

# A Vulnerability Assessment for the Great Barrier Reef



## Shorebirds

Information valid as of Feb 2012

### Summary

#### Diversity

At least 41 species of shorebirds are known to inhabit the Great Barrier Reef World Heritage Area (the World Heritage Area).

#### Susceptibility

The ecology of shorebirds makes them susceptible to a number of pressures occurring in the World Heritage Area and over the entire range of both resident and inter-continental migrant species.

The different species of shorebirds that occur in the World Heritage Area utilise a very wide range of habitats, though at the species level often have very specific habitat and dietary requirements. Many of them migrate to different parts of the country, or to different countries, during the breeding season. Loss or degradation of habitat in any of their feeding, breeding or staging areas can result in failure to breed or death from starvation or predation.

The most crucial habitats for shorebirds are tidal flats, which in many areas are being degraded and sometimes removed altogether. This can result from changed water regimes or reduced water quality due to catchment run-off and pollution, land reclamation and encroachment of coastal development. Onshore nesting and roosting habitats are being impacted by invasive weeds which forces shorebirds into marginal habitats where they can be susceptible to predation or greater disturbance.

#### Major pressures

In the Great Barrier Reef, shorebirds are experiencing significant impacts from pressures in the inshore area including reduced availability of key habitat or suitable alternatives and nesting failure due to human disturbance. Shorebirds are also being impacted by increased intensity of storm and cyclone events (climate change related) and the mortality of chicks, eggs and adults through predation by feral, domestic and wild animals.

#### Cumulative pressures

The most significant cumulative impacts shorebirds are exposed to occur over inshore areas as a result of:

- Coastal development causing reclamation and degradation of key habitats, especially tidal flats
- Uncontrolled tourism and recreational activities on islands, intertidal areas and foreshores
- Predation and disturbance by feral and domestic animals
- Climate change impacts that impact on nesting success and degrade habitat
- Pollution of coastal and estuarine environments
- Water quality degradation due to catchment run-off and pollution with associated impacts on the food web.

If these pressures are not managed effectively they can act in combination and compound over time and/or when applied over the same geographical area. They are often hard to quantify due to the incremental nature of their effects, which in turn makes targeted management difficult.



Bar-tailed godwit (*Limosa lapponica*). Photo courtesy of Queensland Government, A. McDougall.

#### Management in the Great Barrier Reef and adjacent areas in Queensland

Legislative management tools for the conservation of shorebirds that occur in the Great Barrier Reef include:

- Assessment of actions that may impact shorebirds and listing of threatened shorebird species under the *Environment Protection and Biodiversity Conservation Act 1999*
- Migratory shorebirds listed under international migratory bird agreements applied with particular conservation management arrangements across their migratory ranges

- *Great Barrier Reef Marine Park Act 1975* (including planning provisions under the Cairns Area, Hinchinbrook and Whitsundays Plans of Management)
- Spatial protection via the *Great Barrier Reef Marine Park Zoning Plan 2003* (34 per cent of the Great Barrier Reef Marine Park (the Marine Park) closed to extractive use) and reflective provisions under the *Marine Parks (Great Barrier Reef Coast) Zoning Plan 2004* (Qld)
- Queensland Coastal Plan
- *Nature Conservation Act 1992* (Qld)
- Action Plan for Australian birds 2000; and others (refer Management table, p. 10).

### Existing management actions

A number of management actions are in place in the World Heritage Area that 'operationalise' legislative management tools. They provide additional guidance and/or strategic direction to management operations in the Marine Park and include:

- The Coastal Bird Monitoring and Information Strategy (currently under review by the Queensland Government)
- State management plans for island National Parks that have provisions for the protection of birds, including shorebirds
- Examination of the potential impacts of climate change on shorebirds under the *Great Barrier Reef Climate Change Action Plan 2007-2012* with the development of adaptive management options
- The Queensland Government's *Back on Track Actions for Biodiversity* documents 2010.

### Great Barrier Reef Outlook Report 2009 assessment

Not assessed.

### Vulnerability assessment: Medium

- Despite the limited information available to base management decisions on, there is a need for a strategic approach to reduce the existing, potential and perceived stressors that could impact on the long-term viability of shorebird populations, on a local and regional scale.
- Ecology of shorebirds is such that shorebird populations, many of which are migratory across great north-south flyways, show strong site fidelity to their foraging, resting, breeding and nesting grounds.
- Shorebirds are vulnerable to a range of threats including degradation and loss of habitats across their entire distributional range.
- During the breeding season resident shorebirds, many of which are beach-nesters, are susceptible to considerable human disturbance impacts and predation and disturbance by domestic, feral and wild animals.

- The impacts of climate change are likely to be considerable on shorebird populations. Increases in sea level or greater storm activity could have significant impacts on islands, intertidal areas and coastal foreshores through increased erosion and/or accretion, inundation of habitat, increased storm damage and vegetation loss (allowing weed species to invade). Other climate change pressures will affect island ecosystems and processes that shorebirds rely on and contribute to. Such pressures will impact on island morphology, water tables, vegetation composition, ocean-island nutrient cycling, disease and weeds. Current knowledge of the vulnerabilities of island ecosystems to climate change is fragmented and incomplete, and further research is required to determine correlations between these systems for implementation into management.<sup>a</sup>
- There are other significant pressures that threaten shorebirds that need to be managed. These include, but are not limited to commercial and recreational fishing impacts on prey species, the introduction of exotic plants and animals to important nesting locations and ingestion of marine debris by shorebirds.

### Suggested actions to address vulnerabilities

- Continue long-term monitoring programs (such as the Queensland Government Coastal Bird Atlas) that provide vital information on population trends and breeding success for shorebirds used to inform management decisions.
- Continue natural resource management (control of pest flora and fauna and maintain the ecological influence of fire) and monitoring of key foraging, nesting and roosting sites for shorebirds through the Field Management Program and partnerships with non-government waterbird conservation groups. This should be informed by a review of the Coastal Bird Monitoring and Information Strategy. For mainland sites, this is considered to be mostly supported by the Queensland Government.
- Support and facilitate collaborations on shorebird research and monitoring programs with data-set custodians and researchers. These collaborations should be guided by outcomes from processes such as the workshop on *Seabirds and shorebirds in the Great Barrier Reef World Heritage Area* in a changing climate<sup>1</sup> and the review of the Coastal Bird Monitoring and Information Strategy and should focus research on determining correlations between climate change impacts and shorebird ecology, and their supporting habitats and processes. Findings should be implemented within the framework of management actions currently in existence (refer above and the Management table, page 10).
- Implement effective management on a local and regional scale, such as protection of key foraging, roosting and nesting habitat. Management actions at sensitive sites might include ensuring minimal

<sup>a</sup> Refer also to the Vulnerability Assessment for the Great Barrier Reef Islands.

development and infrastructure in key habitat, restriction of vehicles on beaches on sensitive sections of beach, restriction of incompatible activities such as kite surfing, effective pest animal and plant control programs and seasonal closure of breeding sites.

- Advocate for increased protection for important shorebird habitats outside of current conservation reserves within (and adjacent to) the Great Barrier Reef World Heritage Area, in recognition of their important conservation value.
- Continue to implement and strengthen international and intergovernmental partnerships and agreements to ensure key habitat is protected and threatening processes are addressed throughout the range of migratory species.
- Work with national and interstate governing bodies to ensure a network of important habitat for migratory species is maintained across Australia, to maintain crucial linkages for shorebirds migrating along the East Asian-Australasian Flyway.
- Additional research on shorebird biology, ecology, population status, key habitats and threats is required to better inform management decisions for this group of species.
- Work with key non-government environmental management groups such as Birds Australia (and their Australasian Wader Studies Group) to align monitoring efforts and increase the usability of monitoring data for management purposes.
- Identify and support research options that further improve knowledge of species-specific foraging strategies, localities and trophic interplays within the Great Barrier Reef Region for shorebird species.
- Increase awareness of the threats to shorebirds and the importance of conserving shorebirds and their habitats. Increase the level of collaboration between decision makers and the community in conservation programs.
- Continue to monitor other key threats to shorebirds (as outlined in vulnerabilities above) through the joint Australian and Queensland governments' Field Management Program for the Great Barrier Reef World Heritage Area and implement best-practice responses to minimise the impacts of these threats. Key threats that require a management focus within the World Heritage Area come from visitor disturbance and marine debris.
- Great Barrier Reef Marine Park Authority (GBRMPA) Guidelines for managing visitation to islands where shorebirds breed should be periodically reviewed in line with current knowledge. The effectiveness of the management response must also be monitored and reviewed.
- Work to establish arrangements with key authorities and non-government organisations to prevent rubbish entering the marine environment and support the removal of discarded fishing gear/marine debris. Raise public awareness and compliance activities to encourage the responsible disposal of fishing gear/rubbish and investigate the origins of fishing gear/marine debris. Guidance should also be taken from the national *Threat abatement plan for the impacts of marine debris on vertebrate marine life*.



Beach stone-curlew (*Esacus magnirostris*).  
Photo courtesy of Queensland Government, A. McDougall.

## Background

### Brief description of shorebirds

The term shorebird generally refers to species of birds belonging to 13 different families within the Order Charadriiformes.<sup>2</sup> For the purposes of this assessment only species commonly found in coastal areas in the Great Barrier Reef World Heritage Area, and particularly in intertidal and estuarine areas, are included in the assessment (Table 1).

