CHAPTER 5

COMMERCIAL AND NON-COMMERCIAL USE

COMMERCIAL AND NON-COMMERCIAL USE

'an assessment of the commercial and non-commercial use …'
of the Great Barrier Reef Region, s 54(3)(c) of the
Great Barrier Reef Marine Park Act 1975

5.1 Background

The Region has been used for tens of thousands of years by Traditional Owners. Since European settlement, use of the Region's ecosystem has increased through a combination of direct commercial and non-commercial uses (Reef-dependent uses) (Figure 5.1 and Table 5.1). The Region also supports non-Reef-dependent uses that require access through (or to) the area, but do not directly use the natural heritage values of the Region.

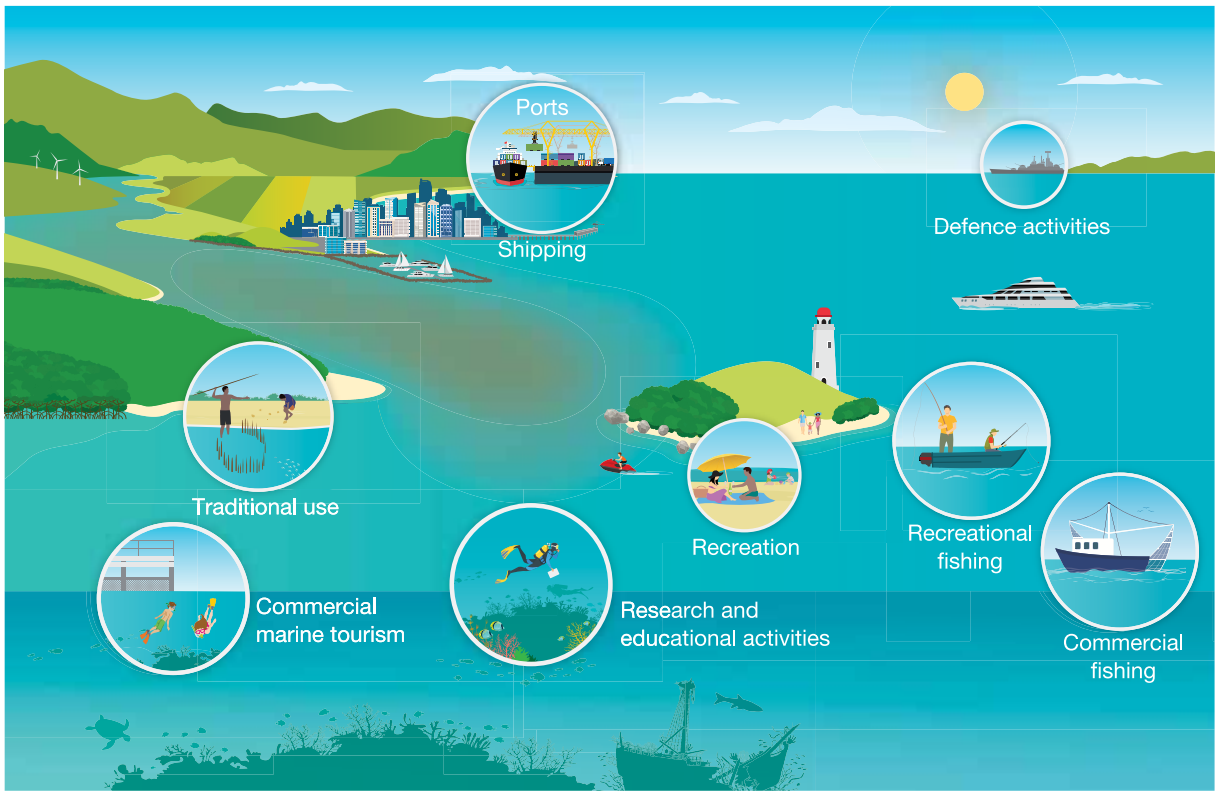


Figure 5.1 Commercial and non-commercial uses
A range of uses occur in the Region; some depend directly on the Reef's natural heritage values and resources.

This assessment of commercial and non-commercial uses examines the current condition and trend of the major uses of the Region and forms the basis for the Chapter 6 assessment of direct use, a factor that influences the Region's values (Section 6.6). The assessment is based on two assessment criteria:

- economic and social benefits of use
- impacts of use on the Region's values.

For more than 40 years, implementation of government management plans and policies have had to balance the protection of the Region against the needs of communities and industries that depend on the Reef for traditional use, social and cultural purposes, and livelihoods. Factors that influence the Region (Chapter 6) have changed and intensified over the years, making this management balance more challenging. Management has been, and continues to be, based on the best available scientific information and intergenerational knowledge. Chapter 7 assesses the effectiveness of the management tools in more detail.

Commercial and non-commercial uses collectively form an important part of the social and economic fabric that supports the adjacent communities in the Catchment and the broader Australian and international communities. The economic and social benefits of each commercial and non-commercial use is considered in terms of its benefit to the community and the natural ecosystem more broadly. All commercial and non-commercial uses, Reef-dependent or not, have the potential to conflict with the long-term protection, conservation and function of the Reef's natural heritage values. Therefore, management of these uses is factored into the assessment of the potential impacts of these uses.

Tourism, fishing, other recreational uses and scientific activities contribute significant benefits to the Australian economy (Table 5.2). The current (2015–16) estimated total contribution of the Reef to the Australian economy is $6390 million (or $6.4 billion) per annum, an increase of about 14 per cent since 2011–12.[846] Tourism and recreational uses have increased their value-added contribution, while commercial fishing has remained relatively stable since the last reporting period. In 2015–16, the Reef supported an estimated total national employment of 64,000 full-time equivalent positions, down from 69,000 in 2011–12[858] (Figure 5.2). This reduction in job figures is assumed to be a reflection of various changes in technology and national economic drivers, rather than significant job losses.[846] Across the various activities in the Region, scientific research (in combination with Reef management) has experienced the strongest value-added growth since 2011–12, with an estimated increase in employment of about 10 per cent. Comparable economic estimates for all commercial and non-commercial uses of the Region over time remain a knowledge gap.

Table 5.1 Commercial and non-commercial uses of the Great Barrier Reef

Reef-dependent uses	Non-Reef-dependent uses
• Commercial marine tourism • Fishing (commercial and recreational) • Recreation (not including fishing) • Research and educational activities • Traditional use of marine resources	• Defence activities • Ports • Shipping

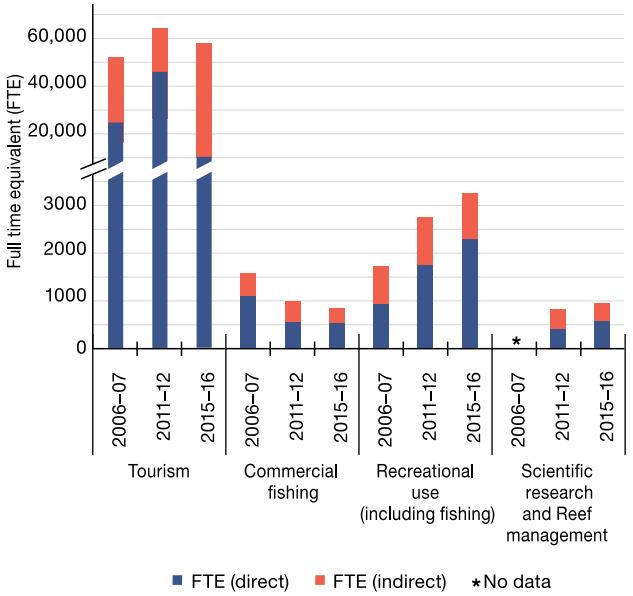


Figure 5.2 National employment levels within some Reef-dependent activities, 2006–07 to 2015–16
Employment numbers are based on direct and indirect full-time equivalent (FTE) employment generated by each activity. Indirect employment estimates include the contribution from support and ancillary goods and services generated by the direct use. Source: Access Economics 2008[859], Deloitte Access Economics 2013[858] and 2017[846]

A cruise ship at anchor on the Great Barrier Reef. © GBRMPA

Table 5.2 Economic contributions to the Australian economy from Reef-dependent activities, 2006–07 to 2015–16

Value-added refers to the output after deducting the value of inputs.

Source: Access Economics 2008[859], Deloitte Access Economics 2013[858] and 2017[846]

Activity	Australian total value-added ($million)			
	2006–07	2011–12	2015–16	Change since 2011–12 (per cent)
Tourism	$5117	$5176	$5700	+10
Commercial fishing and aquaculture	$139	$160	$162	+1
Recreational use (including fishing)	$153	$244	$346	+42
Scientific research and Reef management	-	$98	$182	+86
Total contribution	$5409	$5678	$6390	+13

5.2 Commercial marine tourism

5.2.1 Current condition and trends of commercial marine tourism

Commercial marine tourism is the largest Reef-dependent industry within the Region, contributing significantly to the economy and providing access for more than two million tourists each year. The most common tourism programs on the Reef include vessel-based day trips to reefs, islands, cays and pontoons. From 2011 to 2016, tourism visitation steadily increased from the low experienced during the global financial crisis (Figure 5.3). A slight decrease in visitation in 2017 to approximately 2,240,000 visitor days has continued with a marginal increase in 2018.

