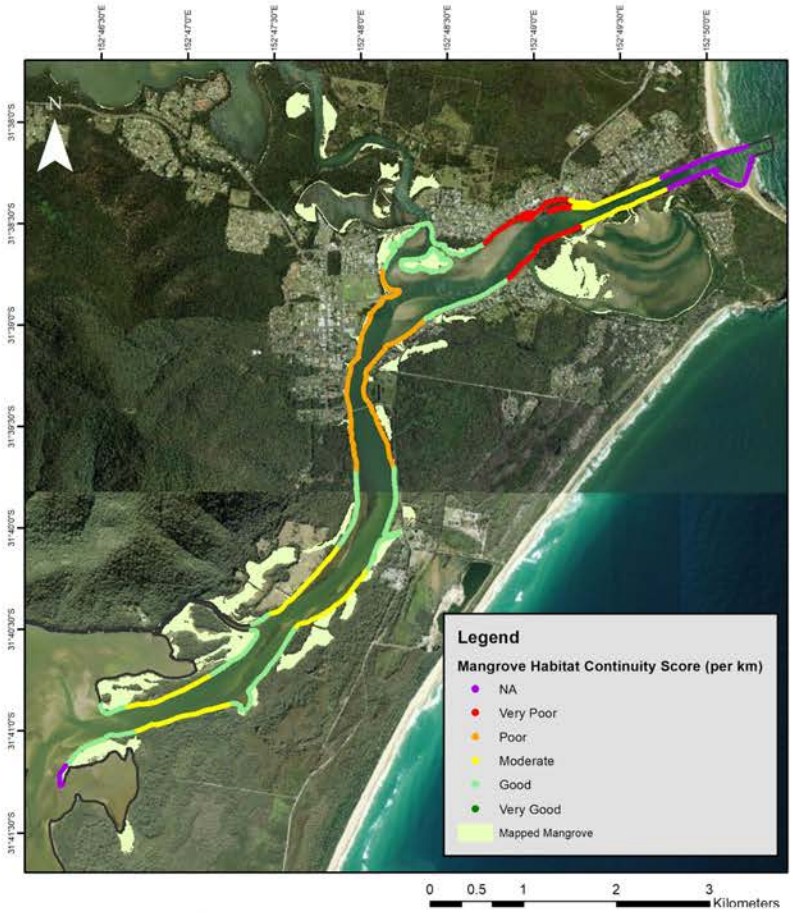
Shoreline Mangrove Continuity

Overall Habitat Continuity Score = 0.37

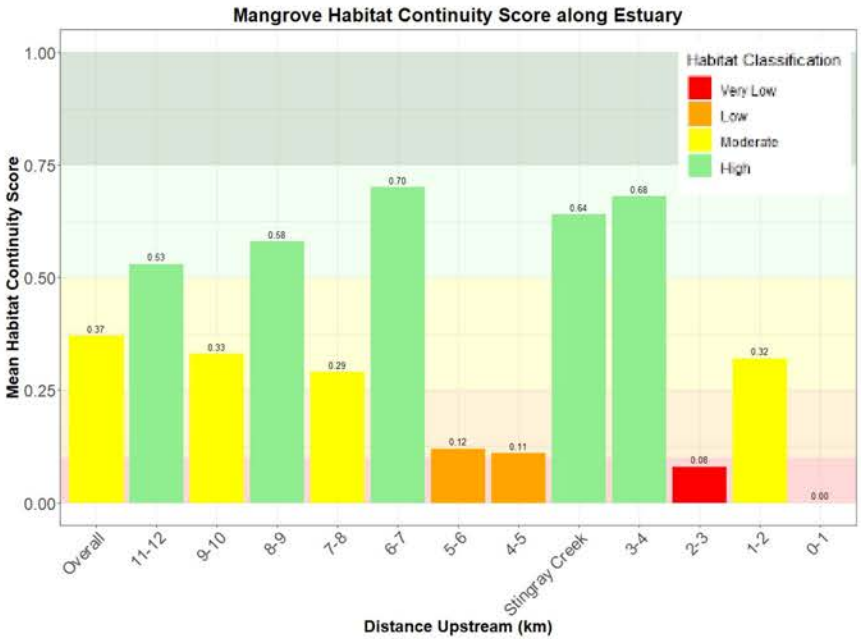
Overall Habitat Continuity Grade = Moderate

Method Summary

The length of mangrove shoreline stands was recorded along the estuary. Each stand was assigned a unique value. The habitat continuity score was derived by normalizing the continuous length of mangrove presence along the shoreline to a scale of 0-4, ensuring equivalence to discrete scores



Habitat patch size is directly linked to habitat values, particularly biodiversity and fisheries values. Reduced patch size increases estuarine shoreline habitat vulnerability to flooding and erosion, and increases the risk of damage to shoreline infrastructure. Mangrove habitat continuity along the Camden Haven River estuary is classed as moderate. Many small isolated mangrove stands (<40m) were observed, particularly where shoreline modification and bank hardening has occurred. Additionally, continuous mangrove fringes are often fragmented for shoreline access and built structures. Habitat continuity was least in the lower estuary and mid-estuary, linked to shoreline modification. Efforts to increase habitat connectivity through habitat creation in the form of living shorelines or gap-infilling measures will increase shoreline habitat ecosystem service values and reduce climate change vulnerability for habitat, shoreline infrastructure and adjacent landuse.