**Table 1. Shorebird species occurring in the Great Barrier Reef World Heritage Area**

Common name	Species name	Migrant/Resident	Australian population estimate*
Australian painted snipe	<i>Rostratula australis</i>	Resident	1500
Australian pratincole	<i>Stiltia Isabella</i>	Migrant	60,000
Asian dowitcher	<i>Limnodromus semipalmatus</i>	Migrant	450
Bar-tailed godwit	<i>Limosa lapponica</i>	Migrant	185,000
Beach stone-curlew	<i>Esacus magnirostris</i>	Resident	5000
Black-tailed godwit	<i>Limosa limosa</i>	Migrant	70,000
Black-winged stilt	<i>Himantopus himantopus</i>	Resident	300,000
Broad-billed sandpiper	<i>Limicola falcinellus</i>	Migrant	10,000
Bush stone-curlew	<i>Burhinus grallarius</i>	Resident	150,000
Common greenshank	<i>Tringa nebularia</i>	Migrant	19,000
Common redshank	<i>Tringa totanus</i>	Migrant	200
Common sandpiper	<i>Actitis hypoleucos</i>	Migrant	3000
Curlew sandpiper	<i>Calidris ferruginea</i>	Migrant	118,000
Double-banded plover	<i>Charadrius bicinctus</i>	Migrant	30,000
Eastern curlew	<i>Numenius madagascariensis</i>	Migrant	28,000
Great knot	<i>Calidris tenuirostris</i>	Migrant	360,000
Greater sand plover	<i>Charadrius leschenaultii</i>	Migrant	75,000
Grey plover	<i>Pluvialis squatarola</i>	Migrant	12,000
Grey-tailed tattler	<i>Tringa breviceps</i>	Migrant	45,000
Lesser sand plover	<i>Charadrius mongolus</i>	Migrant	25,000
Little curlew	<i>Numenius minutes</i>	Migrant	175,000
Marsh sandpiper	<i>Tringa stagnatilis</i>	Migrant	9000
Oriental plover	<i>Charadrius veredus</i>	Migrant	70,000
Oriental pratincole	<i>Glareola maldivarum</i>	Migrant	2,880,000
Pacific golden plover	<i>Pluvialis fulva</i>	Migrant	9000
Pectoral sandpiper	<i>Calidris melanotos</i>	Migrant	Not known
Pied oystercatcher	<i>Haematopus longirostris</i>	Resident	10,000
Red knot	<i>Calidris canutus</i>	Migrant	135,000
Red-capped plover	<i>Charadrius ruficapillus</i>	Resident	95,000
Red-kneed dotterel	<i>Erythronyx cinctus</i>	Resident	25,000 to 1,000,000
Red-necked avocet	<i>Recurvirostra novaehollandiae</i>	Resident	107,000
Red-necked stint	<i>Calidris ruficollis</i>	Migrant	270,000
Ruddy turnstone	<i>Arenaria interpres</i>	Migrant	20,000
Ruff	<i>Philomachus pugnax</i>	Migrant	Not known
Sanderling	<i>Calidris alba</i>	Migrant	10,000
Sharp-tailed sandpiper	<i>Calidris acuminata</i>	Migrant	140,000

Sooty oystercatcher	<i>Haematopus fuliginosus</i>	Resident	11,500
Terek sandpiper	<i>Xenus cinereus</i>	Migrant	23,000
Wandering tattler	<i>Tringa incana</i>	Migrant	Not known
Whimbrel	<i>Numenius phaeopus</i>	Migrant	10,000
Wood sandpiper	<i>Tringa glareola</i>	Migrant	6000

\* taken from Geering *et al.* 2007<sup>2</sup>

These species utilise a wide range of habitats, including beaches, rocky shores, estuaries, intertidal flats, coral cays and reefs, freshwater wetlands, salt lakes, grasslands, pasture land and sewage farms. Most species are generalists in their choice of habitats, with several exceptions including the sooty oystercatcher, which are generally only found on rocky ocean shores.<sup>2</sup>

Shorebirds occur in the coastal regions of both the mainland and many of the islands throughout the Great Barrier Reef World Heritage Area.

## Geographical distribution

There are 17 species of resident shorebirds and 37 species of regular migrant that occur throughout Australia<sup>3</sup>, 41 of which commonly occur in the Great Barrier Reef World Heritage Area. The majority of individuals of migratory species spend part of the year in Australia, departing for their breeding grounds in northern China, Mongolia, Siberia and Alaska from July to October. Their return migration to Australia occurs from March to early June. Birds migrate along the East Asian-Australian Flyway, which includes numerous stopover sites for resting and feeding. Large numbers of birds migrating to New Zealand also use Australia as an important stopover on their journey. Many migrants use northern Australia as an important staging area, before dispersing to different parts of the country. Some non-breeding birds remain in Australia through the winter. The only exception to this migration pattern is the double-banded plover, which breeds in New Zealand and most of the population migrates to Australia for the winter months.<sup>4</sup> All of the resident species are either sedentary or nomadic, with the exception of the Australian pratincole that migrates to northern Australia, New Guinea, Java, Sulawesi and Borneo in the winter months.<sup>2</sup>

## Population status in the Great Barrier Reef Marine Park

Shorebird populations are known to be declining worldwide. In particular, resident shorebirds in Australia have declined significantly, particularly in eastern Australia. Populations of two species of resident shorebirds which occur in the Great Barrier Reef World Heritage Area – the black-winged stilt and red-necked avocet, and at least two migrant species – the eastern curlew and curlew sandpiper - have dropped dramatically at monitoring sites in Australia in the past two decades.<sup>5</sup> No population estimates are available for Great Barrier Reef populations, but some estimates are available for populations in south-east Australia, many of which pass through northern Australia on their annual migration. Australian population estimates are provided in Table 1.

A recent study has found a decline of 73 per cent for migrant shorebirds and 81 per cent for resident shorebirds over a period of 24 years in Australia.<sup>6</sup> The reporting rates have dropped for a number of species, including black-tailed godwit, terek sandpiper, curlew sandpiper, Pacific golden plover, double-banded plover and Australian painted snipe.<sup>2</sup> Internationally significant numbers of shorebirds occur at a number of sites with the Great Barrier Reef World Heritage Area, including the islands off False Orford Ness in Cape York, Pelican Island and nearby islands, Cairns foreshore, Cape Bowling Green, Burdekin River delta, Pioneer River to McEwan's Beach and Notch Point near Mackay, Shoalwater Bay and Broad Sound.<sup>2</sup>



Sooty oystercatchers (*Haematopus fuliginosus*) are listed within Queensland as a threatened species. Photo courtesy of Queensland Government, A. McDougall.

## Ecosystem role/function

As predators of invertebrates and small vertebrates, shorebirds have a function in regulation of aquatic, benthic and infaunal communities.<sup>7</sup> In some habitats, especially coastal and island ecosystems, they have a role in the cycling of nutrients<sup>8</sup> and transporting nutrients from foraging grounds to roosting and nesting localities.

## Ecosystem goods and services

Ecosystem goods and services category	Services provided by the species, taxa or habitat
<b>Provisioning services</b> (e.g. food, fibre, genetic resources, bio-chemicals, fresh water)	Hunting of shorebirds and gathering of their eggs occurs throughout parts of their distribution, particularly in Asia for birds that migrate along the East Asian-Australian Flyway. This includes traditional subsistence hunting, for domestic or international trade, or for sport. Although hunting is regulated in many countries along the Flyway, illegal hunting is still an issue in many regions. <sup>9</sup> In Australia, there is some evidence of traditional use. This is relatively uncommon in the Great Barrier Reef, although some there are anecdotal reports of egg harvesting on the reef and in Torres Strait. Hunting of birds or collection of their eggs is illegal in Queensland, unless they are taken for traditional use. <sup>8,10</sup>
<b>Cultural services</b> (e.g. spiritual values, knowledge system, education and inspiration, recreation and aesthetic values, sense of place)	Shorebirds are of considerable economic, recreational, tourism and aesthetic value to bird watchers, who include recreationists, volunteers from nature conservation organisations, and paying customers on organised bird watching tours. <sup>11,12,13</sup>  Shorebirds feature in some Australian Aboriginal dreaming stories. For instance, the bush-stone curlew is known as the 'messenger bird' or Bullingan in Moreton Bay, because they believed that the bird's wailing cries brought messages from Aboriginal spirits to the people, and that when a person is about to depart this life, the bird visits them at night and gives three calls. <sup>14</sup>
<b>Supporting services</b> (e.g. primary production, provision of habitat, nutrient cycling, soil formation and retention, production of atmospheric oxygen, water cycling)	Shorebirds are an important part of coastal food webs, as they are major consumers of invertebrates. <sup>8</sup> Shorebirds that feed on benthic invertebrates play an important role in maintaining a balance within benthic communities. <sup>7</sup> Shorebirds play an important role in nutrient cycling, by depositing guano and food remains and influencing the growth of plants, especially on island ecosystems.
<b>Regulating services</b> (e.g. invasion resistance, herbivory, seed dispersal, climate regulation, pest regulation, disease regulation, natural hazard protection, erosion regulation, water purification)	Shorebirds play a role in the transport of seeds from the mainland to islands. <sup>8</sup> Through their role in nutrient deposition and seed transportation, shorebirds are likely to play a role in erosion regulation in coastal and island ecosystems.



A flock of shorebirds consisting of a number of species moving across their foraging grounds. This flock includes the terek sandpiper (*Xenus cinereus*) and the grey-tailed tattler (*Tringa brevipes*). Photo courtesy of Queensland Government, A. McDougall.

## Pressures influencing shorebirds in the Great Barrier Reef Marine Park

### Pressures

Shorebirds are exposed to a wide range of pressures throughout their range. For migratory species, many of the most significant pressures they experience occur throughout their migratory flyways outside of Australian jurisdiction (competition with humans for prey species, hunting of birds and gathering eggs, habitat loss and degradation due to multiple pressure sources, human disturbance, water quality and climate related issues). Many countries that fall within these flyways have become signatories to the East Asian-Australasian Flyway Partnership (EAAFP), a multilateral agreement that binds parties to conservation arrangements for listed migratory bird species. Australia is a signatory to this and other bilateral migratory bird agreements and is actively engaged in their implementation and improvement through the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC).

Major threats specific to shorebirds of the Great Barrier Reef World Heritage Area, include loss and degradation of coastal and wetland habitats through coastal development and inappropriate water regimes, human disturbance through unmanaged tourism and recreation, climate change impacts that cause degradation and destruction of breeding habitat (significantly from the increased intensity and frequency of storms and cyclones), , predation by feral, domestic and wild animals, pollution of waterways, the introduction of exotic plants to important shorebird sites, ingestion of garbage and marine debris. The cumulative effects of multiple impacts place this group of species under considerable threat of decline. For some species this is more evident than for others and has resulted in them being listed as threatened species under state and Commonwealth regulations (refer Management table, page 10).

A more detailed description of the range of pressures that impact on these shorebirds in the Great Barrier Reef is provided in the vulnerability assessment matrix.