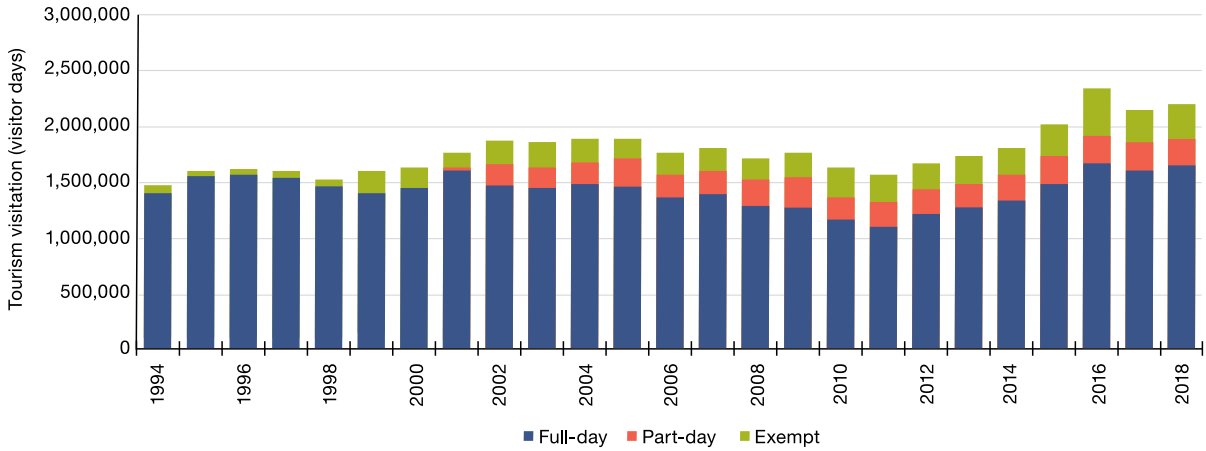


Figure 5.3 Number of tourism visitor days, 1994–2018

A 'visitor day' is a visit by one tourist for one day. For overnight visits, each day is counted separately (for example, a three-day visit by a tourist to the Great Barrier Reef Marine Park is counted as three visitor days). A part-day visit refers to visitors who take a trip of less than three hours. 'Exempt' refers to visitors who are not required to pay the environmental management charge (such as young children, people on trade familiarisation and transfer passengers) as well as those who have already paid the environmental management charge on that day for another tour or who are on their fourth and subsequent days of a trip. These tourism visitor day statistics do not include stand-alone coral viewing activities or scenic flights. Source: GBRMPA 2019[860]

Within the Region, tourism is concentrated in about seven per cent of the area. On average, 86 per cent of tourism visits occur within waters adjacent to Cairns, Port Douglas and the Whitsundays. These areas have plans of management to manage high visitation (Figure 5.4). Tourism in these areas is concentrated around tourism pontoons, popular islands and beaches.

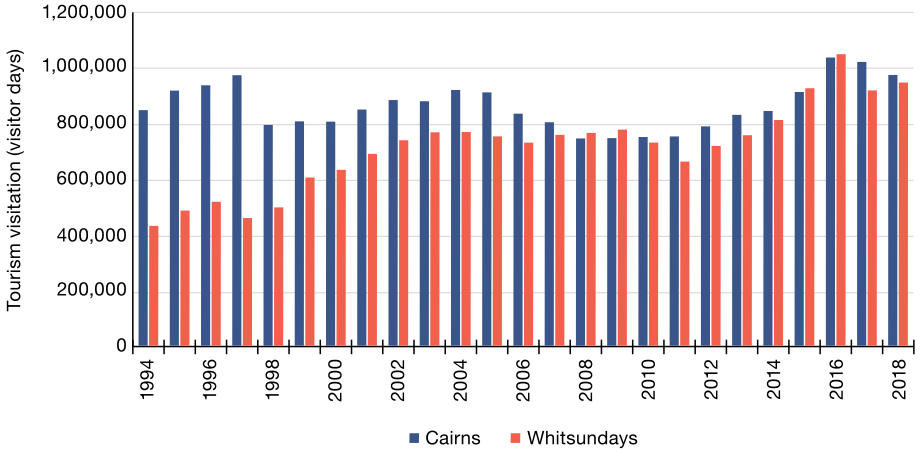


Figure 5.4 Total visitation to the two high-use plan of management areas, Cairns and the Whitsundays, 1994–2018
Source: GBRMPA 2019[860]

Since 2014, Cairns and the Whitsundays have remained the highest use areas for marine tourism. Reef health is critically important to the stability and value of the Reef tourism industry.[861] Between 2016 and 2018, tourism visitation in the Cairns area slightly decreased (five per cent). Tourism visitation also declined in the Whitsundays in 2017, to a greater extent (12 per cent), but in contrast to Cairns, visitation to the Whitsundays increased in 2018 (Figure 5.4).

Record levels of tourism visitation to the Reef have occurred since 2014

The decline in visitation and changes in tourism use around the Whitsundays were probably a result of damaged resorts that had to close, reduced water quality and damage to reef ecosystems following cyclone Debbie, which made landfall in Airlie Beach in March 2017. Media coverage of the back-to-back bleaching events around this time may have also affected travel plans. In response to the underwater damage, some tourism activity appears to have shifted to more island-based activities, while damaged fringing reefs recover.

Between 2014 and 2017, approximately 66 per cent of tourism visitor days in the Region were spent by visitors doing activities run by the 25 most active operators. This proportion is consistent with the previous Outlook Report.

Management Marine tourism in the Region is well established with planning, policy and permit systems in place. The *Great Barrier Reef Marine Park Zoning Plan 2003* (Zoning Plan)[862] and the complementary Queensland Government zoning plan[863] list activities that require permission and those that are allowed as of right. Commercial marine tourism requires permission in every case and can be conducted in almost all zones (except Preservation Zones) of the Marine Park and several other restricted areas.

Applications for permission to conduct tourist programs are jointly assessed and managed by the Marine Park Authority and Queensland Parks and Wildlife Service. In high-use tourism areas within the Marine Park, an added layer of planning complements the Zoning Plan rules, including statutory plans of management for the Cairns, Hinchinbrook and Whitsunday planning areas. These location-based plans of management manage cumulative use, including by capping the number of tourism operations and defining maximum group and vessel sizes at specific locations.

Tourism activities at Hardy Reef off the Whitsundays.
© Matt Curnock

Of the numerous policies and guidelines currently approved by the Marine Park Authority, just over half directly relate to tourism management. In 2017, the Marine Park Authority updated the permissions system policy and implemented further guidelines to provide transparency and certainty about how permits are considered and assessed, including for tourism. An established Tourism Reef Advisory Committee continues to inform the development of policy and strategic direction in the management of the Marine Park. One of the committee's key roles is to advise the Marine Park Authority Board about actions that can be taken to address the risks to the Marine Park identified in the Outlook Report.

In response to cyclone Debbie, managing agencies initiated the largest ever post-cyclone clean-up. Whitehaven Beach, on Whitsunday Island, was re-profiled, and visitor infrastructure was increased and upgraded in this area. This investment supported ongoing presentation of values to visitors and increased recovery of island beaches. The Australian and Queensland governments also provided significant funding through the Tourism Recovery Fund to facilitate tourism recovery following cyclone Debbie. The Queensland Government committed an extra $25 million towards a Great Barrier Reef Island Resorts Rejuvenation Program. This program promotes adopting renewable energy technologies, improved water and waste infrastructure, and conservation and environmental protections against weather events.

The Marine Park Authority's High Standard Tourism Operator program has been in place since 2004. Tourism operators who are independently eco-certified are invited to become part of the program, which lets them apply for longer-term 20-year permits. Sixty four operators were certified as high standard as at December 2018, an improvement from 44 in 2009 (45 per cent increase).

Auditing and reporting are undertaken to make sure high standard tourism operators are meeting certification requirements. Following audits in 2015, it was determined that the level of interpretive content delivered by tourism guides could be improved to better present the values of the World Heritage Area and how it is managed.

To address this gap, the Marine Park Authority launched the Reef Discovery Course in 2018. It is a comprehensive online training course made freely available to staff within the Reef tourism industry. This course aims to increase knowledge of areas such as biology, ecology, geology, heritage and management, and make sure interpretation is accurate.

In 2018, the Marine Park Authority also established the Master Reef Guide program in partnership with Tourism and Events Queensland and the Association of Marine Park Tourism Operators. The program aims to train guides to provide up-to-date information on the Reef, the World Heritage Area and what visitors can do to protect these places. Twenty-six Master Reef Guides had completed the training course as at April 2019.

5.2.2 Benefits of commercial marine tourism

The Reef continues to be recognised locally, nationally and internationally as an iconic nature-based tourism experience. Benefits to people can be cultural, social or economic, and they can be linked to wellbeing and a sense of identity.[785] Commercial marine tourism delivers benefits to both tourists and tourism operators. The environment may also benefit (albeit to a lesser extent), because strong cultural connections with the environment can empower stewardship and engagement in environmental protection.[785] Some tourism operators have increased stewardship at their local sites through adhering to responsible reef practices, practising small-scale permitted coral gardening, and delivering high quality interpretation about the Reef by accredited Master Reef Guides.