Shoreline Mangrove Condition

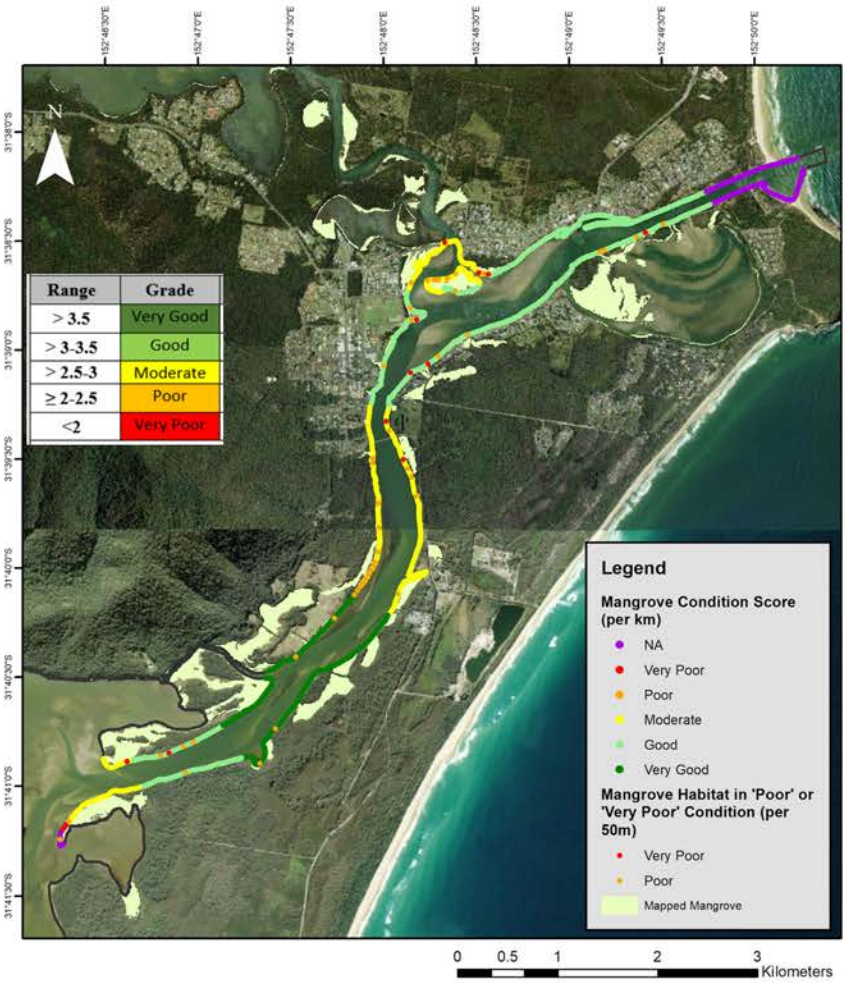
Mean Habitat Condition Score = 3.2

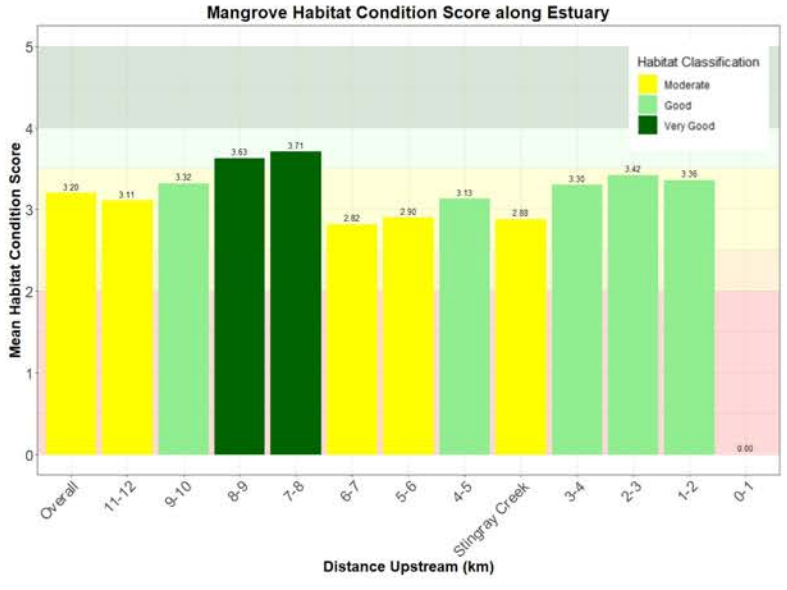
Overall Habitat Condition Grade = Moderate

Method Summary

The health of mangroves along the shoreline was scored every 50m where mangroves were present based on canopy cover density and estimated canopy loss associated with dieback and tree mortality within the fringing mangrove stand. The condition scores were 5: 0% canopy loss (no dieback), 4: 1-10% canopy loss (minor dieback), 3: 10-30% canopy loss (moderate dieback), 2: 30-60% canopy loss (significant dieback), 1: 60-90% canopy loss (major dieback), 0: >90% canopy loss (severe dieback & stand mortality).