### Vulnerability assessment matrix

The *Great Barrier Reef Outlook Report 2009*<sup>15</sup> identified a number of commercial and non-commercial uses of the Marine Park, along with habitat loss and degradation as a result of climate change, coastal development and declining water quality due to catchment run-off as the key pressures reducing the resilience of the ecosystem.

From the *Great Barrier Reef Outlook Report 2009*<sup>15</sup> it was considered that pressures such as climate change, coastal development, catchment run-off and direct use are the key factors that influence the current and projected future environmental, economic and social values of the Great Barrier Reef. These pressures can impact directly and/or indirectly on habitats, species and groups of species to reduce their resilience. Using the vulnerability assessment framework adapted by Wachenfeld and colleagues,<sup>16</sup> this Vulnerability Assessment aims to provide an integrated assessment of social, ecological, economic and governance information. For each key pressure in the Marine Park, exposure and sensitivity is assessed in relation to each other to reach a level of potential impact. The potential impact is then reassessed having considered the level of natural adaptive capacity that shorebirds have to respond to the pressure and the adaptive capacity that management has, or can apply, to reduce the potential impact from the pressure.

This provides managers and stakeholders with an understanding of the key elements that each pressure can impose on these species to reach a final assessment of the overall residual vulnerability of shorebirds to that particular pressure. This allows for the formulation of suggested actions to minimise the impact of the pressures which shorebirds are most vulnerable to.

A summary of the assessment of impacts of pressures is tabled below, however, for the detailed assessment and explanatory notes refer to Appendix 1.



Wandering tattler (*Tringa incana*). Photo courtesy of Queensland Government, A. McDougall.

Vulnerability assessment matrix summary for shorebirds

		Exposed to source of pressure (yes/no)	Degree of exposure to source of pressure (low, medium, high, very high)	Sensitivity to source of pressure (low, medium, high, very high)	Adaptive capacity – natural (poor, moderate, good)	Adaptive capacity – management (poor, moderate, good)	Residual vulnerability (low, medium, high)	Level of confidence in supporting evidence (poor, moderate, good)
<b>Pressures</b>	<b>Commercial marine tourism</b>	Yes; locally (with regional significance)	Medium; locally	High	Moderate	Moderate	Medium	Poor
	<b>Defence activities</b>	Yes; locally	Low	High	Moderate	Good	Low	Moderate
	<b>Commercial fishing</b>	Yes; Reef -wide	Low	Low	Moderate	Moderate	Low	Poor
	<b>Recreational fishing</b>	Yes; predominantly developing coast	Low	Medium	Moderate	Moderate	Low	Poor
	<b>Ports and shipping</b>	Yes; locally (with potential for regional significance)	Medium	Medium	Moderate	Moderate	Medium	Good – effects of oil spills Poor – cumulative effects
	<b>Recreation (not fishing)</b>	Yes; regionally	High	Very high	Moderate	Moderate	High	Good – effects on populations Poor – ecological and ecosystems processes
	<b>Traditional use of marine resources</b>	No	Low	Low	Good	Good	Low	Moderate
	<b>Climate change</b>	Yes	Very high	Very high	Poor	Poor	High	Moderate
	<b>Coastal development</b>	Yes; developing coast	High	High	Poor	Moderate	High	Good
	<b>Declining water quality due to catchment run-off</b>	Yes; developing coast	Medium	High	Poor	Moderate	Medium	Poor

**Key concerns**

- The different species of shorebirds that occur in the World Heritage Area utilise a very wide range of habitats, though at the species level often have very specific habitat and dietary requirements. Many of them migrate to different parts of the country, or to different countries, during the breeding season. Loss or degradation of habitat in any of their feeding, breeding or staging areas can result in failure to breed or mortality through starvation or predation. The most crucial habitats are tidal flats, which in many areas are being degraded and sometimes removed altogether as a result of altered water regimes or reduced water quality due to catchment run-off and pollution, land reclamation, encroachment of coastal development. Onshore nesting and roosting habitat is being impacted by invasive weeds which forces them into marginal habitat where they can be susceptible to predation or greater disturbance. A high level of co-operation and co-ordination between



government agencies within and between countries throughout the Flyway is required to adequately protect migratory species.

- Shorebirds exhibit a high degree of site fidelity and a tendency to form large aggregations, which can result in disproportionate decline in numbers when important habitats are lost.<sup>4</sup>
- Many shorebird species have specialised diets and feeding techniques, which means that only small changes in foraging habitats or prey sources may seriously impact their ability to gather food and maintain adequate energy reserves for migration.<sup>4</sup>
- Many resident shorebird species breed over spring and summer, and most, such as the beach stone-curlew, make open nests on beaches just above the high tide line. Their breeding season coincides with the peak season of beach activities for humans, and these activities can impact on the breeding success and survival of these species. Key threats are driving vehicles on beaches and foreshore areas, trampling of nests by people and animals accessing the beach, and disturbance of birds by people and domestic animals passing too close to the nest, which can lead to eggs or chicks overheating or dehydrating while the adults are engaging in distraction behaviours.<sup>3,17,18</sup>
- Significant mortality of adults, eggs and chicks of resident birds can result from predation by domestic, feral and wild animals. Dogs, cats, foxes and rats are the most common species to predate on shorebird species. The abundance of natural predators, such as gulls and ravens, are artificially increased in many areas around human settlements, due to the increased availability of food resources, which put further pressure on shorebird populations.<sup>19</sup> Human disturbance can compound this problem, as nests are left vulnerable to predation by native species while the adults are trying to distract people or dogs from their young.<sup>3</sup>
- The impacts of climate change are likely to significantly impact on the survival of shorebird populations, both locally and internationally. Extreme weather events such as cyclones and storm surges are a major cause of nest failure for beach-nesting residents, especially when coupled with high tides, as nests are often located just above the high-tide line and become inundated during such events.<sup>20</sup> The increased incidence and intensity of extreme weather events is predicted as a likely impact of climate change is a major threat to shorebird populations. An increase in the intensity of tropical cyclones has been observed for the last few decades.<sup>21</sup> Inundation of important sites such as tidal mudflats through sea-level rise is likely to significantly reduce available foraging habitat.<sup>4</sup> Shifts in the distributional ranges of birds are also predicted, and these have already been observed in some species, including the beach stone-curlew.<sup>22</sup>
- Direct competition with humans for food has been documented as a major threat to shorebird populations in some countries, especially important stopover sites such as the Yellow Sea in China<sup>23</sup> but appears to be less of an issue in the Great Barrier Reef. Shorebirds may also be prevented from accessing foraging sites through human activities such as vehicles, beach fishing and beaching of boats.
- Hunting of birds and collection of eggs from nests is a major issue in some countries along the East Asian-Australasian Flyway, but has not been reported as a major threat in the Great Barrier Reef World Heritage Area.<sup>9,24</sup>
- Climate change pressures will affect island and coastal ecosystems and processes that shorebirds rely on and play an ecological role within. El Niño Southern Oscillation events are expected to continue as a source of high inter-annual climate variability in northeast Australia under predicted climate change scenarios.<sup>21</sup> Climate variability that produces reduced rainfall and longer periods of drought may lead to vegetation loss, greater weed invasion, and lowered water tables with salt water intrusion. Increased rainfall periods will have direct and indirect impacts that will alter short and long-term island processes.<sup>25,26</sup> In the short-term, under predicted climate change scenarios which create increased rates of sea level rise, many coral cays are expected to accrete.<sup>21,27</sup> In the long term, however, increased catchment water run-off that provides poorer water quality to the Great Barrier Reef reefal lagoon, along with climate-related changes to physiochemical oceanography, may disrupt calcium-accumulating organisms, most notably, coral reefs.<sup>26,28</sup> This would eventually impact on island formation.<sup>29</sup> While it is anticipated that in the long term some cays may erode, determining which will erode is the key to understanding threats to cay habitat and the shorebirds they support. Symbiotic relationships between shorebirds and island vegetation may also breakdown.<sup>25,26</sup> Reduced shorebird provisioning (and more significantly, seabird provisioning) will mean alterations to marine to island nutrient cycling and seed dispersal, affecting the generation of island vegetation which in turn could reduce suitable nesting habitat for shorebirds, developing a negative feedback loop.<sup>25,26</sup> Current knowledge of the vulnerabilities of island ecosystems to climate change is fragmented and incomplete, and further research is required to determine correlations between these systems for incorporation into management. (Refer also to the Vulnerability Assessment for the Great Barrier Reef Islands).
- Despite the paucity of information on which to base management decisions, there is a need for a strategic approach to mitigate potential and perceived stressors to the ecological systems that underpin the long-term viability of shorebird populations, on local and regional scales. Such approaches are being developed through programs such as the *Great Barrier Reef Climate Change Action Plan 2007-2012* and the *Raine Island Climate Change Adaptation Plan 2010–2070* currently being developed by the Queensland Government. Research

and monitoring has also demonstrated that direct visitor disturbance of some species of shorebirds affects breeding participation and success. Research needs to inform policy and the regulation of approach distances to colonies and individual species, which should also be applied to research and monitoring protocols.

- There are other significant pressures that threaten shorebirds that need to be managed. These include, but are not limited to; commercial and recreational fishing, direct disturbance by visitors to islands, degradation and destruction of breeding habitat, the introduction of exotic plants and animals to important breeding colonies, as well as ingestion of marine debris and water quality degradation. These pressures are cumulative and can also impact the food web and habitats shorebirds rely on.