The Reef is an iconic tourism destination

Commercial marine tourism contributes significantly to the economy and the estimated icon value of the Reef. In 2015–16, tourism was the most prominent direct use of the Region, generating $2.4 billion (value-added) for Catchment communities.[846] More recent analyses of Reef-dependent and Reef-associated industry value have not been undertaken, and remain a knowledge gap. In the year ending December 2018, international visitation to Queensland reached approximately 2.8 million, the highest visitation recorded since reporting began in 2005, representing a 2.3 per cent increase from 2017. Of this total visitation to Queensland, approximately 51 per cent (1.43 million) occurred in tourism regions adjacent to the Reef.[864]

Culturally, the commercial marine tourism industry benefits tourists by providing access to the Reef and islands, and more broadly presenting the values of the World Heritage Area. Approximately half of the 1800 or so tourists surveyed in 2013 and 2017 felt the Reef contributed to their quality of life and wellbeing.[785] Tourists also derived benefits from the Reef through the different ways they value it. Ninety-five per cent said they valued the Reef because it supported a variety of life, such as fishes and corals. The status of the Reef as a World Heritage Area was also a recognised benefit. Over 65 per cent of tourists stated they valued the Reef for its cultural heritage because it provided a place where people can continue to pass down their wisdom, traditions and way of life.[785]

From a wellbeing perspective, 88 per cent of tourists surveyed in 2017 thought the Reef supported a desirable and active way of life. Commercial marine tourism operators also derive social benefits from the Reef with 89 per cent feeling that the Reef contributed to their quality of life and wellbeing.[785]

The strong connection both tourists and tourism operators feel to the Reef translated into positive intentions to help with environmental issues. For example, in 2017, tourists visiting the Reef indicated strong aspirations to do more to help the Reef, with 62 per cent believing they had personal capacity to make a difference.[785] Eighty-five per cent of tourism operators interviewed aspired to do more to help protect the Reef, and 68 per cent thought climate change was an immediate threat.[785]

While most tourists (approximately 80 per cent) were highly satisfied with their Reef experience, tourists interviewed in 2017 thought the condition of the Reef had deteriorated since 2013. The scores with the greatest decline related to a perception of deteriorated reef condition by international tourists. In contrast to the tourists' perception of deterioration, Reef tourism businesses remained highly optimistic about the future.[785,847] The value tourists place on the Reef and their desire to learn more about its condition and help protect it has increased significantly over time.[847]

5.2.3 Impacts of commercial marine tourism

Commercial marine tourism activities can pose threats to ecosystem and heritage values. The most significant of these include: incompatible uses (where tourism use may displace or affect another user group, such as Traditional Owners or recreational users); groundings of vessels; emissions (both from air travel and vessel operations); and, in some locations, marine debris and discharge of sewage.

Commercial marine tourism can leave a direct or indirect footprint on the values of the Region. Direct effects include damage to coral by snorkelling tourists and the footprint left by concrete mooring blocks associated with tourism pontoons. Indirect effects are harder to measure and can include displacement of other users by tourism use and changes in behaviour of animals that are fed or harassed at tourism sites.

Globally, tourism is responsible for five per cent of the world's fossil fuel consumption and associated carbon emissions.[865] Given the large distance of mid and outer-shelf reefs from the Queensland mainland, fuel consumption in the Reef tourism industry is likely to be far greater than at other locations where reefs are in closer proximity (for example, Ningaloo, Western Australia). The Reef (like Australia) is also typically a long-haul destination for visitors from most countries, so carbon emissions associated with international visitation are higher than those for other tourist destinations. An integral part of the assessment for the High Standard Tourism Operator program is providing evidence that the tourism operation is dedicated to reducing carbon emissions and committed to sustainable practices that address climate change.

Tourism use and associated impacts mainly occur in a few high-use areas

High-use areas offshore from Cairns, Port Douglas and the Whitsundays may each receive 200 to 400 tourists per day. Concentrated snorkelling and diving in these areas is likely to cause some level of direct and indirect damage to ecosystem and heritage values. Site-specific tourism operations mitigate impacts through guided snorkel tours, trails and resting stations that reduce contact with corals. **Physical damage** to reefs and shoals can be caused by the grounding and, in some cases, sinking of tourism vessels in the Region. These **groundings** are only a small proportion of the total vessels operating in the Marine Park on any given day (Section 5.5.3 Figure 5.18). Following the global financial crisis, reduced profitability across the industry increased the potential risks associated with maintaining tourism-related structures, such as pontoons, jetties, underwater observatories and moorings in the Region. An increased focus on permit compliance and auditing by the Marine Park Authority since 2016 found only low levels of non-compliance for tourism pontoons.

Established tourism operations at set locations have the **potential to displace** other users. A 2017 survey found that people in the Fitzroy and Mackay–Whitsunday regions felt they did not have fair access to the Reef compared with other users.[785] In contrast, people in the Wet Tropics and Burnett–Mary regions felt their access was equitable. The areas with the greatest feeling of equity were also sites within the Reef that either have restrictions on tourism use in high-value recreation sites (for example, Vlasoff Cay off Cairns), or have site-specific plans that attempt to balance recreational and tourism use in some areas (for example, Lady Musgrave Island).

Sewage discharge from vessels (both commercial and recreational) can increase nutrients in the water, reduce water quality and damage habitats. Within the Region, macerated sewage must be discharged from vessels at least one nautical mile (1.8 kilometers) seaward from the nearest reef, island, mainland or aquaculture facility, and this does not require a permit. There are few land-based sewage pump-out facilities adjacent to the Region, with only five fixed onshore pump-out facilities registered.[866] Discharging sewage sludge at sea that was loaded to a vessel from a tourism pontoon or other source requires a permit under the *Environment Protection (Sea Dumping) Act 1981* (Cth). Since 2014, three permits allowing sea dumping of sewage have been assessed and approved. This type of permit enables the tourism operator to remove sewage and grey water from their pontoons and discharge it, provided it is more than 500 metres from a reef. Volumes per year range from 13,000 litres for a small pontoon up to 227,000 litres for a larger pontoon. The sewage is discharged while the vessel is underway to increase dilution.

Although a considerable number of **offences** by tourism operators are recorded each year, particularly from the Cairns and Whitsunday planning areas, the environmental impact of these is relatively low compared with other non-compliant activities.[867] Offences by tourism operations typically include breaching of plans of management, failing to comply with the conditions of their Marine Parks permit, grounding vessels on coral, charter fishing in Marine National Park no-take zones, anchoring in no-anchoring areas, unpermitted or non-compliant moorings and approaching too close to whales.[868]

Emerging impacts from tourism activities include: installation of underwater infrastructure (for example, underwater art installations and small-scale reef restoration activities) that are unplanned or poorly financed; disturbance of wildlife and tourists by drones; and increased marine debris (Section 6.5.1).

5.3 Defence activities

5.3.1 Current condition and trends of defence activities

The Australian Defence Force has operated and trained in the Region for more than 100 years. Australian Navy, Army and Air Force bases at Cairns and Townsville serve as key platforms for defence operational activities in the Region. Training activities are regularly undertaken in designated areas, which cover less than four per cent of the Region (Figure 5.5).

Management Defence activities are allowed under the Zoning Plan, and management of the environmental impacts in the Region is undertaken by the Australian Department of Defence in collaboration with the Marine Park Authority and Queensland Government. Other management tools for defence activities include environmental management plans and a strategic environmental assessment for defence activities.[869,870] All operational and training defence activities are managed directly by the Department of Defence, including the conduct of training activities by visiting international defence forces. Many defence activities are conducted with dedicated observers, who may collect data on marine wildlife sightings or delay activities, if required, to avoid or minimise impacts on the environment.[871]

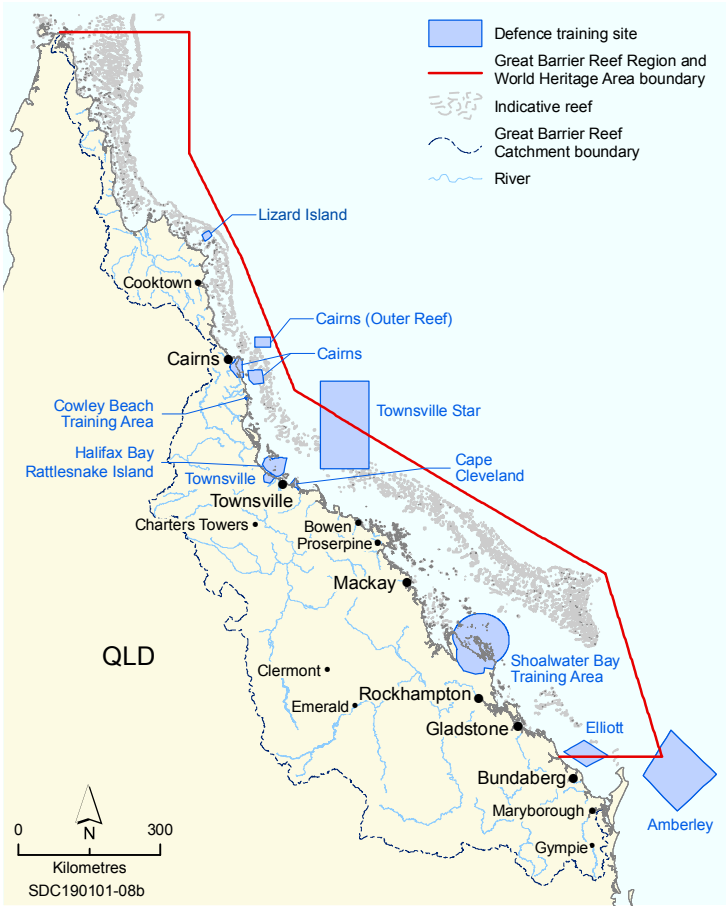


Figure 5.5 Defence training sites in the Region
The Australian Defence Force undertakes training in designated areas within the Region, shown in blue. The Townsville Star and Shoalwater Bay Defence training areas are some of Australia's largest.