Mangrove condition along the Camden Haven River estuary is moderate, indicating that the majority of mangrove stands have minor dieback present, with many stands experiencing more severe dieback. Healthy mangrove stands (score 4-5) represent 42% of mangroves. An additional 35% had moderate dieback present. Mangrove stands in poor or very poor condition represented 22% of mangroves assessed, equivalent to 3.2km of mangrove shoreline. The relatively high proportion of poor condition mangroves suggests the presence of an ongoing or recent stressor impacting mangroves. Mangroves in the estuary were impacted by the 2019 bushfires, although this impact was largely restricted to the upper estuary in Watsons-Taylor Lake indicated by the moderate mangrove condition score for 11-12 km upstream. Based on this assessment, mangroves in the upper-mid estuary (5-7km upstream) and at the confluence of Stingray Creek had the lowest mangrove condition scores. Field inspection at the time of surveys show the cause of mangrove dieback and mortality in these estuary sections is linked to the 2021 flood event. This impact is described in more detail in the following report card section.



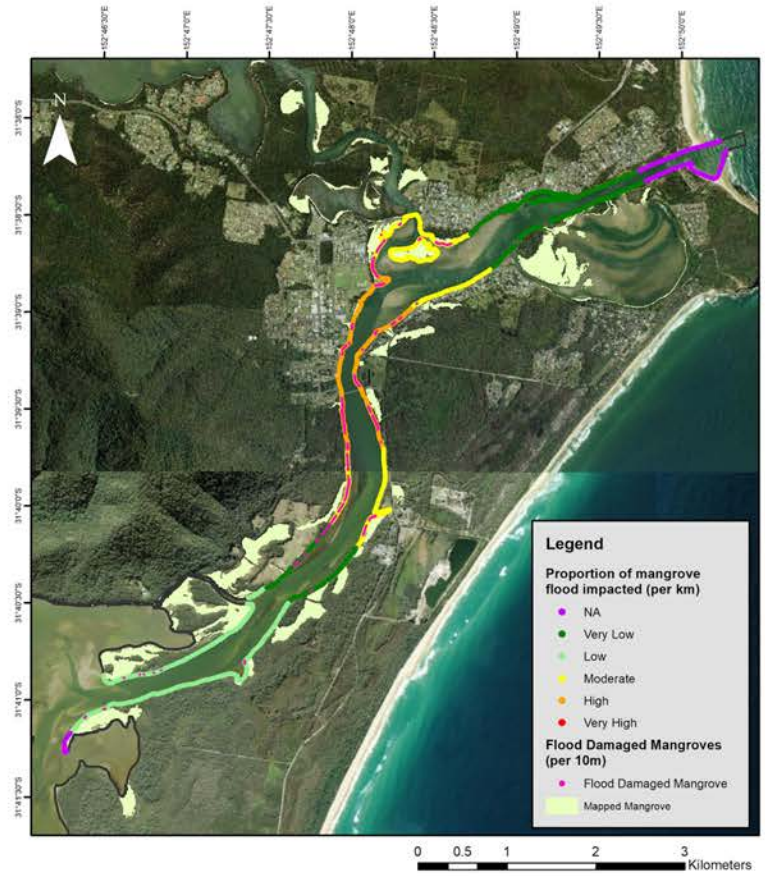


Shoreline Mangrove 2021 Flood Imapct

Proportion of mangrove habitat impacted by floods = 31%

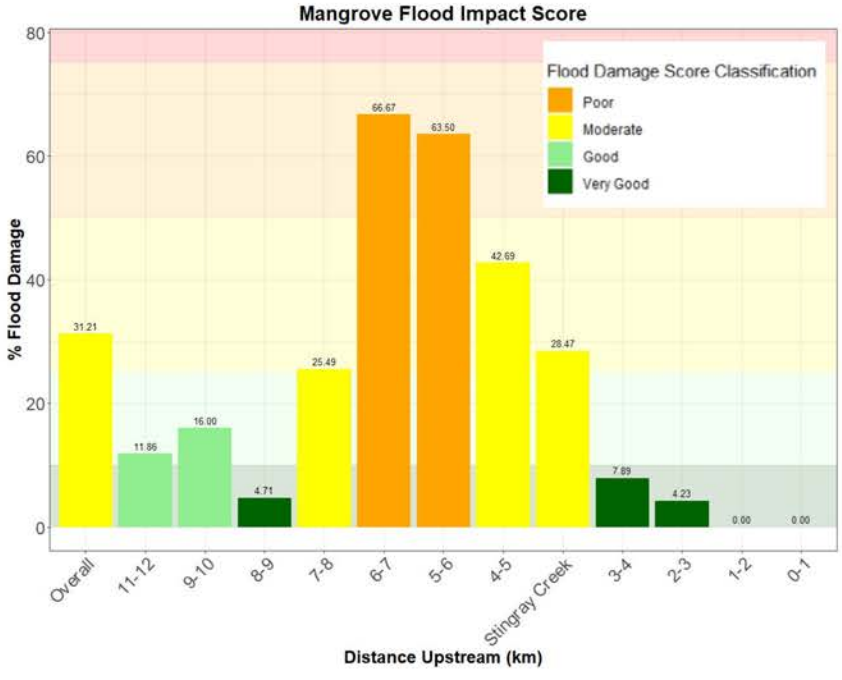
Method Summary

Mangroves with obvious recent flood damage were recorded every 10m. Flood damage was determined by the presence of multiple dead and stressed trees resulting from either erosion or root burial from sediment deposits. Flood damage scores are based on expert judgement from previous post-flood mangrove impact assessments.