## Management of shorebirds in the Great Barrier Reef Marine Park

**Management agencies with responsibilities for managing these species or impacts on these species within the Great Barrier Reef World Heritage Area and the statutory and non-statutory tools that influence the conservation management of these species.**

Legislation or policy	Object as it applies to the species	Tools for conservation	Who administers it
World Heritage Convention	<ul style="list-style-type: none"> <li>• Four natural heritage criteria with associated conditions of integrity. Criteria focus on (i) geological processes and phenomena, including the evolution of the earth; (ii) ongoing ecological and biological processes; (iii) linked aesthetic components of the natural world; (iv) the biological diversity and habitats of threatened species.</li> <li>• Natural heritage Criteria iv states that the natural heritage asset must contain the most important and significant natural habitats for in situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.</li> </ul>	<ul style="list-style-type: none"> <li>• Provides State Parties to the Convention with definitions of natural and cultural heritage, measures for the protection of natural and cultural heritage; the means of administration and obligations of the Convention; funding arrangements, educational programs and reporting obligations.</li> </ul>	United Nations Educational, Scientific and Cultural Organization (UNESCO)
Convention on Biological Diversity (CBD)	<ul style="list-style-type: none"> <li>• The three main objectives of the CBD are:                             <ul style="list-style-type: none"> <li>• The conservation of biological diversity</li> <li>• The sustainable use of the components of biological diversity</li> <li>• The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Provides State Parties to the Convention with global principles, objectives and obligations for the conservation of biodiversity.</li> <li>• Guides Australia's strategic planning to achieve national priority actions for biodiversity conservation through a range of objectives and targets for each.</li> </ul>	United Nations Environment Programme (UNEP) – CBD Secretariat
International wildlife conventions: CMS – Convention on Migratory Species CITES - Convention on International Trade of Endangered Species of wildlife fauna and flora.	<ul style="list-style-type: none"> <li>• All birds of the family Charadriidae (plovers, lapwings and dotterels) and Scolopacidae (snipes, woodcocks, dowitchers, turnstones, sandpipers, ruffs, phalaropes, godwits, curlews [not stone-curlews], shanks) are listed on Appendix II of the CMS. (refer to Table 1 above)</li> <li>• No shorebirds species are listed under CITES.</li> </ul>	<ul style="list-style-type: none"> <li>• Migratory species that have an unfavourable conservation status or would benefit significantly from international co-operation organised by tailored agreements are listed in Appendix II of the CMS.</li> </ul>	United Nations Environment Program (UNEP)

<p>International migratory bird agreements</p> <p>Bilateral: Japan-Australia Migratory Bird Agreement (JAMBA); China-Australia Migratory Bird Agreement (CAMBA); Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).</p> <p>Multilateral: East Asian-Australasian Flyway Partnership (EAAFP)</p>	<ul style="list-style-type: none"> <li>• JAMBA and CAMBA agreements require the parties to protect migratory birds by: <ul style="list-style-type: none"> <li>• limiting the circumstances under which migratory birds are taken or traded</li> <li>• protecting and conserving important habitats</li> <li>• exchanging information; and</li> <li>• building cooperative relationships</li> </ul> </li> <li>• The ROKAMBA formalises Australia's relationship with the Republic of Korea in respect to migratory bird conservation and provides a basis for collaboration on the protection of migratory shorebirds and their habitat</li> <li>• The EAAFP represents the major international framework for the conservation of migratory waterbirds and their habitat in the flyway, promoting dialogue, cooperation and collaboration between a range of stakeholders. International cooperation is essential for the conservation of migratory waterbirds by providing for their protection throughout the flyway.</li> </ul>	<ul style="list-style-type: none"> <li>• Birds listed under migratory bird agreements are classed as matters of 'National Environmental Significance' under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> and species listed are protected under the Act (refer to <i>EPBC Act 1999</i> section below)</li> <li>• Reporting requirements for progress of agreement implementations for migratory bird agreements and partnerships</li> <li>• Inshore or coastal foraging shorebirds listed as 'Migratory' and 'Marine' under the EPBC Act due to their listing in migratory bird agreements:</li> <li>• Objectives of the Flyway Partnership (EAAFP) are to: <ul style="list-style-type: none"> <li>• develop the Flyway Network of sites of international importance for the conservation of migratory waterbirds</li> <li>• enhance communication, education and public awareness of the values of migratory waterbirds and their habitats</li> <li>• enhance flyway research and monitoring activities, build knowledge and promote exchange of information on waterbirds and their habitats</li> <li>• build the habitat and waterbird management capacity of natural resource managers, decision makers and local stakeholders</li> <li>• develop, especially for priority species and habitats, flyway wide approaches to enhance the conservation status of migratory waterbirds</li> </ul> </li> <li>• Under the EPBC Act, no actions taken in relation to listed species must be inconsistent with a migratory bird agreement.</li> </ul>	<p>Administered in Australia by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC)</p>
<p>Ramsar Convention (Convention on Wetlands of International Importance)</p>	<ul style="list-style-type: none"> <li>• The Ramsar Convention is an international, intergovernmental treaty that provides a framework for national action and international co-operation on the conservation and sustainable use of wetlands and their resources</li> <li>• Australian National Guidelines for Ramsar Wetlands currently being developed by DSEWPaC to implement the Ramsar Convention in Australia</li> <li>• Three wetland areas in the marine park are Ramsar listed –</li> </ul>	<ul style="list-style-type: none"> <li>• The aim of the guidelines is to facilitate improved management of Ramsar sites and maintenance of ecological character, in line with Australia's commitments under the Ramsar Convention and responsibilities under the <i>Environment Protection and Biodiversity Conservation Act 1999</i>. The guidelines will provide a framework for Ramsar Convention implementation in Australia and provide jurisdictions and other interested parties with clear guidance on</li> </ul>	<p>Ramsar Secretariat. Administered in Australia by DSEWPaC.</p>

	Bowling Green Bay, Shoalwater Bay and Corio Bay.	the management of Ramsar sites	
International Union for the Conservation of Nature and Natural Resources – Red List of Threatened Species (v. 2011.2)	<ul style="list-style-type: none"> <li>• System for classifying species at high risk of global extinction. The general aim of the system is to provide an explicit, objective framework for the classification of the broadest range of species according to their extinction risk. (Classifications may not be applicable at the local or regional scale)</li> <li>• Species listed as 'Endangered': <ul style="list-style-type: none"> <li>• Australian painted snipe</li> </ul> </li> <li>• Species listed as 'Vulnerable' <ul style="list-style-type: none"> <li>• Eastern curlew</li> <li>• Great knot</li> </ul> </li> <li>• Species listed as 'Near Threatened': <ul style="list-style-type: none"> <li>• Asian dowitcher</li> <li>• Beach stone-curlew</li> <li>• Black-tailed godwit</li> <li>• Bush stone-curlew</li> </ul> </li> <li>• Species listed as 'Least Concern': <ul style="list-style-type: none"> <li>• All other shorebirds that occur in the World Heritage Area (refer Table 1)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• For 'Endangered' species, best available evidence indicates these species face a <i>very high</i> risk of extinction in the wild</li> <li>• For 'Vulnerable' species, best available evidence indicates these species face a <i>high</i> risk of extinction in the wild</li> <li>• 'Near Threatened' species are close to qualifying for or is likely to qualify for a threatened category in the near future</li> <li>• 'Least Concern' taxa are considered widespread and abundant or populations have not declined at a rate justifying a vulnerability listing</li> <li>• Processes of review and re-assessment as required.</li> </ul>	International Union for the Conservation of Nature and Natural Resources (IUCN)
Action Plan for Australian Birds, 2000. <sup>30</sup>	<ul style="list-style-type: none"> <li>• The Action Plan presents assessments of the status of individual bird species.</li> <li>• Four shorebird species that occur in the World Heritage Area are listed: <ul style="list-style-type: none"> <li>• Australian painted snipe</li> <li>• Bush stone-curlew</li> <li>• Beach stone-curlew</li> <li>• Sooty oystercatcher.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Action Plan describes the conservation status, key threats and existing conservation measures for a large number of species and makes recommendations for further management actions</li> <li>• Processes of review.</li> </ul>	DSEWPaC
Shorebirds 2020	<ul style="list-style-type: none"> <li>• The primary objectives of the program are to collect data on the numbers of shorebirds in a manner that can be utilised to aid their conservation and management, specifically long and short-term population trends, and explore what may be causing those changes.</li> </ul>	<ul style="list-style-type: none"> <li>• Coordinated national shorebird monitoring in Australia that will allow for the detection of national population trends, mapping important shorebirds areas, and putting together a shorebird counters toolkit online</li> <li>• Program will also work towards the reinvigoration of the community in shorebird monitoring and conservation.</li> </ul>	Collaborative program administered by Birds Australia's Australasian Wader Studies Group and supported by the Commonwealth government's Caring for Our Country program and the World Wide Fund for Nature.
<i>Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and Environment Protection and Biodiversity Conservation Regulations 2000.</i>	<ul style="list-style-type: none"> <li>• Legislative framework for environmental protection in Australia</li> <li>• The Great Barrier Reef Marine Park is one of eight matters of national environmental significance in Australia</li> <li>• Provides means of assessment of 'actions' (often called a proposal or project) within Australian marine and terrestrial environments that are likely to impact on a matter of national environmental significance</li> </ul>	<ul style="list-style-type: none"> <li>• An action will require approval if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance protected under the EPBC Act. The action must be referred to the Minister and undergo an assessment and approval process</li> <li>• Draft Significant Impact Guidelines (2009) for 36 species of shorebirds that occur in Australia (many of which occur in the Marine Park) have been</li> </ul>	DSEWPaC