5.3.2 Benefits of defence activities

Defence activities in the Region continue to directly contribute to the training and operation of Australia's defence services. The economic benefits of most Defence Force activities to the coastal communities adjacent to the Region are not quantified. Periodic visits from international naval ships to the ports of Cairns and Townsville generate short-term economic benefits.[872]

Defence operational activities directly and indirectly support management objectives for the Region through hydrographic surveys, and fishery and border protection patrols. The management agreement between Defence and the Marine Park Authority supports cooperative research programs relevant to environmental management of the Region and adjacent Defence estates.[873] Examples of cooperative research include: collaboration on surveys to detect marine pest incursions; environmental baseline studies; studying the impacts of noise; and developing mitigation strategies regarding waste discharge and wildlife interactions with defence activities. During the acquisition of new land or planning for new development and major activities, the Department of Defence assesses natural, Indigenous and historic heritage values on its estate. Heritage assessments can include consultation with Traditional Owners, who may also participate in monitoring and remediation works.[874]

Defence undertakes hydrographic surveys and patrols (for fishery and border protection) that support management of the Region

In 1965, the Department of Defence acquired the Shoalwater Bay Training Area land. Since then, it has assisted in regenerating degraded areas to a relatively natural state through active land management and excluding grazing and coastal development pressures. In December 2016, Defence partnered with the Marine Park Authority and the Fitzroy Basin Association to reduce the number of feral pigs at the Shoalwater Bay Training Area.[875]

5.3.3 Impacts of defence activities

Defence activities occur in some sensitive areas

While modern defence training activities are well managed and have negligible impacts on the Reef, defence activities are predicted to intensify in the Region[876], coinciding with a decline in the Region's ecosystem health. By their nature, defence activities pose threats to the Region that must be continually monitored and managed, particularly in sensitive areas, such as Shoalwater Bay. Local and regional-scale impacts include: **debris** and residue from expendable stores; death, injury or **disruption to marine life**; exclusion of other users; **discharge of sewage** and other wastes; **oil spills**; and risks to other users and their property if they stray into Defence training areas during exercises. The implementation of mitigation measures results in reduced, or rare, incidents causing harm to the habitats and species of the Region. Balancing Defence training requirements with conservation of critical environmental values will remain a significant challenge for managing agencies and Defence. For example, a satellite-tracking study conducted at Triangular Island (in Shoalwater Bay) in 2014 monitored noise impacts on turtles. The study found that the underwater noise and vibrations associated with large explosive detonations did not result in displacement or disturbance to behaviours by resident foraging green turtles. The turtles continued to display strong site fidelity, irrespective of whether they were foraging a few hundred metres from the detonation area or kilometres away.[877]

A range of legacy impacts associated with past defence activities continue. The most significant is the presence of large amounts of **unexploded ordnance** (shells, missiles and bombs) and chemical warfare agents that were deliberately dumped at sea at the end of World War II.[878,879]

In 2004, Defence began phasing out the use of firefighting foams containing specific active ingredients, particularly per and poly-fluoroalkyl substances (PFAS) (Section 6.5). These **chemicals** are environmentally persistent and can cause liver toxicity, tumours and reproductive effects in animals. Current evidence is unclear whether these chemicals cause adverse health effects in humans.[880,881] One of four identified PFAS investigation sites in Queensland includes coastal wetlands and beaches surrounding RAAF Base, Townsville. A risk assessment has begun based on the initial findings of the detailed site investigation.[882]

Amphibious landing at Freshwater Beach, Exercise Talisman Sabre 2017. © Department of Defence (Cth)

5.4 Fishing

Fishing is the largest extractive use of the Region and comprises a range of fishing activities targeting a variety of species, including fishes, crabs and prawns. For the purposes of this report, the term 'fishing' includes recreational, charter and commercial fisheries. Fishing activities associated with traditional use are considered in Section 5.9. About two thirds of the Marine Park is available to most types of fishing.

Fishing continues to be an important use of the Region

At present, no marine-based aquaculture operations are underway in the Region, although permission has been granted for a small pearl oyster facility to be established at Albany Island, Cape York. Some land-based aquaculture operations exist in the Catchment (Section 6.4.1).

5.4.1 Current condition and trends of fishing

Recreational fishing Fishing remains one of the most popular recreational activities on the Reef. Even though more than half of Queensland's recreational fishers live in the south-east of the state, the highest participation rates (up to 30 per cent of the residential population) are in regional areas.[883] The most recent telephone survey data available[883] indicate that in 2013–14 the Gladstone residential region had the highest level of boat ownership among fishing households (70 per cent), followed by the Mackay–Whitsunday residential region (67 per cent). During the 2013–14 period, Queensland residents fished for approximately 2.5 million days, similar to the 2.6 million days estimate in 2010–11. Participation rates reduced slightly over that period from 17 per cent to 15 per cent.

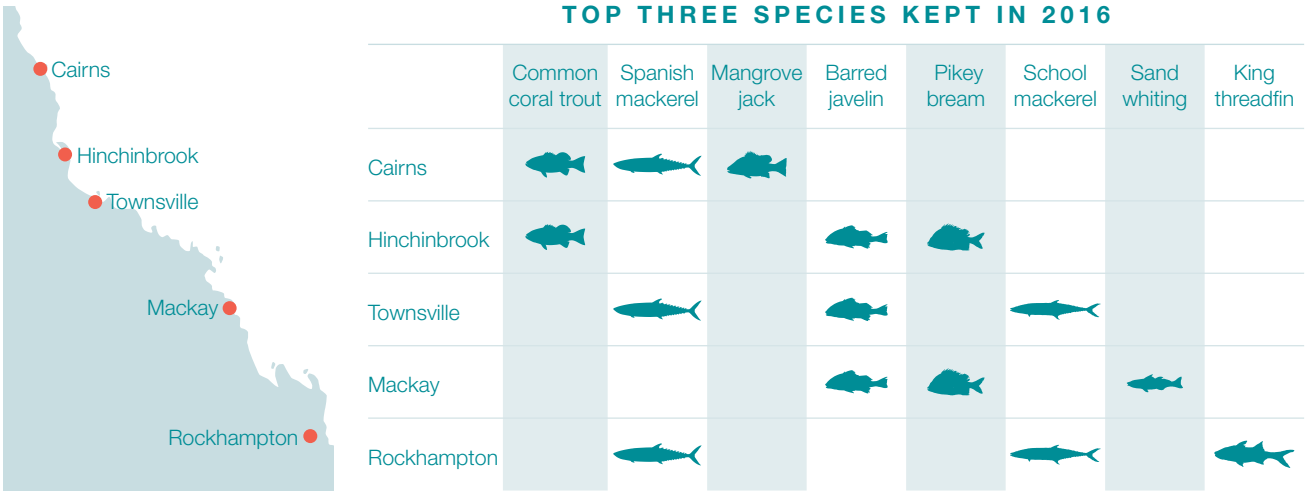


Figure 5.6 Top three species caught and kept by recreational fishers during a 12-month period (November 2015 to October 2016)
This infographic highlights regional variation in the fish species most commonly harvested by recreational fishers, using data gathered through surveys conducted at boat ramps. Source: Department of Agriculture and Fisheries (Qld) 2017[884]

For recreational fishing in the Region's estuary and ocean waters in 2013–14, tropical snapper, emperor, coral trout, cod and grouper were the most caught finfish species groups.[883] Large numbers of invertebrate species, including crabs, were also taken. Target species vary among locations (Figure 5.6).[883,884]

Charter fishing Operators take paying customers on boat trips to fish recreationally as visitors on a tourism vessel. For the year 2016–17, 96 active charter fishing licencees reported catch from within the Marine Park. The annual charter fishery effort (fishing days) within the Marine Park declined overall from 2008 to 2018, with a slight upward trend for 2016 to 2018.[885] Catch also increased somewhat for 2016 to 2018, but remained lower than historical levels (Figure 5.7).

Species of importance to the charter fishery differ by location. Overall, coral trout, redthroat emperor, mackerel and tropical snapper make up the greatest proportion of catch reported

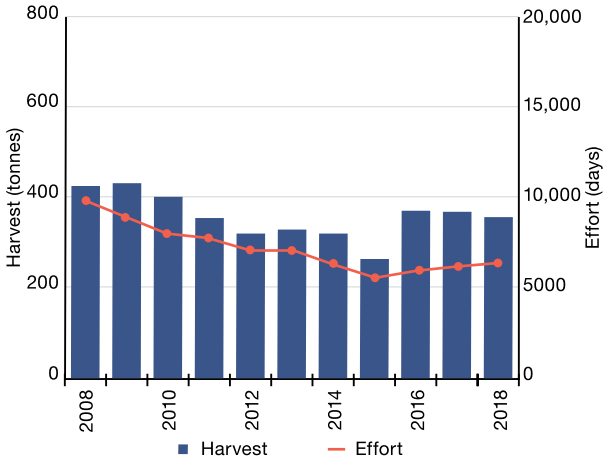


Figure 5.7 Charter fishing total catch and effort in the Great Barrier Reef, 2008–2018
Source: Department of Agriculture and Fisheries (Qld) 2019[885]

by charter fishers within the Marine Park. These are highly prized recreational and targeted commercial species. Some concerns exist regarding aspects of the completeness and accuracy of data reported through commercial and charter logbooks, as there is no independent validation program.[886,887]