Recent severe flooding in NSW and Qld has significantly impacted fringing mangrove habitats. The Camden Haven River estuary experienced record flooding towards the end of March, 2021. The combination of the physical force of floodwaters, extended inundation period, sediment deposition on breathing roots, sediment erosion, impacts of prolonged freshwater on mangrove fauna and potential chemical pollutant deposition can result in extensive mangrove mortality. Often the effects of severe flooding do not become apparent until 6-12 months after flooding. Whilst mangroves can recover from flood events, full recovery from severe impacts can take 10-30 years. During the recovery period mangroves are vulnerable to additional climate and human pressures Increasing sea levels often results in fringing mangrove setback leading to a nett loss of shoreline habitat. Within the Camden Haven River estuary, 31% of mangroves were severely impacted by flooding, with the most extensive impact in the mid-estuary. The primary driver of flood-related impacts appears to be sediment root burial. However, elevated nutrient loads may also increase flood impact risk.

This flood event highlights the vulnerability of shoreline mangroves to climate stressors. Given the recovery trajectory and likely loss of mangrove habitat, additional efforts to enhance and protect unimpacted mangroves should be considered.



Shoreline Physical Process

Overall Shoreline Process Score = 11.25

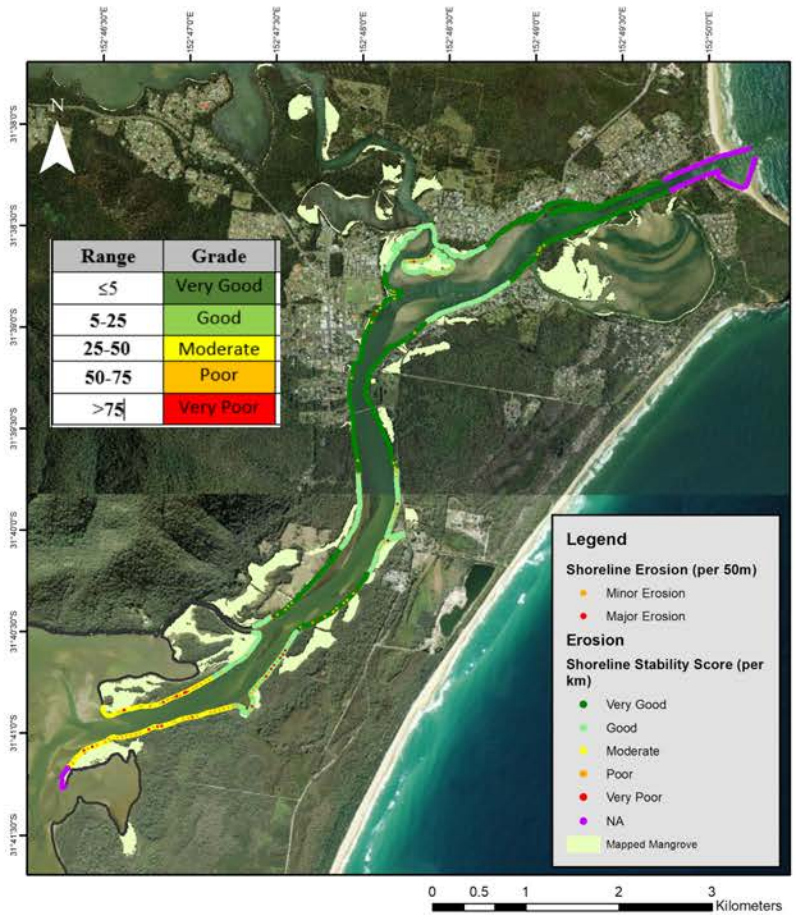
Overall Shoreline Process Grade = Good

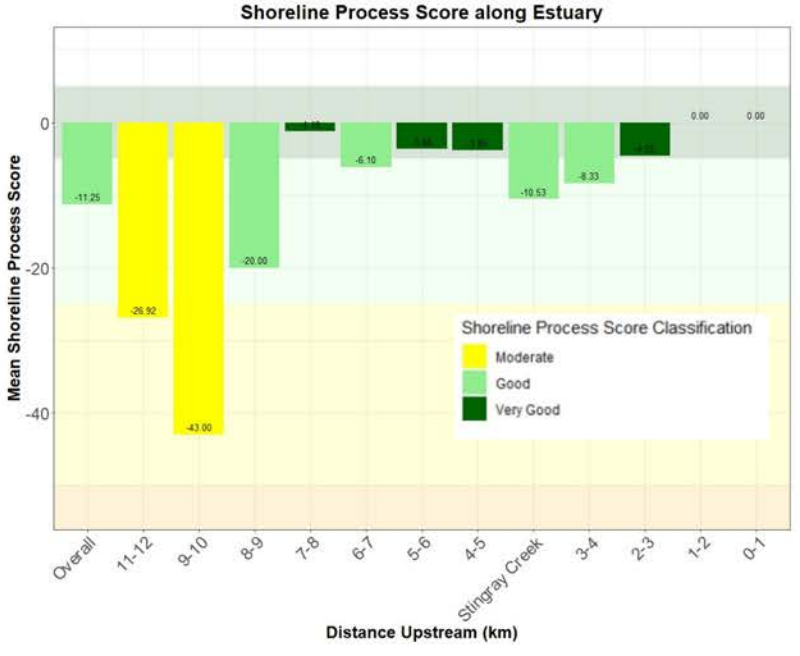
Proportion of shoreline eroded = 28%

Proportion of shoreline expanding = 9%

Method Summary

Shoreline changes were assessed every 50m: severe erosion with habitat and infrastructure damage received a -2 score, minor erosion a -1, densely populated mature mangrove seedlings a 2, and sparse seedlings or evident sediment deposits a 1. The overall shoreline process score was derived by summing these weighted scores and dividing by the maximum potential score. Negative scores indicate more erosion than deposition





Erosion is the dominant shoreline physical process in the Camden Haven River estuary with 28% of the shoreline in an exposed and retreating state, however only 6% of erosion was classified as severe. Most erosion was recorded in the upper estuary. The extensive shoreline armouring along the lower estuary prevents natural shoreline dynamics that would normally be observed. The only erosion area of concern is an island at the confluence of Stingray Creek where high value habitat with very old Grey Mangroves (Avicennia marina) is at risk of loss from shoreline retreat.

Shoreline Naturalness

Overall Shoreline Naturalness score = 40.3

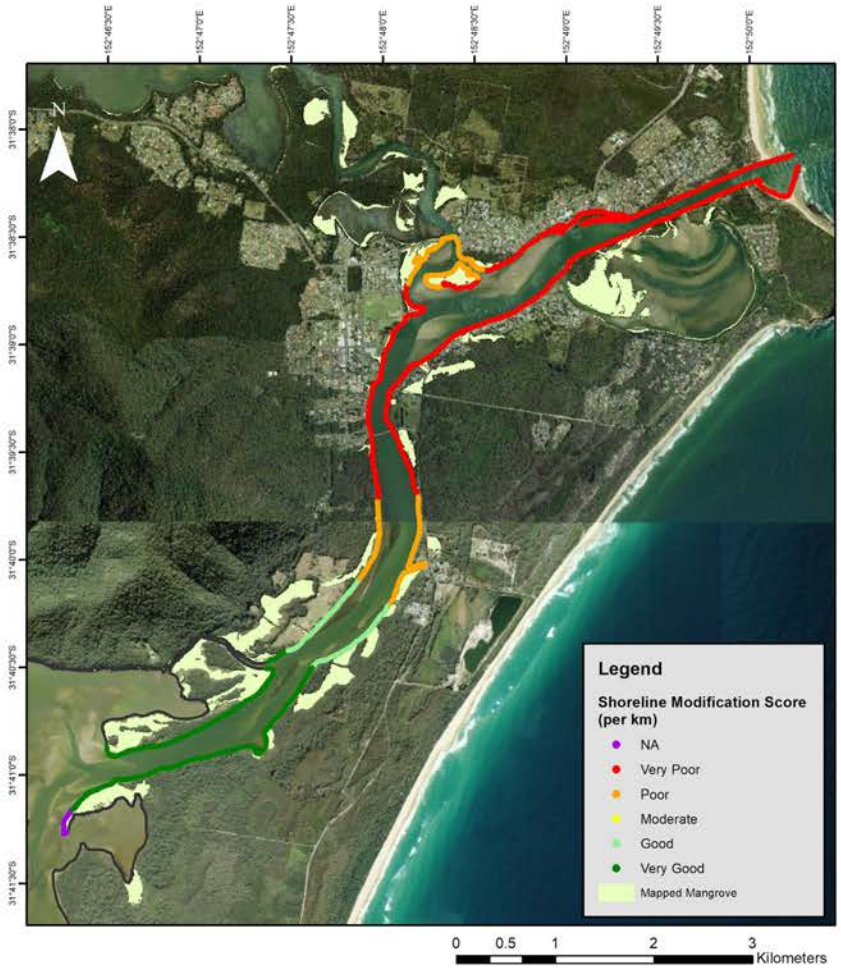
Overall Shoreline Naturalness Grade = Moderate