	<p>protected under the EPBC Act</p> <ul style="list-style-type: none"> <li>• Legislative role includes the listing and regulation of threatened and protected species and communities, the preparation of recovery plans for threatened and protected species, the identification of key threatening processes and, where appropriate, the development of threat abatement plans (e.g. harmful marine debris, introduced pests), recovery plans and wildlife conservation plans</li> <li>• See comments in Migratory bird agreements above regarding species listed as 'Migratory' under the EPBC Act.</li> <li>• Under this legislation it is illegal to harm, interfere with or disturb shorebirds except for traditional use</li> <li>• Australian painted snipe listed as 'Vulnerable', 'Marine' and 'Migratory' (under CAMBA).</li> <li>• Many other species listed as 'Marine' and 'Migratory' (refer to <a href="#">EPBC Act web pages</a>)</li> </ul>	<p>developed as a resource for the support of assessment and approvals process for actions</p> <ul style="list-style-type: none"> <li>• An action likely to have a significant impact on shorebirds could be deemed to be a 'controlled action' under the EPBC Act and require a greater level of scrutiny through an environmental impact assessment before consideration of approval</li> <li>• Strategic assessment is an alternative to a case by case approach and is considered a better way to address cumulative impacts over a landscape scale which may stem from a policy, plan or program or multiple projects providing combined impact</li> <li>• Threat Abatement Plans: <ul style="list-style-type: none"> <li>• guide industry regulation and outline the necessary research and management actions required to address these threats</li> <li>• reviews existing policies, codes of practice, conventions and activities to determine their effectiveness</li> <li>• coordinates abatement strategies identified in separate marine animal Recovery Plans</li> </ul> </li> <li>• Penalties for non-compliance</li> <li>• Processes of review.</li> </ul>	
<p>Wildlife Conservation Plan for Migratory Shorebirds (February 2006)</p>	<ul style="list-style-type: none"> <li>• Developed under provisions in the EPBC Act</li> <li>• Migratory wildlife, including waterbirds, are considered as Matters of National Environmental Significance under the EPBC Act</li> <li>• The Plan outlines national activities to support flyway shorebird conservation initiatives and provides a strategic framework for the implementation of conservation actions.</li> </ul>	<ul style="list-style-type: none"> <li>• Identifies objectives, criteria to measure the achievement of the Plan against objectives and required research and management actions to achieve objectives</li> <li>• Research and management actions are to be integrated and remain focused on the long-term survival of migratory shorebird populations and habitats at priority sites</li> <li>• Inclusion of internationally important sites in Flyway Network</li> <li>• Review of plan every five years.</li> </ul>	<p>DSEWPaC</p>
<p><i>Great Barrier Reef Marine Park Act 1975 and Great Barrier Reef Marine Park Regulation 1983</i></p>	<ul style="list-style-type: none"> <li>• Legislative framework for the management of biodiversity conservation through zoning, issuing of permits and implementation of plans of management that collectively enable management of human activities in the Great Barrier Reef Marine Park.</li> </ul>	<ul style="list-style-type: none"> <li>• Regulation 29, Table 29 of the Regulation provides a list of Protected Species including all birds (including shorebirds)</li> <li>• Parts 10, 11, 12 of the Regulations provides controls for human interactions with shorebirds at key nesting sites within the Cairns, Whitsundays and Hinchinbrook Plans of Management regulations respectively</li> </ul>	<p>Great Barrier Reef Marine Park Authority (GBRMPA)</p>

		<ul style="list-style-type: none"> <li>• Under this legislation it is illegal to harm, interfere with or disturb birds except for non-commercial traditional use</li> <li>• Regulation provides for the creation of Special Management Areas within the Marine Park</li> <li>• Regulation of scientific research in the Marine Park</li> <li>• Regulation of activities and development within the Marine Park</li> <li>• Regulation on the discharge of waste into the Marine Park</li> <li>• Penalties for non-compliance.</li> </ul>	
<i>Great Barrier Reef Marine Park Zoning Plan 2003</i>	<ul style="list-style-type: none"> <li>• A multiple-use marine protected area management tool that protects biodiversity by the regulation of activities within the Great Barrier Reef Marine Park</li> <li>• The Representative Area Program that provided the basis for the Zoning Plan spatial planning decisions, described 70 broad-scale habitats, or bioregions, and as such provides the basis for ecosystem-based management in the Marine Park.</li> </ul>	<ul style="list-style-type: none"> <li>• Special Management Areas can be created under certain circumstances</li> <li>• Restricted Access Special Management Areas (SMA) provide protection of sites considered important to shorebirds (and other marine animals and ecosystems) (e.g. Michaelmas Cay)</li> <li>• Thirty-four per cent of the Marine Park is dedicated as Marine National Park (green) or Preservation (pink) zones in which no extractive activities are permitted</li> <li>• Penalties for non-compliance.</li> </ul>	GBRMPA
<i>Great Barrier Reef Marine Park Act 1975 -plans of management (PoM)</i>	<ul style="list-style-type: none"> <li>• Plans of Management are generally prepared for intensively used, or particularly vulnerable groups of islands and reefs, and for the protection of vulnerable species or ecological communities</li> <li>• Plans of Management complement zoning by addressing issues specific to an area, species or community in greater detail than can be accomplished by the broader reef-wide zoning plans</li> <li>• Regulations for bird conservation are found in: <ul style="list-style-type: none"> <li>• Cairns PoM – Part 1, Div. 2, subdiv. 6;</li> <li>• Whitsundays PoM - Part 1, Div. 2, subdiv. 5;</li> <li>• Hinchinbrook PoM – Part 1, Div. 3, subdiv. 4.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• PoMs outline the values, issues and strategies for the conservation of shorebirds in the respective management areas (includes seasonal closures of important nesting sites and restriction on visitor numbers).</li> <li>• PoMs reviewed on regular basis in line with changes to management requirements, legislation and national guidelines.</li> <li>• Penalties for non-compliance.</li> </ul>	GBRMPA
<i>Marine Parks Act 2004 (Qld) and Marine Parks Regulation 2006</i>	<ul style="list-style-type: none"> <li>• The object of this Act is to provide for the conservation of the marine environment by: <ul style="list-style-type: none"> <li>• declaring State marine parks</li> <li>• establishing zones, designated areas and highly protected areas within marine parks</li> <li>• developing zoning and</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Aims to involve all stakeholders cooperatively</li> <li>• Coordination and integration with other conservation legislation</li> <li>• Penalties for non-compliance</li> <li>• Processes of review.</li> </ul>	Queensland Government

	<p>management plans</p> <ul style="list-style-type: none"> <li>• recognising the cultural, economic, environmental and social relationships between marine parks and other areas</li> <li>• applying the precautionary principle.</li> </ul>		
<p><i>Marine Parks (Great Barrier Reef Coast) Zoning Plan 2004</i> (Qld)</p>	<ul style="list-style-type: none"> <li>• A multiple-use marine protected area management tool that protects biodiversity by the regulation of activities within the Great Barrier Reef Coast Marine Park.</li> <li>• The Representative Area Program that provided the basis for the Zoning Plan spatial planning decisions, described 70 broad-scale habitats, or bioregions, and as such provides the basis for ecosystem-based management in the Great Barrier Reef Coast Marine Park.</li> </ul>	<ul style="list-style-type: none"> <li>• Spatial management of activities within State waters of the Great Barrier Reef based on protection of representative bioregions</li> <li>• Penalties for non-compliance</li> <li>• Complements spatial management zones and certain regulatory provisions established under the <i>Great Barrier Reef Marine Park Zoning Plan 2003</i>.</li> </ul>	<p>Queensland Government</p>
<p>Queensland <i>Nature Conservation Act 1992</i> and <i>Nature Conservation (Wildlife) Regulation 2006</i>; and <i>Nature Conservation (Wildlife Management) Regulation 2006</i></p>	<ul style="list-style-type: none"> <li>• Act provides for the conservation of nature, including wildlife, in Queensland jurisdiction</li> <li>• Provides for the protection of birds, including shorebirds. Under this legislation it is illegal to harm, interfere with or disturb coastal birds except for non-commercial traditional use</li> <li>• Regulation lists the plants and animals considered presumed extinct, endangered, vulnerable, rare, common, international, and prohibited. It discusses their significance and states the declared management intent and the principles to be observed in any taking and use for each group</li> <li>• Listed as Vulnerable – <ul style="list-style-type: none"> <li>• <i>Esacus magnirostris</i> (beach stone-curlew)</li> <li>• <i>Rostratula australis</i> (Australian painted snipe)</li> </ul> </li> <li>• Listed as Rare – <ul style="list-style-type: none"> <li>• <i>Numenius madagascariensis</i> (eastern curlew)</li> <li>• <i>Haematopus fuliginosus</i> (sooty oystercatcher).</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Prescribes protected native wildlife, their management principles and the management intent</li> <li>• Provides for the preparation of Conservation Plans for native wildlife and their habitat under Ministerial discretionary powers</li> <li>• No Conservation Plan for any species of shorebirds currently in force</li> <li>• Section 332 of the Wildlife Management regulation prohibits tampering with protected animals' place of breeding being used to incubate or rear the animal's offspring</li> <li>• Penalties for non-compliance</li> <li>• Processes of review.</li> </ul>	<p>Queensland Government</p>
<p>Coastal Bird Atlas</p>	<ul style="list-style-type: none"> <li>• The Coastal Bird Atlas database includes records for seabirds, migratory shorebirds and other bird species that occur on Queensland islands and coastal areas</li> <li>• The data predominantly relates to the Great Barrier Reef islands, cays and reefs and the coastal waters but data is also present from the Gulf of Carpentaria.</li> </ul>	<ul style="list-style-type: none"> <li>• Provides managers with data on population estimates and trends in order to assess risks and gauge the effectiveness of conservation efforts.</li> </ul>	<p>Queensland Government (jointly funded by the GBRMPA through the Field Management Program)</p>
<p>Coastal Bird Monitoring Strategy for the Great Barrier</p>	<ul style="list-style-type: none"> <li>• The coastal bird monitoring strategy for the Great Barrier Reef World Heritage Area</li> </ul>	<ul style="list-style-type: none"> <li>• Strategy reviewed on regular basis in line with changes to management requirements,</li> </ul>	<p>GBRMPA</p>