Commercial fishing Trawl, net, line and pot remain the most significant commercial fishing methods in use in the Region (Table 5.3). In 2017, the commercial harvest (retained catch) of fisheries product in the Region was about 7600 tonnes, not including marine aquarium fish or coral. Of this, around 96 per cent came from the four main fishing methods. The largest change in the past 10 years has been in the net fishery sector, as a result of licence buybacks.[888,889,890,891] The 2017 harvest was 57 per cent (1331 tonnes) lower than the harvest in 2007 (Table 5.3 and Figure 5.8). New management arrangements for all commercial (and recreational) fisheries in the Region are currently being developed, as part of the implementation of the Queensland Sustainable Fisheries Strategy 2017–2027 (Sustainable Fisheries Strategy).[892]

Table 5.3 Commercial harvest in the Great Barrier Reef by fishery in 2007, 2012 and 2017
Data are accurate at the point of extraction from QFish and other databases. Differences to 2007 and 2012 figures reported in the 2014 Outlook Report generally result from subsequent database corrections or the use of QFish's new Reef data extraction boundaries. For instance, the mud and blue swimmer crab harvest figures now include animals caught in rivers and creeks.
Source: Department of Agriculture and Fisheries (Qld) 2018[885]

Fishing method	Fishery	Commercial harvest (retained catch)			Main target species in the Region
		2007 (tonnes)	2012 (tonnes)	2017 (tonnes)	
Trawl	Otter trawl	3333	3426	3637	Prawns, scallops, bugs, squids
	Beam trawl	70	33	21	Prawns
Net (mainly large mesh net)	East Coast Inshore (principally)	2341	1697	1010	Barramundi, sharks, grey mackerel, threadfin salmons, sea mullet, whiting
Hook and line	Coral Reef Finfish and Spanish Mackerel (principally), and hook and line component of East Coast Inshore	2122	1746	1845	Coral trouts, cods, emperors, tropical snappers, Spanish mackerel, other mackerels, sharks
Pot	Mud crab, blue swimmer crab - pot	601	893	667	Mud crab, blue swimmer crab
	Spanner crab - dillies	526	205	132	Spanner crab
Hand-based collection (harvest)	Coral	106	85	20	'Live rock' and potentially hundreds of species of coral
	Marine aquarium fish	179,948 fish	146,650 fish	90,360 fish	Potentially hundreds of species, mostly damselfish, anemone fish, wrasses, angel fish
	Tropical rock lobster	238	154	185	Tropical rock lobster
	Trochus	141	16	0	Trochus
	Sea cucumber	252	379	262	White teatfish, blackfish, curryfish

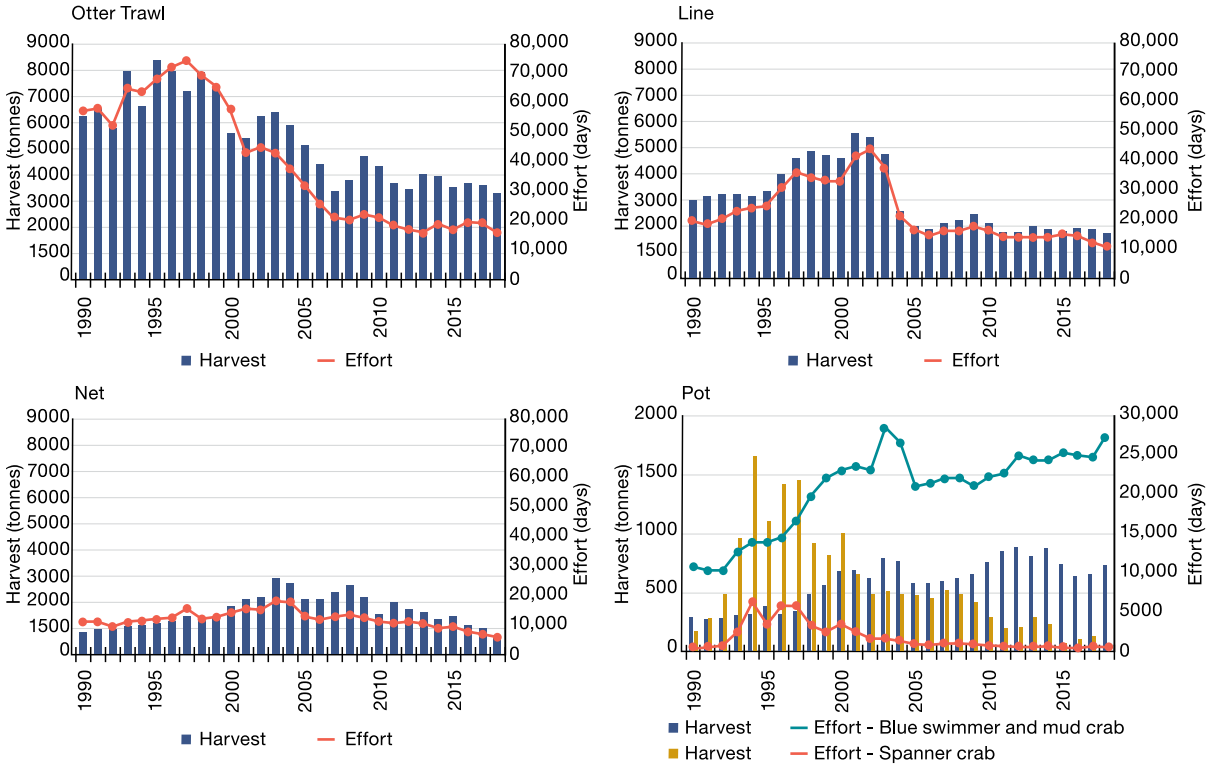


Figure 5.8 Commercial fisheries harvest and effort in the Great Barrier Reef, 1990–2018
Annual harvest and fishing effort for the four major fisheries (otter trawl, net, line, and pot) from 1990 to 2018. Data are based on commercial fisher logbook records. Effort is expressed in fishing days. A day of fishing effort has not been standardised over time and does not account for changes in fishing power (such as technology advances and fishing efficiency). Source: Department of Agriculture and Fisheries (Qld) 2019[885]

Trawler off Low Isles in the north of the Region. © GBRMPA, photographer: Pine Creek Pictures

There are two basic types of trawling: otter trawling and beam trawling. The otter trawl fishery, which operates in more open waters is by far the larger, accounting for most of the total harvest taken each year (Table 5.3 and Figure 5.8). The **East Coast Otter Trawl Fishery** is the largest fishery in Queensland, both in terms of the volume of product caught and the economic value of the product.

Within the Region, trawl fishing is currently allowed in all General Use Zones (with some additional spatial restrictions), totalling 34 per cent (118,488 square kilometres) of the World Heritage Area.[893] In 2017, the total area of fisheries reporting grids (excluding where trawling is not allowed) for which otter and beam trawl harvest was recorded equaled approximately 30 per cent (106,629 square kilometres) of the World Heritage Area. Some areas in the Region, particularly deep areas (down to about 250 metres) of the outer southern Reef, have among the highest trawl footprints and effort intensity in Australia.[894]

Since 2014, the state of saucer scallops in Queensland has come under increased focus. Standardised trawl harvest rates of saucer scallops from January 2015 to April 2016 were the lowest in the 39-year record. Estimates of spawning stock in 2015 were potentially as low as five to six per cent of 1977 levels, when the fishery was in its early development. By 2016, profitability in the scallop fishery relied on the value of a co-caught species (Moreton Bay bugs).[113] The 2016 stock status assessment concluded that the saucer scallop fishery was recruitment overfished.[895,896] The classification system[897] has since changed and the 2018 assessment gives the status as depleted.[898] The 2017 fishery-independent scallop survey (sampling in October 2017) indicated very low abundance of scallop compared to previous survey years and concluded the stock's likely biomass remains very low.[899] In December 2016, legislative changes were made to keep all scallop replenishment areas permanently closed from January 2017 and introduce winter closure (1 May to 31 October) on all east coast saucer scallop harvesting to protect the spawning stock over the winter months.[900] Further management arrangements may be required to recover the stocks and make sure overfishing does not continue.[901]

The **East Coast Inshore Fishery** is complex, covering various target species and multiple types of commercial gear. In the Region, the main gear types are mesh net, bait net and line. Many of the species targeted by commercial fishers are also targeted by recreational fishers, including bream, flathead, whiting, barramundi, jewfish, threadfin salmons and trevally.

Commercial effort in the East Coast Inshore Fishery has been reduced in the last five years with the removal of 120 large mesh net licences. There is limited information on a range of species within this fishery, including for many that have an undefined stock status.[902] There are serious sustainability concerns for black jewfish.[903,904] The commercial catch of black jewfish has increased ten-fold, reaching 95.5 tonnes for the 2018–19 year by the end of December 2018[885] due to the high economic value of the species' swim bladders (up to $920 per kilogram). The annual historical average for commercial harvest of this species is 16 tonnes. Fisheries Queensland is implementing management actions to address unsustainable harvest of black jewfish, including changes to the commercial fishing reporting requirements that took effect in April and May 2019.[904] The total allowable commercial catch for sharks and rays constrain the amount of hammerhead shark that fishers can harvest (including under a new management arrangement that began on 1 January 2018). However, they do not constrain harvest at a species level for other shark and ray species. This situation may be significant for species, such as pigeye shark, where fishing mortality estimates are relatively high and harvest rates may have been unsustainable in the past.[905,906]

Live coral trout harvested by line fishing. © GBRMPA

In the **Spanish Mackerel Fishery** (a line-only fishery) almost one third of the total commercial harvest is taken from a very small area off the coast of Townsville and most of this is during the spring months.[907,908] Following a substantial reduction in effort associated with the fisheries management and Marine Park zoning changes in 2004, fishing effort has since increased from around 9000 to 13,500 tender vessel days, with fishing effort almost doubling on the main fishing grounds off Townsville over the past eight years.[907,908] The most recent stock assessment for Spanish mackerel suggests the current harvest level for the east coast stock is sustainable.[909,910] However, only about half of the total allowable commercial catch (574.6 tonnes) has been harvested in recent years. If the total allowable commercial catch was to be largely used, and current or increased charter and recreational harvests continued, then the biomass of the Spanish mackerel population may decline.[909] The risks from fishing spawning aggregations are also a critical consideration.[909] The spatial and temporal distribution of spawning aggregations has contracted in the Region, with one aggregation in Cairns now commercially extirpated.[15,16] Current catch rates at spawning aggregations are up to 90 per cent lower than those reported in the early 1900s[15] (Section 2.2.2).