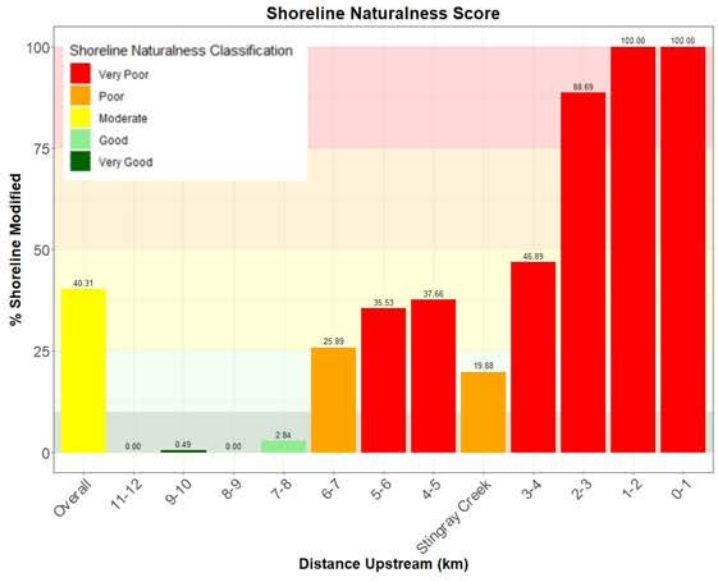
Proportion of shoreline modified = 39%

Method Summary

The length of mangrove shoreline stands was recorded along the estuary. Each stand was assigned a unique value.

The majority of shoreline in the lower Camden Have River estuary is modified with rockwall and rip-rap structures. These modifications have substantially altered estuary hydrodynamics and increased tidal flow velocity in the lower estuary. High flow velocity limits mangrove rockwall colonisation and establishment potential. Consequently, there is low fish habitat diversity along the lower estuary main channel. In the mid estuary, mangroves are more frequently observed seaward of rock wall structures, highlighting the potential to integrate additional green-grey shoreline modification approaches within the estuary. Historically, bank hardening was not designed with mangrove habitat in mind. However, these existing structures can be modified to enhance mangrove colonisation to maximise both shoreline protection and stabilisation and habitat-related values including climate change risk reduction using a 'living shoreline' approach.





Shoreline Marine Debris

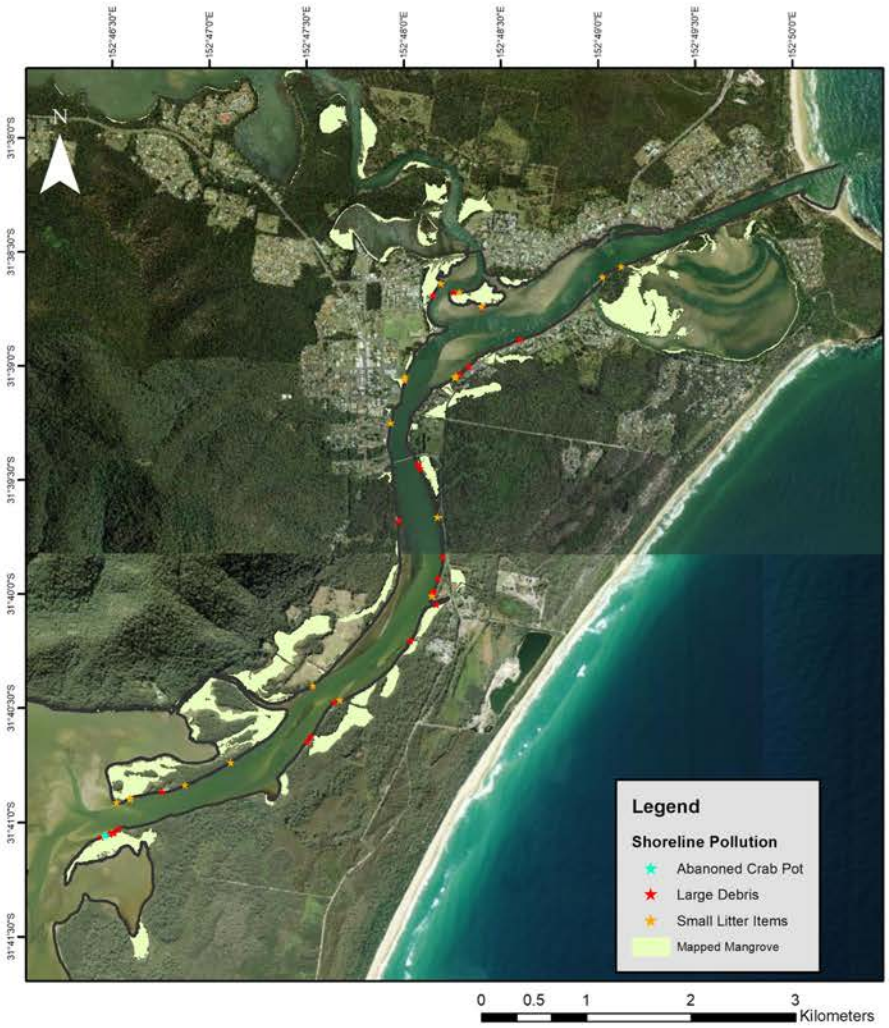
Descriptor: The number of marine debris items along the shoreline

Total items observed = 49
(2.33 items per km)