Reef World Heritage Area, 2002.	<p>outlines the value of coastal bird monitoring and sets out the minimum monitoring required</p> <ul style="list-style-type: none"> <li>• Also provides information on legislative and international obligations and threatening processes.</li> </ul>	<p>legislation and national guidelines. Currently under review and will be re-identified as the Coastal Bird Monitoring and Information Strategy for the Great Barrier Reef World Heritage Area</p> <ul style="list-style-type: none"> <li>• Strategy intended to assist managers to plan and program, as well as assist staff monitoring the birds to conduct their responsibilities.</li> </ul>	
<i>Great Barrier Reef Climate Change Action Plan 2007-2012</i>	<ul style="list-style-type: none"> <li>• Establishes a strategic approach to the development of resilience within Great Barrier Reef ecosystems as a means to enable those systems to adapt to climate change impacts.</li> </ul>	<ul style="list-style-type: none"> <li>• Resilience analysis identifies the means to reduce human impacts and disturbances, and conserve the Great Barrier Reef 's biodiversity and ecological processes.</li> </ul>	GBRMMPA
GBRMMPA guidelines and programs.	<ul style="list-style-type: none"> <li>• Guidelines for managing visitation to seabird breeding islands</li> <li>• Best Environmental Practices for reef visitors to minimise their impacts when observing birds or visiting permitted nesting sites</li> <li>• Responsible Reef Practices – a tool developed to educate tourism industry staff about minimising their impacts of their operations on birds</li> <li>• Best Environmental Practices on the correct disposal of waste</li> <li>• Sea Guardians program to educate and build stewardship capacity with regards to marine pollution and fishing best practice.</li> </ul>	<ul style="list-style-type: none"> <li>• Industry and public education tools reviewed in line with best practice and current knowledge.</li> </ul>	GBRMMPA
<i>Great Barrier Reef Biodiversity Conservation Strategy 2012</i>	<ul style="list-style-type: none"> <li>• Identifies shorebirds as species 'at risk' in the Marine Park</li> <li>• Grades the level of risk experienced by shorebirds through a vulnerability assessment process.</li> </ul>	<ul style="list-style-type: none"> <li>• The Biodiversity Conservation Strategy outlines a Framework for Action with three strategic objectives aimed at building or maintaining ecosystem resilience and protecting biodiversity: <ol style="list-style-type: none"> <li>1. Engage communities and foster stewardship</li> <li>2. Building ecosystem resilience in a changing climate</li> <li>3. Improved knowledge</li> </ol> </li> <li>• Objectives are comprised of program-level outcomes with key actions and contain targets for measuring success</li> <li>• Implementation of the Strategy will be undertaken through a multi-agency, multi-stakeholder collaborative approach.</li> </ul>	GBRMMPA
Policy on managing activities that include the direct take of a Protected Species from the Great Barrier Reef Marine Park. June 2005. Additions September 2008.	<ul style="list-style-type: none"> <li>• Provides a framework for the consistent and effective management of activities that include the direct take of a Protected Species from the</li> <li>• Great Barrier Reef Marine Park. Permissions unlikely to be granted for take of birds unless</li> </ul>	<ul style="list-style-type: none"> <li>• Justifications and assessment guidelines on the take of protected species for certain anticipated (and unanticipated) uses.</li> <li>• Review of Policy.</li> </ul>	GBRMMPA



	for research.		
GBRMPA Position Statement on managing access to the Restricted Access Special Management Areas surrounding Raine Island, Moulter Cay and MacLennan Cay.	<ul style="list-style-type: none"> <li>Restricts activities been undertaken under permit to low impact that cannot reasonably be undertaken elsewhere and provide benefits that outweigh any potential disturbance, in order to protect significant natural values of the island and cays, including the 12 species of summer migrant shorebirds.</li> </ul>	<ul style="list-style-type: none"> <li>Review of position statement in line with current knowledge.</li> </ul>	GBRMPA
Back on Track Biodiversity Action Plans	<ul style="list-style-type: none"> <li>The Back on Track Species Prioritisation Framework identifies priority species for conservation management, regional threats, and suggested recovery actions</li> <li>The beach stone-curlew and Australian painted snipe are listed as a High priority for action in regions where they occur.</li> </ul>	<ul style="list-style-type: none"> <li>Identifies regionally-appropriate management actions to mitigate the risks to these species</li> <li>Process of review.</li> </ul>	Queensland Government with regional Natural Resource Management groups and other stakeholders for implementation of identified management actions.
<i>Reef Water Quality Protection Plan 2009</i>	<ul style="list-style-type: none"> <li>An overarching framework to achieve a sustainable future for the Great Barrier Reef and the industries in the Reef's catchment by improving water quality that flows into the Great Barrier Reef lagoon.</li> </ul>	<ul style="list-style-type: none"> <li>Improve water quality that flows into the Reef by targeting priority outcomes, integrating industry and community initiatives and incorporating new policy and regulatory frameworks.</li> </ul>	Joint Australian Government and State of Queensland initiative
<i>Great Barrier Reef Protection Amendment Act 2009 (Qld)</i>	<ul style="list-style-type: none"> <li>A framework for reducing the levels of dangerous pesticides and fertilisers found in the waters of the Great Barrier Reef by 50 per cent in four years.</li> </ul>	<ul style="list-style-type: none"> <li>Mix of strict controls on farm chemicals and regulations to improve farming practices.</li> </ul>	Queensland Government
<i>Coastal Protection and Management Act 1995 (Qld) and Coastal Protection and Management Regulation 2003</i>	<ul style="list-style-type: none"> <li>Provides the legislative framework and regulations for the coordinated management of the diverse range of coastal resources and values in the coastal zone. This framework includes provisions that establish the Queensland Coastal Plan.</li> </ul>	<ul style="list-style-type: none"> <li>Queensland Coastal Plan outlines directions for effective protection and management of the coastal zone.</li> </ul>	Queensland Government
<i>Queensland Coastal Plan</i> (prepared under the <i>Coastal Protection and Management Act 1995</i> and includes a state planning policy under the <i>Sustainable Planning Act 2009</i> )	<ul style="list-style-type: none"> <li>The Queensland Coastal Plan has two parts: State Policy for Coastal Management and the State Planning Policy 3/11: Coastal Protection (SPP).</li> </ul>	<ul style="list-style-type: none"> <li>The State Policy for Coastal Management provides policy direction for natural resource management decision-makers about land on the coast, such as coastal reserves, beaches, esplanades and tidal areas</li> <li>The SPP provides policy direction and assessment criteria to direct land-use planning and development assessment decision making under the <i>Sustainable Planning Act 2009</i>.</li> </ul>	Queensland Government
<i>Sustainable Planning Act 2009 (Qld) and Sustainable Planning Regulation 2009</i>	<ul style="list-style-type: none"> <li>Establishes process for land-use planning and development assessments. Identifies state legislation that may be triggered by development assessments and the process by which developments must be assessed against each piece of legislation</li> <li>Establishes the framework for the development of Regional</li> </ul>	<ul style="list-style-type: none"> <li>Regional plans operate in conjunction with other state planning instruments, usually taking precedence over them</li> <li>Regional plans must conform to policies established within the Queensland Coastal Plan</li> <li>Regional plans identify:                             <ul style="list-style-type: none"> <li>desired regional outcomes</li> </ul> </li> </ul>	Queensland Government

	Plans.	<ul style="list-style-type: none"> <li>• policies and actions for achieving these desired regional outcomes</li> <li>• the future regional land use pattern</li> <li>• regional infrastructure provision to service the future regional land use pattern</li> <li>• key regional environmental, economic and cultural resources to be preserved, maintained or developed.</li> </ul>	
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## References

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## Appendix 1. Vulnerability assessment matrix

	Pressures									
	Commercial marine tourism	Defence activities	Commercial fishing	Recreational fishing	Ports and shipping	Recreation (not fishing)	Traditional use of marine resources	Climate change	Coastal development	Declining water quality due to catchment run-off
<b>Exposed to source of pressure (yes/no)</b>	Yes; locally (with regional significance)	Yes; locally	Yes; Great Barrier Reef -wide	Yes; Predominantly developing coast	Yes; locally (with potential for regional significance)	Yes; regionally	No	Yes	Yes; Developing coast, from Port Douglas south	Yes; Predominantly developing coast from Cooktown south
<b>Degree of exposure to source of pressure (low, medium, high, very high)</b>	Medium. Permitted tourism activities such as kite surfing, jet skiing, horse riding, vehicle touring and windsurfing are known to significantly impact on the foraging behaviour of shorebirds. Across known significant shorebird sites, exposure is medium.	Low. Shorebirds are not thought to be significantly impacted by defence activities in the Great Barrier Reef as defence operations avoid key nesting sites.	Low. Pressure from recreational fishing comes mostly from disturbance during commercial inshore fishing operations. Exposure exists but is not considered to be high. Studies by University of Queensland on the impact of commercial bait collection activities on tidal flats in Moreton Bay, Queensland, found little effect on shorebird populations. Quantifiable effects on shorebird prey from commercial fisheries are currently undetermined.	Low. Pressure from recreational fishing comes from disturbance during inshore fishing and boating activities. Exposure exists but is not considered to be high. Quantifiable effects on shorebird prey from recreational fisheries are currently undetermined.	Medium. Shorebirds are not thought to be widely impacted by the activities of ports and shipping in the Great Barrier Reef. However, many shorebird species forage over coastal and estuarine habitats and would be affected by habitat loss, disturbance and pollution as ports and shipping activity increases in localised hubs. The risks presented by potential shipping incidents and resultant pollution could be serious for shorebirds and their nesting and foraging sites.	High. Exposure at local and regional scales is high as recreational visitors approach and visit locations important to shorebirds that are experiencing population declines. In some localities within the Great Barrier Reef these declines can be partly attributed to human disturbance. At Great Barrier Reef -wide scale overall exposure may be considered to be lower although this is currently difficult to determine.	Low. In the Great Barrier Reef World Heritage Area, some collection of eggs and hunting of birds is may still occur in the far north, but exposure is not considered to be high. Shorebirds are not considered to be under pressure from traditional use.	Very High. Inundation of important foraging habitat is likely in many areas, shifts in the distribution in some species is also occurring, extreme weather events are likely to increasingly impact breeding success for beach-nesting birds. Breeding habitat for migratory species that breed in the Arctic is likely to contract and conceivably disappear altogether. Extremes of El Niño Southern Oscillation events are expected to occur more frequently under predicted climate change scenarios. Impacts from these extremes include rainfall variability, higher sea-surface temperatures, and increases in the frequency and	High. Coastal development and related human population increase will increase human-induced pressures that have been identified as impacting on the populations of shorebird species (habitat loss and degradation, increased visitation/ disturbance of important sites, increased pollution and marine debris, greater capacity for the spread of weeds, pests and disease).	Medium. Discharge and run-off into the Great Barrier Reef lagoon affects water quality that determines ecosystem health of the Great Barrier Reef. This has many direct and indirect impacts on shorebird ecology and the habitats and processes on which they rely. Such impacts may include detrimental effects on food webs and long-term island formation processes. Marine debris has been identified as a threat for all shorebirds. Although most garbage located on the remote