There are concerns for the two most important species harvested by the **Rocky Reef Fishery**: Australian snapper and pearl perch. While some take of these species occurs in the Region, most of the harvest has historically occurred further south. However, commercial and recreational catches have been declining and there may be related movement of additional fishing effort into the Region.

Concerns exist for some species harvested by commercial and recreational fishers

The Queensland component of the east-coast stock of Australian snapper is recruitment overfished[911,912] and its status was assessed as depleted in 2018.[909,913] The Queensland fishery appears to have relatively few older fish and fishery-independent data (2007–2015) show a decrease in relative catch rates of 57 per cent since 2014 and 94 per cent since 2011.[914] Also, commercial, recreational and charter sector data for Queensland all show harvest declines to historic lows during the period 2007 to 2015.[907,915,916] The current level of fishing pressure is thought to be too high to allow recovery of the Queensland component of the stock.[911,914] Geographically, commercial harvests have increased at the northern extent of the fishery within the Region (particularly the Swain Reefs area) and further offshore, potentially in response to declining catches and catch rates in areas south of the Region.[912]

The east coast pearl perch stock is classified as depleted and considered recruitment impaired.[917] Commercial harvest rates declined by about 40 per cent between 2006 and 2014.[895,918,919] A similar decline also occurred in the charter and recreational fishing sectors.[919] Commercial harvest in 2016–17 was about 17 tonnes, continuing around five years of historically low harvest levels.[885] From 2012 to 2017, the proportion of the total harvest taken from within the Region increased from around 27 per cent to around 52 per cent. Fishing effort, measured as days when pearl perch are landed, also increased in the Region, from 295 fishing days in 2012 to 578 days in 2017. Collectively, these indicators suggest fishing pressure is increasing on pearl perch within the Region as harvests in southern Queensland decline.

The commercial component of the **Coral Reef Finfish Fishery** operates predominantly in the Marine Park using only line fishing. The majority of catch is from the commercial sector, targeting coral trout (Section 8.3.4 and Figure 5.9) for live export. However, the fishery also includes substantial recreational and charter fishing sector effort. All three sectors target coral trout, emperor and tropical snapper species and around 120 other fish species are also taken. The annual total allowable commercial catch for coral trout has been significantly reduced over time. In 2004, it was set at 1350 tonnes and by 2015 was constrained to a record low of 917 tonnes. Since then, the total allowable commercial catch has slowly increased, to 1163 tonnes for the 2018–19 season (Figure 5.9). Total allowable commercial catch levels for red throat emperor (611 tonnes) and 'other species' (956 tonnes) have not changed since 2004 because decision rules are not yet[892,920] in place for adjusting the total allowable commercial catch for these species. Some species within the 'other species' category are more at risk of over-exploitation than others and there is potential for their excessive harvest within the total allowable commercial catch.[288,921]

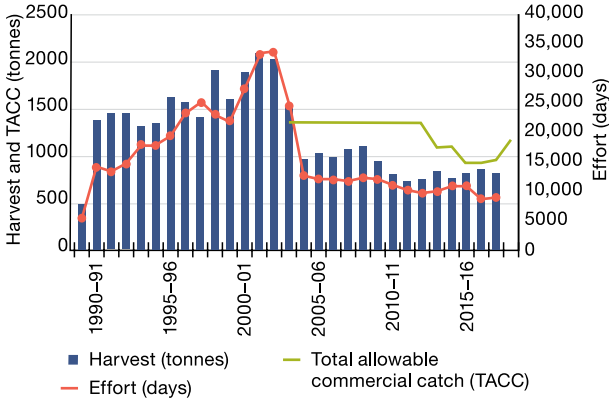


Figure 5.9 Commercial coral trout line fishing harvest and effort in the Great Barrier Reef, 1989–90 to 2017–18
Data only includes coral trout caught by line fishing. Effort is expressed in fishing days (primary vessel). Source: Department of Agriculture and Fisheries (Qld) 2019[885]

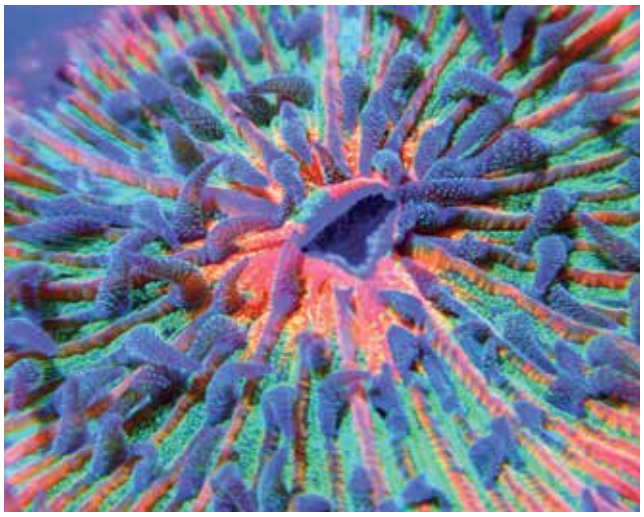
Several **crab species** (Figure 5.8) are commercially and recreationally targeted in the Region. Mud crabs are an important species for fishers throughout the Region. Blue swimmer and spanner crabs are mostly harvested south of the Region (about 95 per cent of the total reported commercial pot harvest), and are taken in relatively small numbers in the southern areas of the Region. In 2016, the status of all three species was assessed as sustainable.[922,923,924]

Protection of all female mud and blue swimmer crabs and size limits that protect immature males strongly contributes to sustainability.[922,923] However, catches in the mud crab fishery have been declining over recent years and many commercial fishers state that current catch rates are no longer economically viable.[925] The commercial harvest of blue swimmer crabs in Queensland in recent years has been about one quarter of that harvested in 2003 and 2004, and the most recent stock assessment noted that significant reductions in fishing effort are required to make sure stocks are sustainable and promote an optimum economic yield.[925] These stocks are under considerable pressure and there is concern about overcapacity, competition, localised depletion and reduced recreational fishing satisfaction.[925] Reports of black-marketing due to the high value of mud crab are increasing.[925]

Depletion is also an issue for the spanner crab fishery[926], particularly as spanner crabs are longer lived and slower growing than most other commercial crab species. In 2015–16, the total allowable commercial catch for the main fishing area was 1631 tonnes[927], but it was reduced by almost 50 per cent for 2018–19 (to 847 tonnes) in response to declining catch rates in recent years.[924,928,929] The 2018 stock status assessment classifies spanner crabs as depleting.[895,930]

The main commercial **dive-based harvest fisheries** operating within the Region are the sea cucumber fishery, coral fishery, marine aquarium fish fishery and the tropical rock lobster fishery. In the east coast Queensland sea cucumber fishery, currently 18 commercial harvest licences (all owned by two operators) are authorised to take sea cucumber by hand using scuba or surface-supplied air. Total harvest for the fishery has remained relatively stable over the last decade (Table 5.3).[931] The stock status for the two main commercially caught species, white teatfish and burrowing blackfish, are rated as sustainable.[895] However, all other sea cucumber species are grouped under the fixed total allowable commercial catch for 'other species'. This does not allow the total allowable commercial catch to be adjusted at the species level to ensure commercially significant species that are sensitive to localised fishing pressure are harvested sustainably.[932] The exception is black teatfish, for which there is currently (Section 8.3.3) a total allowable commercial catch of zero tonnes within the fishery's total allowable commercial catch.[2,928]

The reporting requirements and quota rules for the coral fishery have changed since the 2014 Outlook Report. A total of 59 commercial harvest licences are currently authorised for Queensland.[928] No stock assessments are in place due to the large number of species harvested. The average amount of product harvested under the Queensland coral fishery has increased over the past 14 years (Table 5.3 and Figure 5.10). In 2016–17, 48 per cent of the 'specialty coral' and 37 per cent of the 'other coral' allowances were used by fishers.[933] The wildlife trade operation assessment for the fishery, which allows for export, suggests impacts are likely to be low.[934]



The coral fishery supplies marine aquarium enthusiasts with attractive specimens like this Fungia species. © Cairns Marine

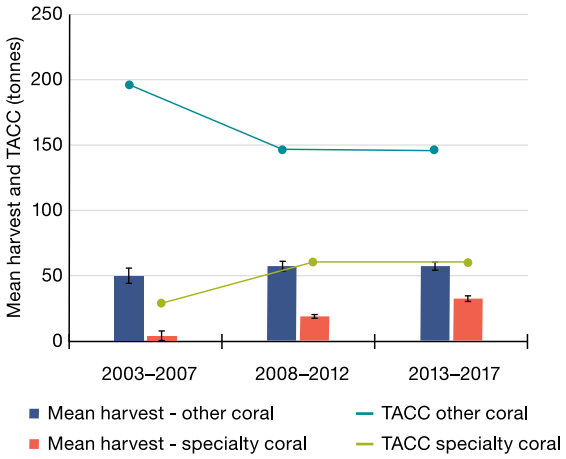


Figure 5.10 Average annual product harvested in the coral fishery in the Great Barrier Reef for three 5-year periods 2003–2007, 2008–2012, 2013–2017

Coral harvest weights are based on unloads recorded via the quota monitoring system rather than logbook data because, since the start of the 2015–16 quota season, fishers log the number of pieces of coral rather than weight. For each period, harvest is shown as a mean +/- standard error. Note that the total allowable commercial catch (TACC) shown for the 2003 to 2007 period applies to 2003 to 2005 only. During 2006 and 2007, TACC was at the level shown for 2008 to 2012. Source: Department of Agriculture and Fisheries (Qld) 2018 and 2019[885,928,933]

The marine aquarium fish fishery collects a wide variety of fish and invertebrates for the live aquarium trade, most of which is exported. As is the case for the coral fishery, stock assessments are not conducted due to the high number of species harvested and the impact has been assessed as likely to be low.[935] Currently, 42 licences are authorised, with 21 of those reporting catch in 2017 and the rest inactive. Collection is carried out using scuba or surface-supplied air with hand-held fishing gear, including lines, small nets and herding devices. Both effort and catch have substantially reduced in 2017 compared with historical levels (Table 5.3 and Figure 5.11). This decline may be partly related to international market demand, as many species are now grown in aquaculture facilities.