Small litter = 20, Large Debris = 27,
Abandoned Crab Pots = 2

Method Summary

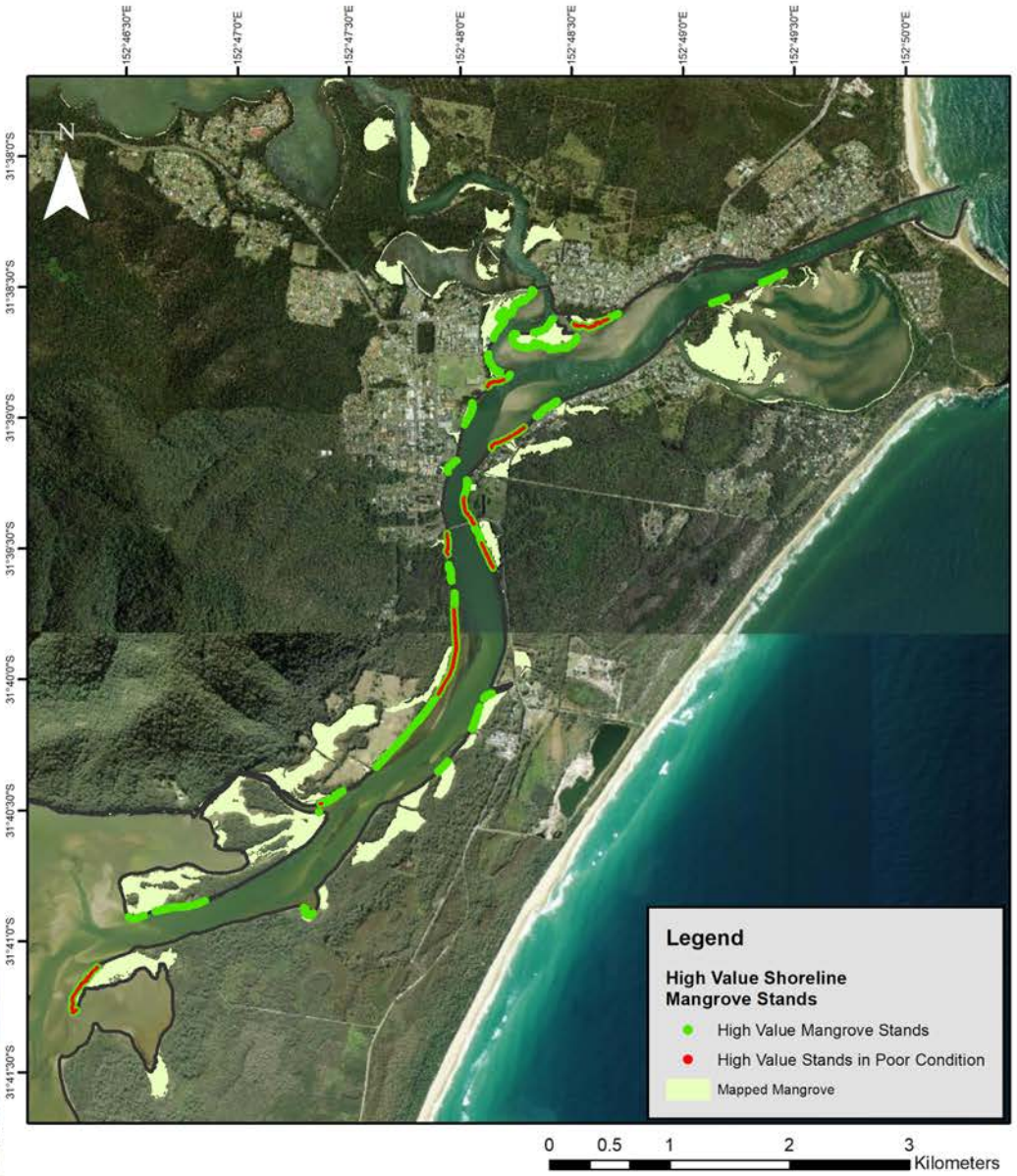
The presence of small litter, larger debris items (eg. barrels) and abandoned crab pots was recorded at 10m intervals



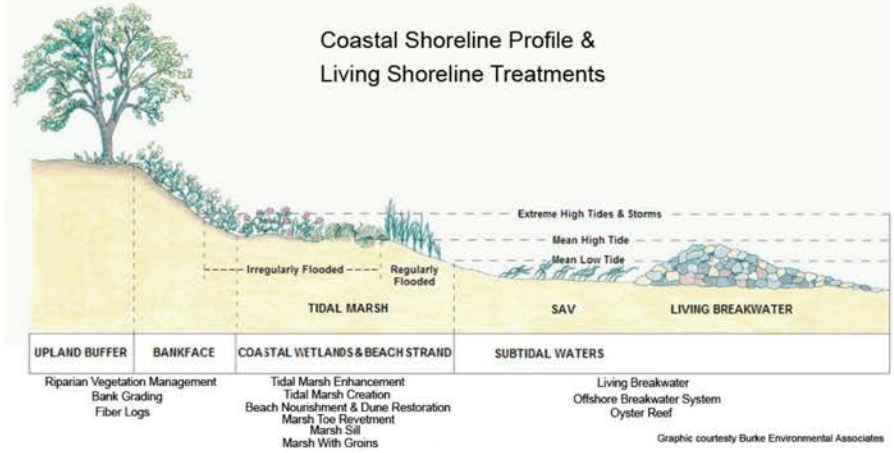
There were 49 items of marine debris along the surveyed shoreline, equivalent to 2.33 items per km of shorelines. Small litter items were mostly soft plastic packaging. Larger debris items were blue storage barrels associated with the oyster industry, other larger plastic items and dumped building rubble used for shoreline stabilisation. The breakdown of these items can lead to microplastic pollution and additional toxins entering the marine environment and marine food chain. Exposed geofabric along some rockwall sections. This material has been shown to be a significant source of microplastics. Plastic in the mangrove environment is likely to impact crabs and other mangrove macrobenthic fauna important for ecosystem health.