	Pressures									
	Commercial marine tourism	Defence activities	Commercial fishing	Recreational fishing	Ports and shipping	Recreation (not fishing)	Traditional use of marine resources	Climate change	Coastal development	Declining water quality due to catchment run-off
								intensity of storms and cyclones. They present serious threats to shorebird populations and island and foreshore ecosystems and processes on which they rely. Altered ocean chemistry, temperature and sea level rise under predicted climate change scenarios also present serious threats to shorebird populations and island ecosystems and processes on which they rely.		islands of the Great Barrier Reef is found to come from vessels, increased catchment run-off could contribute to increases of marine debris that impact on shorebirds.
<b>Sensitivity to source of pressure</b> (low, medium, high, very high)	Very high. Visitation disturbance is known to discourage nesting site selection and reduce breeding participation and success and foraging ability to varying degrees for different species. When shorebirds lose access to preferred habitat as a result of regular disturbance, they are often	High. Many shorebird species are easily disturbed by intrusive activity and this is known to discourage nesting site selection and reduce breeding participation and success and foraging ability to varying degrees for different species.	Low. The pressure on shorebirds from commercial fishing would mainly come from disturbance of feeding and nesting shorebirds during activities that occur in the process of inshore commercial fishing operations. This could be significant at important shorebird sites. At a Great Barrier	Medium. The pressure on shorebirds from recreational fishing would mainly come from disturbance of feeding and nesting shorebirds during activities that occur in the process of inshore recreational fishing and boating activities. This could be significant at	Medium. The pressures presented by ports and shipping in the World Heritage Area have to be considered cumulatively with other pressures that threaten coastal and estuarine habitats that shorebirds use. Given the importance of the World Heritage Area to shorebirds for foraging (and for some species, nesting), the	Very high. Visitation disturbance is known to discourage nesting site selection and reduce breeding participation and success and foraging ability to varying degrees for different species. People recreating interact with shorebirds in many locations in and around human settlements. Recent studies	Low. The exposure to this source of pressure is expected to continue to remain low. This determines that the sensitivity to this source of pressure is also low.	Very high. The ecological traits of shorebirds make them highly sensitive to the very high exposure they have to climate change pressures. Particular concern arises when considering the combined effects of other known pressures such as tourism/recreation disturbance, habitat loss and degradation due to coastal development and reduced water quality impacts.	High. Shorebirds are known to have specific habitat requirements for foraging and nesting. Pressures that reduce the availability or productivity of these supporting habitats have been shown to cause population declines.	High. Shorebirds are known to have specific habitat requirements for foraging and nesting. Pressures that reduce the availability or productivity of these supporting habitats have been shown to cause population declines.

	Pressures									
	Commercial marine tourism	Defence activities	Commercial fishing	Recreational fishing	Ports and shipping	Recreation (not fishing)	Traditional use of marine resources	Climate change	Coastal development	Declining water quality due to catchment run-off
	<p>forced to utilise less suitable habitat that can, for example, have a higher cost of energy to the birds in order to provision themselves or may expose them to predation. This brings into jeopardy their preparation to breed or undertake long migrations.</p>		<p>Reef-wide spatial scale this pressure is not expected to be high.</p>	<p>important shorebird sites. At a Great Barrier Reef-wide spatial scale this pressure is not expected to be high.</p>	<p>sensitivity of these species to ports and shipping pressures is medium on a Great Barrier Reef -wide scale.</p>	<p>in south-east Queensland have found that several recreational activities in particular greatly impact on the foraging activities of shorebirds (in order of significance) – dog walking on beaches, jet skis and walkers without dogs. A study conducted in Broome, WA, found beach walkers were a major cause of disturbance. Vehicles on beaches are also a major threat to foraging and resting shorebirds at sensitive sites. Other activities such as kite surfing and windsurfing are known to significantly impact on the foraging activities of shorebirds. When shorebirds lose access to preferred habitat as a result of</p>				

	Pressures									
	Commercial marine tourism	Defence activities	Commercial fishing	Recreational fishing	Ports and shipping	Recreation (not fishing)	Traditional use of marine resources	Climate change	Coastal development	Declining water quality due to catchment run-off
						regular disturbance, they are often forced to utilise less suitable habitat that can, for example, have a higher cost of energy to the birds in order to provision themselves. This brings into jeopardy their preparation to breed or undertake long migrations.				
<b>Adaptive capacity – natural (poor, moderate, good)</b>	Moderate. The mobility and varied habitat use of many shorebirds may enable them to select other suitable habitat localities to forage and nest if necessary. This needs to be assessed cumulatively with pressures from climate change, coastal development and catchment run-off that may degrade or reduce the availability of alternative suitable nesting or roosting	Moderate. The mobility and varied habitat use of many shorebirds may enable them to select other suitable habitat localities to forage and nest if necessary. This needs to be assessed cumulatively with pressures from climate change, coastal development and catchment run-off that may degrade or reduce the availability of alternative suitable nesting or roosting	Moderate. Shorebirds are not significantly exposed to disturbance pressures that could occur during commercial inshore fishing activities. This equates to a limited adaptive capacity requirement from shorebirds due to this pressure.	Moderate. Shorebirds are not significantly exposed to disturbance pressures that could occur during recreational inshore fishing activities. This equates to a limited adaptive capacity requirement from shorebirds due to this pressure.	Moderate. Moderate adaptive capacity at the Great Barrier Reef-wide scale. The mobility and varied habitat use of many shorebirds may enable them to select other areas away from ports and shipping activity in which to nest, forage and roost. This needs to be assessed cumulatively with pressures from climate change, coastal development and catchment run-off that may	Moderate. The mobility and varied habitat use of many shorebirds may enable them to select other suitable habitat localities to nest if necessary. This needs to be assessed cumulatively with pressures from climate change, coastal development and catchment run-off that may degrade or reduce the availability of alternative suitable nesting or roosting habitat, or the	Good. On-going low exposure to this source of pressure.	Poor. This needs to be assessed cumulatively in light of pressures from coastal development and catchment run-off that may degrade or reduce the availability of alternative suitable nesting or roosting habitat, or the productivity of foraging grounds. The mobility and varied habitat use of many shorebirds may enable them to select alternative suitable habitat localities to nest if necessary. The actual adaptive capacity of	Poor. At a Great Barrier Reef-wide scale, shorebird adaptive capacity to this pressure may allow them to select alternative suitable habitat. However, this needs to be assessed cumulatively in light of pressures from climate change and catchment run-off that may degrade or reduce the availability of alternative suitable nesting or roosting habitat, or the productivity of foraging grounds. The mobility and	Poor. Considering the spatial scale over which this pressure acts, the adaptive capacity of shorebirds to it is considered poor. It needs to be assessed cumulatively with other pressures that impact on the ability of shorebird species to source food or locate suitable nesting or roosting habitat. It is anticipated that long-term reductions in Great Barrier Reef water



	Pressures									
	Commercial marine tourism	Defence activities	Commercial fishing	Recreational fishing	Ports and shipping	Recreation (not fishing)	Traditional use of marine resources	Climate change	Coastal development	Declining water quality due to catchment run-off
	<p>habitat, or the productivity of alternative foraging grounds. The actual adaptive capacity of shorebirds to disturbance pressure is not well understood with regards to individual species' foraging ecology and nesting locality requirements. It is not known what the thresholds of pressure may be, or what population decline may occur if shorebirds were forced to transition to less disturbed, though marginally suitable localities.</p> <p>The ecologies and life history traits of shorebirds means they are not well adapted to respond to the cumulative impacts presented by the range of pressures they</p>	<p>habitat, or the productivity of alternative foraging grounds. The actual adaptive capacity of shorebirds to disturbance pressure is not well understood with regards to individual species' foraging ecology and nesting locality requirements. It is not known what the thresholds of pressure may be, or what population decline may occur, if shorebirds were forced to transition to less disturbed, though marginally suitable localities.</p> <p>The ecologies and life history traits of shorebirds means they are not well adapted to respond to the cumulative impacts presented by the range of pressures they</p>			<p>degrade or reduce the availability of alternative suitable nesting or roosting habitat, or the productivity of alternative foraging grounds.</p> <p>However, impacts could be significant if a spill from a shipping incident made landfall at a key seabird nesting site or had severe impacts on a key foraging ground used by inshore and coastal foraging seabird species.</p>	<p>productivity of alternative foraging grounds. The actual adaptive capacity of shorebirds to disturbance pressure is not sufficiently understood with regards to individual species' foraging ecology and nesting locality requirements. It is not known what the thresholds of pressure may be, or what population decline may occur, if shorebirds were forced to transition to less disturbed, though marginally suitable localities.</p> <p>The ecologies and life history traits of shorebirds means they are not well adapted to respond to the cumulative impacts presented by the range of pressures they</p>		<p>shorebirds to these pressures is not sufficiently understood with regards to individual species' foraging ecology and nesting locality requirements. It is not known what the thresholds of pressure may be, or what population decline may occur, if shorebirds were forced to transition to alternative localities if previous ones were lost or degraded beyond suitability or were not productive enough to support provisioning.</p> <p>The ecologies and life history traits of shorebirds means they are not well adapted to respond to the cumulative impacts presented by the range of pressures they face.</p>	<p>varied habitat use of many shorebirds may enable them to select alternative suitable habitat localities to nest if necessary. The actual adaptive capacity of shorebirds to these pressures is not sufficiently understood with regards to individual species' foraging ecology and nesting locality requirements. It is not known what the thresholds of pressure may be, or what population decline may occur, if shorebirds were forced to transition to alternative localities if previous ones were lost or degraded beyond suitability or were not productive enough to support provisioning.</p> <p>The ecologies and life history traits of shorebirds means they are not well adapted to respond to the cumulative impacts presented by the range of pressures they face.</p>	<p>quality or increased scale and severity of freshwater bleaching may disrupt calcium-accumulating organisms that underpin the habitats that shorebirds rely upon.</p> <p>The ecologies and life history traits of shorebirds means they are not well adapted to respond to the cumulative impacts presented by the range of pressures they face.</p>