The harlequin tuskfish is a popular aquarium fish due to its bright colours and striking patterns. © Cairns Marine, photographer: Phil Woodhead

The tropical rock lobster fishery predominantly supplies a live export market. Collection is by hand, in reef waters to a depth of 25 metres. The commercial fishery in the Region is restricted to operating north of latitude 14 degrees south (around Princess Charlotte Bay). Recreational take in the Region is small. Although 28 commercial licences are authorised, only nine licence-holders hold quota. The stock was classified in 2018 as sustainable[895] and 95 and 83 per cent of the total allowable commercial catch was harvested in 2017 and 2018 respectively (Figure 5.12).

Since 1962, the **Queensland shark control program** has been implemented under the *Fisheries Act 1994* (Qld) (as amended) to reduce the risk of shark attacks on bathers at popular swimming locations by targeting the removal of sharks identified as posing a risk to swimmers. For this reason, the extraction and other impacts of the methods used are included in the fishing assessment.

Since the 2014 Outlook Report, all five remaining nets have been removed from the Marine Park and replaced with drumlines. A maximum of 173 drumlines can be set in the Marine Park at any one time. In the Region (outside the Marine Park) two nets remain at Harbour Beach, Mackay. From 2014 to 2017, 1251 sharks of targeted species were taken from within the Region under the program. A further 232 sharks of non-target species were also caught, with approximately 36 per cent released alive.[936] None of the sharks are considered retained take. Evidence from the program indicates that once nets are replaced with drumlines the number of species caught decreases and the percentage released alive increases.[937]

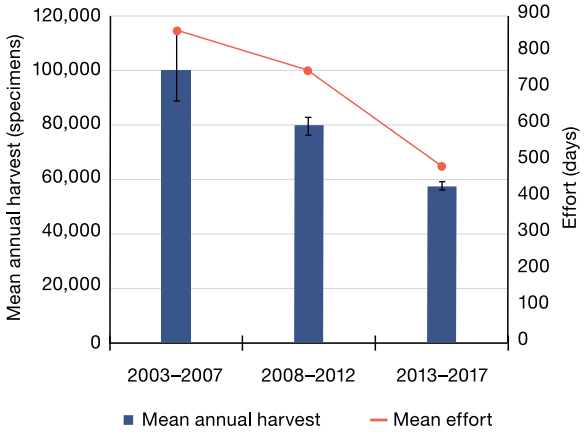


Figure 5.11 Marine aquarium fishery harvest and effort in the Great Barrier Reef for three 5-year periods 2003–2007, 2008–2012, 2013–2017
Harvest is expressed as the number of individual specimens and effort is expressed in fishing days (of primary vessel). For each period, harvest is shown as a mean +/- standard error.
Source: Department of Agriculture and Fisheries (Qld) 2019[885]

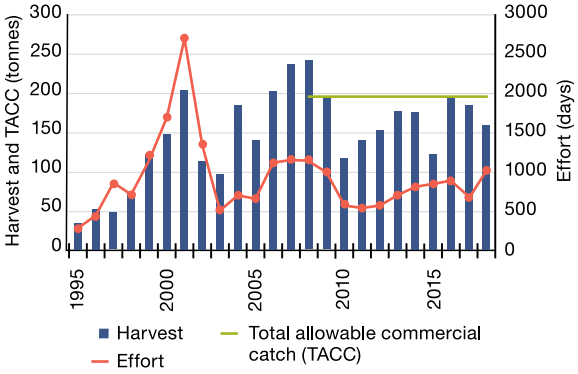


Figure 5.12 Tropical rock lobster fishery harvest and effort in the Great Barrier Reef, 1995–2018
Harvest and total allowable commercial catch (TACC) are expressed in tonnes; effort is expressed in fishing days.
Source: Department of Agriculture and Fisheries (Qld) 2019[885]

Management The Australian and Queensland governments, in aiming for ecologically sustainable fishing in the Region, take an integrated and collaborative approach to fisheries management.[938] Statewide fishery management arrangements are applied under the *Fisheries Act 1994 (Qld)*, and the Australian and Queensland governments work cooperatively in the Region through the Reef Joint Field Management Program, including to conduct fisheries-related surveillance and other enforcement activities. The Zoning Plan and *Marine Parks (Great Barrier Reef Coast) Zoning Plan 2004* apply to all fishing activities in the Great Barrier Reef Marine Park, and specify areas that can be fished and the type of fishing that can be undertaken. Subject to meeting the overarching objective of the *Great Barrier Reef Marine Park Act 1975*, namely long-term protection and conservation, the Offshore Constitutional Settlement[939] provides for the Queensland Government to have lead responsibility for fisheries management within the Region.

Ensuring ecological sustainability is crucial

As in many other regions and jurisdictions[940], allocation of fisheries resources is an ongoing source of conflict between the commercial and recreational sectors within the Region. In November 2015, three net-free fishing zones prohibiting commercial net fishing were introduced to improve recreational and charter fishing opportunities near Cairns, Mackay and Rockhampton and reduce interactions with species of conservation concern.[941] Surveys conducted in 2015 and 2016 showed recreational fishers were satisfied with their fishing experience in the net-free zones and expected further improvements over time.[942,943]

Recreational fishers in Queensland do not require a fishing licence.[944] Recreational fish size, take, possession and gear limits apply in tidal waters and the sale of any fish caught recreationally is prohibited. Seasonal closures also apply for some species. Guidance on best-practice release techniques for line-caught fish is available.[945] Improved monitoring for recreational fishing is needed to address information gaps.[892]

For commercial fishing activities, direct management arrangements include licences for all operators, total allowable commercial catches for some species, fish size and possession limits, restrictions on fishing apparatus, closed areas and seasonal closures.[946] The management arrangements for most commercial fisheries in the Region are accredited for export approval against the guidelines for the ecologically sustainable management of fisheries[947] under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth). Commercial harvest fisheries and all developmental fisheries also require Marine Parks permits. Currently, fisheries managed solely under a total allowable commercial catch system may be more at risk of exceeding harvest limits than those managed under individual transferable quotas[948] because the latter have more robust reporting requirements.

Fishing practices and management continue to improve

Since 2014, some legislated changes for the East Coast Otter Trawl Fishery have been implemented to improve environmental outcomes for the fishery. In 2015, mandatory use of improved bycatch reduction devices began, to help reduce the substantial incidental capture of sea snakes and other bycatch species. Further changes were also made to improve turtle excluder devices (mandatory in the fishery for over a decade) and trawl spikes became prohibited.[949,950,951] Ways to address some remaining environmental risks to species and habitats are being considered in the current fishery reform process, noting trawl fishing effort is a key driver of ecological risk.[952,953]

Boat ramps, including this one at Yorkey's Knob, Cairns, provide recreational fishers access to the Region.

Legislative adjustments have been made regarding hammerhead sharks, in recognition of declines in some species.[954,955,956,957,958,959] New Queensland fisheries regulations came into effect on 1 January 2018 to strengthen the management controls around hammerhead sharks. When the scalloped hammerhead became listed as 'conservation dependent' under Commonwealth legislation in March 2018, the Marine Park regulations were amended to recognise this listing and enable management consistency and continued take.[954]

Concerns remain regarding some aspects of current fisheries management. For example, current management arrangements for the Coral Reef Finfish Fishery do not enable responses to changes in species status at a stock level or regional scale. There is no independent validation of fishers' logbook reporting, following cessation of the independent fishery observer program (for all fisheries) in 2013.[960] It is also recognised that the fishery's current 'other species' category does not adequately constrain harvest of species considered to be at high risk, including red emperor and saddle-tail snapper.[921,961] Historically, monitoring of these species, including fishery discards, has not been strong. However, recent commitments[962] have included initiation of improvements to biological monitoring for a number of fishes within the 'other species' category.

While fishing practices and management continue to improve, ensuring ecological sustainability is critical. As outlined above, information remains limited in some areas and sustainability concerns exist for some species. Of major significance since the 2014 Outlook Report is the development of the *Queensland Sustainable Fisheries Strategy 2017–2027.*[892] Work towards implementing the strategy has commenced with actions identified across 10 reform areas (Box 6).