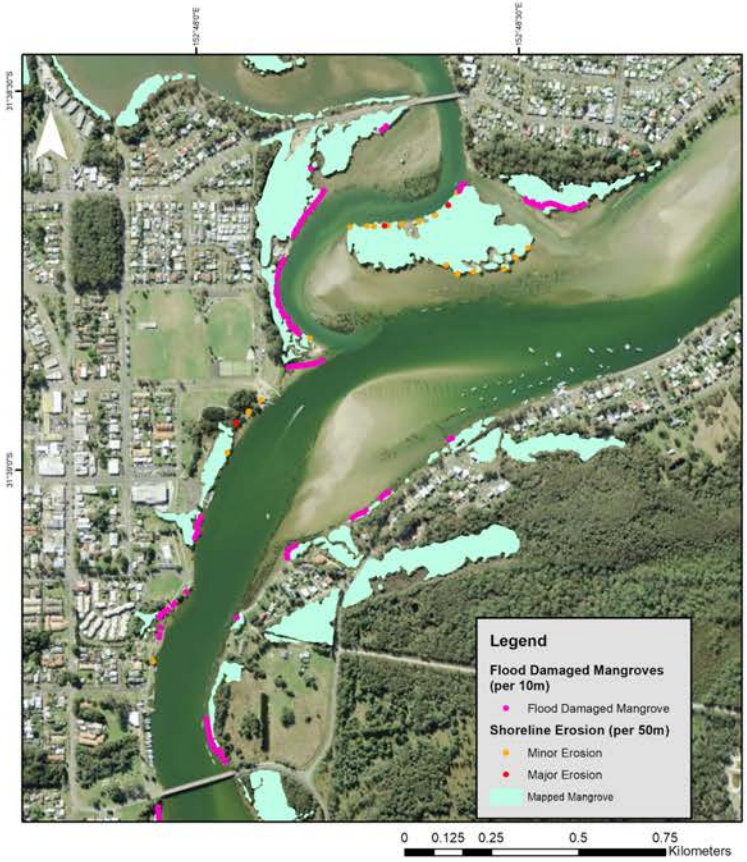
High Value Habitat At Risk

High-value mangrove stands were identified in the lower Camden Haven River estuary using a combination of standardised and normalised habitat continuity and habitat structure scores. The identified high-value mangrove stands have extensive continuous shoreline cover and high habitat structural value linked to mangrove ecosystem service provision. The majority of these high-value stands are present in the mid and upper mid-estuary. Some of these stands were severely impacted by the 2021 floods, placing these important estuary habitats at risk. To assist the prioritisation of future management actions and investment in the estuary, these at-risk high-value estuary patches are shown on the adjacent map. Activities that seek to enhance habitat recovery or reduce additional ecosystem risks to these mangrove stands should be prioritised. Such activities may include, litter and debris removal, feral animal control, reducing pollutant and nutrient loads and minimising boat wake. Active climate adaptation enhancement measures such as facilitate planting combined with engineering approaches to prevent habitat loss should also be considered.

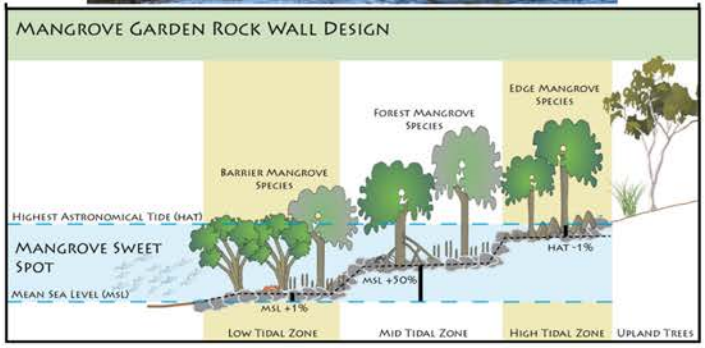


Targeted Management Actions





Mangroves in the mid-estuary near the confluence of Stingray Creek were severely impacted by the 2021 flood event and resulting sediment root burial and shoreline erosion. There is risk of significant and high-value habitat loss in the near future without intervention. Compounding climate change pressures increase the need for implementing active climate adaptation measures to protect mangrove habitat to ensure the long-term protection of estuary ecosystem values and reduce coastal hazard risks. These measures will require integrated engineering approaches. The business-as-usual conservation approach to estuary management is no longer appropriate. During S-VAM surveys it was observed that historically dumped oyster shells provided a living breakwater that protected adjacent mangroves from flood events. Similar observations have been made elsewhere. The opportunity to install additional living breakwaters using oyster shell as a means to protect mangrove habitat should be investigated. Living breakwater structures could be complimented by the construction of 'mangrove garden' living shorelines to assist in offsetting any additional habitat loss in the mid-estuary.



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hello@earthwatch.org.au

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