	Pressures									
	Commercial marine tourism	Defence activities	Commercial fishing	Recreational fishing	Ports and shipping	Recreation (not fishing)	Traditional use of marine resources	Climate change	Coastal development	Declining water quality due to catchment run-off
	face.	face.				face.				
<b>Adaptive capacity – management</b> (poor, moderate, good)	Moderate. The permitting and management of inshore-based tourism activities lies within the jurisdiction of the Queensland state government. Inshore areas are a highly contested zone with many stakeholders.  The <i>Great Barrier Reef Marine Park Act 1975</i> provides limited scope to manage activities outside the Marine Park. To achieve good conservation outcomes for the shorebirds, collaborative partnerships with industry, the community, local and state government and other Australian government agencies require continued development to influence the management and planning of catchment and	Good. Defence activities are well managed and limited in extent, duration and geographic distribution. <sup>15</sup>  Further management could be applied as required through a consultative approach with Defence.	Moderate. If disturbance pressure at important shorebird locations was resulting from commercial inshore fishing activities, the capacity to adapt the <i>Great Barrier Reef Zoning Plan 2003</i> and <i>Great Barrier Reef Marine Park Regulation 1983</i> to meet changing spatial management requirements is most practically undertaken through the use of species protection Special Management Area provisions. There would be a need to collaborate with the Queensland state government on similar provisions in state waters.	Moderate. If disturbance pressure at important shorebird locations was resulting from recreational inshore fishing activities, the capacity to adapt the <i>Great Barrier Reef Zoning Plan 2003</i> and <i>Great Barrier Reef Marine Park Regulation 1983</i> to meet changing spatial management requirements is most practically undertaken through the use of species protection Special Management Area provisions. There would be a need to collaborate with the Queensland state government on similar provisions in	Moderate. GBRMPA has strategies (e.g. Environmental Management Plans) and statutory tools to lower the risk of vessel related oil spills and pollution incidents. However, the risks can only be lowered and not eliminated.  Environmental impact assessments made under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> provide a process to assess and mitigate or offset the impacts of proposed port developments.	Moderate. Shorebirds use diverse range of habitat and much of this is outside of conservation or protected area estate. Inshore areas are a highly contested zone with many stakeholders often with conflicting interests.  The <i>Great Barrier Reef Marine Park Act 1975</i> provides limited scope to manage activities outside the Marine Park. To achieve good conservation outcomes for the shorebirds, collaborative partnerships with industry, the community, local and state government and other Australian Government agencies require continued development to influence the management and planning of catchment and	Good. On-going low exposure to this source of pressure.	Poor. Options for local or regional scale management of climate impacts on shorebirds remain very limited because most impacts are directly linked to large-scale global climate phenomena rather than more local threatening processes.  Current available information on climate change impacts on shorebirds is being implemented into developing management actions within the World Heritage Area.	Moderate. The <i>Great Barrier Reef Marine Park Act 1975</i> provides limited scope to manage activities outside the Marine Park. To achieve good water quality and coastal ecosystem outcomes for the Great Barrier Reef, GBRMPA facilitates the development of partnerships with industry, the community, local and state government and other Australian government agencies to influence the management and planning of catchment and coastal pressures, developing and maintaining a culture of mutual obligation.  This is undertaken by providing input into the Queensland Coastal Plan policies and statutory Regional Plans which plan for coastal development in	Moderate. The <i>Great Barrier Reef Marine Park Act 1975</i> provides limited scope to manage activities outside the Marine Park. To achieve good water quality and coastal ecosystem outcomes for the Great Barrier Reef, GBRMPA facilitates the development of partnerships with industry, the community, local and state government and other Australian government agencies to influence the management and planning of catchment and coastal pressures, developing and maintaining a culture of mutual obligation.  This is undertaken by fostering partnerships through the <i>Reef Water Quality Protection Plan</i>

	Pressures									
	Commercial marine tourism	Defence activities	Commercial fishing	Recreational fishing	Ports and shipping	Recreation (not fishing)	Traditional use of marine resources	Climate change	Coastal development	Declining water quality due to catchment run-off
	<p>coastal pressures to foster and maintain a culture of mutual obligation.</p> <p>This is undertaken by providing input into the Queensland Coastal Plan, state planning policies, statutory Regional Plans and local government planning schemes which plan for coastal development in Queensland.</p> <p>Regulations restricting seasonal access to key seabird nesting sites provides subsequent protection to shorebirds that use the locality but may not necessarily address species-specific conservation requirements for shorebirds.</p>			state waters.		<p>coastal pressures to foster and maintain a culture of mutual obligation.</p> <p>This is undertaken by providing input into the Queensland Coastal Plan, state planning policies, statutory Regional Plans and local government planning schemes which plan for coastal development in Queensland.</p> <p>Regulations restricting seasonal access to key seabird nesting sites provides subsequent protection to shorebirds that use the locality but this may not necessarily address species-specific conservation requirements for shorebirds.</p> <p>The Australian government has obligations under international</p>			<p>Queensland.</p> <p>The GBRMPA also provides input into environmental assessments for projects referred under the EPBC Act.</p>	<p>2009 and Reef Rescue Program.</p>

	Pressures									
	Commercial marine tourism	Defence activities	Commercial fishing	Recreational fishing	Ports and shipping	Recreation (not fishing)	Traditional use of marine resources	Climate change	Coastal development	Declining water quality due to catchment run-off
						<p>agreements to address waterbird habitat loss that must be met and to implement conservation measures for them.</p> <p>Many conservation measures concerning recreational use regulation of the inshore area is within the jurisdiction of Queensland local government authorities whom are bound to follow state plans and planning policy.</p>				
<b>Residual vulnerability</b> (low, medium, high)	Medium	Low	Low	Low	Medium	High	Low	High	High	Medium
<b>Level of confidence in supporting evidence</b> (poor, moderate, good)	Poor. Limited published supporting evidence.	Moderate. Department of Defence have conducted numerous studies on the effects of defence activities on shorebirds in Shoalwater Bay Training Area. O'Neill 2009 <sup>31</sup> .	Poor. Limited published supporting evidence available for Australia.	Poor. Limited published supporting evidence.	Poor. The impacts from an ill-directed oil spill are widely understood to have serious implications for breeding shorebirds. Evidence of cumulative impacts of ports and shipping in	Good. Bank & Bryant 2007 <sup>17</sup> ; Rogers <i>et al.</i> 2006 <sup>32</sup> ; Williams <i>et al.</i> 2004 <sup>33</sup> ; David Milton pers. comm. (Qld Wader Study Group) – study not yet published.	Moderate. Networking amongst Traditional Owners suggests that traditional use of shorebirds is not common in the Great Barrier Reef World Heritage Area.	Moderate. Chambers 2007 <sup>22</sup> ; Meltotte 2007 <sup>34</sup> ; Rehfishch & Crick 2003 <sup>35</sup> .	Good. Atkinson 2003 <sup>36</sup> ; Asia-Pacific Migratory Waterbird Conservation Committee 2001 <sup>9</sup> ; Environmental Protection Agency 2005 <sup>10</sup> ; Clemens <i>et al.</i> 2008 <sup>37</sup> ; DEWHA 2009 <sup>4</sup> ;	Poor. Limited published supporting evidence. Hutchings <i>et al.</i> 2005 <sup>39</sup> .

	Pressures									
	Commercial marine tourism	Defence activities	Commercial fishing	Recreational fishing	Ports and shipping	Recreation (not fishing)	Traditional use of marine resources	Climate change	Coastal development	Declining water quality due to catchment run-off
					combination with other pressures is poor.	Poor – ecological and ecosystems processes.			Pirie <i>et al.</i> 2009. <sup>38</sup>	

The pressures addressed in this Vulnerability Assessment were identified in the *Great Barrier Reef Outlook Report 2009*.<sup>15</sup>

Coastal habitats (rivers, estuaries, seagrasses, mangroves and wetlands) are under increasing pressure from human activities. More than 85 per cent of Queensland's population live on the coastal fringe. Predicted strong population growth means that the intensity of activity and development in coastal zones is likely to persist.<sup>40</sup>

The purpose of the vulnerability assessment process is to provide a mechanism to highlight key concerns and make assessments of the vulnerabilities that species, groups of species or habitats have to known sources of pressure within the Great Barrier Reef World Heritage Area (the World Heritage Area) using a standardised and transparent process. This was undertaken using a standard approach to assess exposure and sensitivity and adaptive capacity to potential impacts (Figure 1) based on the best-available information on that particular habitat, species or group of species.

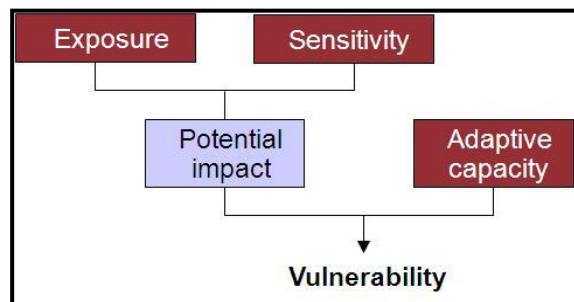


Figure 1. The key components of vulnerability assessments (Adapted from Wachenfeld *et al.*, 2007)

To achieve this objective it has been necessary to apply a linear relationship to comparisons that are sometimes non-linear by nature. For example, when applying the potential impact matrix<sup>b</sup> to create a combined score for exposure and sensitivity, if a species, group of species or habitat has a very high level of exposure to a pressure but low sensitivity to it, it is scored as having a medium-high potential impact score. This medium-high score may be the same as determined for another assessment where there may be a low level of exposure but a very high level of sensitivity. This implies a linear relationship for the sensitivity a species or habitat has to a given level of exposure, which may not necessarily be the case. However, it does provide managers with the required level of resolution on these relationships for the purpose of the vulnerability assessments that inform the *Great Barrier Reef Biodiversity Conservation Strategy 2012*.

The methods used to determine the degree of exposure or sensitivity of shorebirds of the World Heritage Area against each source of pressure are described within the vulnerability assessments page of the GBRMPA website.

<sup>b</sup> The potential impact matrix is described within the vulnerability assessments page of the GBRMPA website.

The natural capacity of shorebirds to adapt to pressures in the Great Barrier Reef, and the capacity of management to intervene (which in turn may assist shorebirds to adapt to these pressures), are considered as two dynamics that affect their residual vulnerability to any of the identified pressures. These two dynamics are then combined to produce an overall rating for adaptive capacity and then applied to the potential impact rating to provide a score for the residual vulnerability that shorebirds may be expected to experience for the given pressure. An explanation of the procedure by which this process has been applied and qualifying statements for the assessment of adaptive capacity (natural and management) scores are provided within the vulnerability assessments page of the GBRMPA website.

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