BOX 6

Queensland Sustainable Fisheries Strategy 2017–2027

In June 2017, the Queensland Government released the *Sustainable Fisheries Strategy 2017–2027*[892], paving the way for Queensland to have a world-class fisheries management system that makes sure fish stocks are healthy and supports Queensland jobs. The strategy identifies 10 areas for reform and commits to a range of important initiatives, including:

- setting a target of 60 per cent virgin biomass for all stocks by 2027 — a critically important contribution to a healthy marine ecosystem and ecologically resilient Great Barrier Reef
- installing vessel-tracking units on all commercial boats by 2020, with a priority to have them on net, line and crab boats by the end of 2018 (Section 5.4.3 Box 7)
- developing a harvest strategy for each specific fishery — these (and future ecological risk assessments) should explicitly consider and respond to all high risks relating to fishing, particularly the very high risk of incidental catch of species of conservation concern identified by the 2014 and current Outlook Reports
- modernising Queensland's fisheries laws, including introducing stronger compliance powers and penalties for serious offences, such as seafood black-marketing
- boosting engagement and field presence — achievements so far include establishing new fishery working groups and an expert panel, employing 20 new compliance officers and reopening the Queensland Boating and Fisheries Patrol office in Gladstone
- rolling out new biological monitoring and implementing of a data validation plan that aims to improve commercial and charter logbook information.

Ensuring fisheries are ecologically sustainable is important for maintaining a healthy and resilient Great Barrier Reef. The Queensland Department of Agriculture and Fisheries will continue to publish regular progress reports on the Sustainable Fisheries Strategy.[892,963,964]

5.4.2 Benefits of fishing

Fishing is important socially and economically

Commercial fishing is an important source of income for Queensland coastal communities and plays a vital role in Australia's seafood industry.[846] In 2015–16, the total value of commercial fishing in the Region was estimated to be $104 million.[846] In 2015–16, the Region's commercial fishing, together with the land-based aquaculture industry, value-added an estimated $162 million to the national economy and generated the equivalent of 814 full-time jobs Australia-wide.[846]

The gross value product forecast for Queensland-wide commercial and recreational fisheries combined for 2018–19 is $275 million ($181 and $94 million, respectively).[965] The commercial and recreational fishing figures are three and five per cent greater, respectively, than the average for the previous five years. Inshore fisheries are believed to produce economic benefits to local communities beyond their immediate gross value product.[966] Concurrent implementation of no-take zones and fisheries harvest controls, including reduced effort, have enhanced the benefits to both fish populations and fisheries. For example, commercial fisheries' catch data and population biomass observations for coral trout indicate the species responded positively following important management changes in 2004 (Section 8.3.4).[967]

Commercial fishers continue to have a high attachment to their industry and most have been involved for more than 30 years. Commercial fishers' level of optimism about their business in the Reef was higher in 2017 than 2013.[968] Generally, fishers rely heavily on the industry, with most receiving about 65 per cent of their income from the Region.[969] Commercial fishers have high personal connection to the Reef and state they have strong appreciation for the biodiversity, aesthetic and lifestyle benefits it provides. They consider they would be personally affected if the Reef's health declined.[969]

Fishing is one of the most popular recreational pastimes in the Region, generating somewhere between $70 and $311 million in expenditure on recreational fishing and related equipment in 2015–16.[846] People enjoy recreational fishing for the opportunity to catch fresh local seafood and for appreciating the Region's natural beauty, wildlife watching, outdoor physical activity, relaxation, and spending time with family and friends.[970] Recreational fishers also identify environmental and wellbeing benefits, including fostering respect and connection with the environment, understanding food sources, building relationships, and enhancing community cohesion.[970] In terms of appreciation of lifestyle, biodiversity and aesthetics, and pride in its World Heritage Area status, local residents (including recreational fishers) show higher levels of dependency on the Reef than commercial fishers and tourism operators.[969]

Recreational fisher with a bar-cheeked coral trout. © *Henriette van den Heever 2016*

5.4.3 Impacts of fishing

Fishing removes biomass from the Region and, when harvest is not conducted in an ecologically sustainable way, it can affect the abundance of targeted species locally and at a population level. Declines in populations of culturally-significant species affected by fishing can have flow-on implications for the Region's Indigenous heritage values (Section 4.3), such as cultural practices, observances, lore, stories, songlines and sites.[971] The status of some targeted species is cause for community and scientific concerns.[909,911,933,972]

Illegal fishing continues to add pressure to an already deteriorating system

Predators, such as coral trout, emperors, mackerel and sharks make up about 40 per cent of the total commercial retained catch (Figure 5.13) and the majority of the recreational fishing catch.[883] Reductions in predator populations can have long-term effects on marine systems, including direct and indirect effects on the food chain[176,605] (Section 3.4.5). For example, predator abundance and behaviour changes can alter food webs and result in flow-on effects for herbivore populations that moderate algal cover on coral reefs.[607,973,974]

Some predatory species are subject to considerable fishing effort and data limitations hamper some fisheries assessments. The Queensland component of the east coast stock of Australian snapper is considered depleted as are pearl perch.[911,913,917] Black jewfish have been subjected to significantly increased levels of harvest in recent years because of the high value of their swim bladders.[975] This predatory species is vulnerable to overfishing if catch limits are not in place. Also of concern, the stock status for cobia and mangrove jack were downgraded in 2017 from sustainably fished to undefined. Approximately 40 per cent of the more than 60 Queensland east coast fisheries resources that have been assessed are currently classified as undefined, including commercially and recreationally important jewfish, barred javelin and some emperors.[895]

Some sharks and rays are at higher risk from fishing than others.[147,288,297,906,951,952] The 2015 stock assessment of whaler and hammerhead sharks in Queensland found the quota and catch rates of these sharks were sustainable.[976] However, the 2015 stock assessment remains uncertain due to data limitations around species composition and discards.[977] Sharks and rays are discarded in the trawl fishery, but mortality and health impacts are still a concern.[978,979,980,981] The equipment used in the Queensland shark control program extracts targeted sharks and also interacts with other species, including some species of conservation concern. From 2014 to 2017, 16 individuals of protected species, including two crocodiles, five marine turtles, six Queensland groper, two manta rays, and one dolphin, were incidentally caught on shark control program gear within the Region; 11 of these (68 per cent) were released alive.[885] Some species targeted under the program[982] are protected, including the white shark, longfin mako, shortfin mako, school shark and silky whaler.[983] Some of these species have not been caught in the Region since the early 2000s, and others may be unlikely to be caught due to their pelagic nature.[937]

Particle feeders (such as prawns and scallops) account for over half of the weight of the total retained commercial catch across the Region's four main fishery types (Figure 5.13). Overharvesting can cause population declines. Potential flow-on effects of extraction include damage to other particle feeders, such as sponges, and changes to other ecosystem processes (for example, to predation through changed feeding opportunities).[176] The 2012 ecological risk assessment for the East Coast Otter Trawl Fishery assessed trawling as generally low risk for non-target particle feeders at the Reef scale.[176]

In addition to extracting retained catch, fishing also causes death, injury and stress of **discarded species**. For example, post-trawl survival analysis for two small elasmobranch (shark and ray) species caught incidentally in the Region's prawn fisheries found lowered survival with increased time on deck and differences in capture and release resilience.[979] Preliminary analysis for the Region in the 2009 Outlook Report suggested non-retained catch (discards and bycatch) by commercial fisheries is likely to be significantly higher than the retained catch, with the trawl fishery responsible for most of the non-retained catch.[1] Discards from the Queensland East Coast Otter Trawl Fishery declined by around one third between 1988 and 2014. However, this decrease was primarily due to concurrent reductions in fishing effort over this period.[951] Knowledge about the amount of non-retained commercial catch in the Reef has not improved and uncertainty remains high.

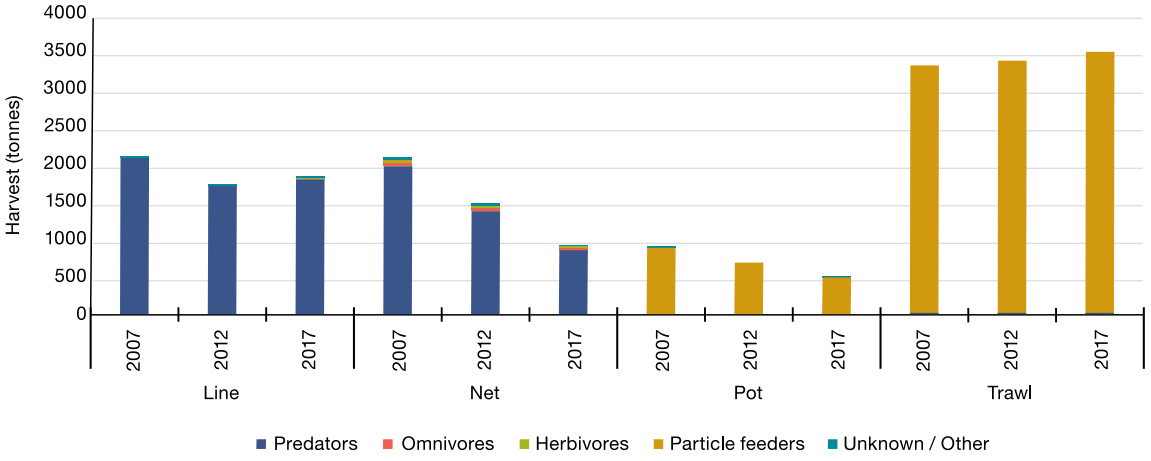


Figure 5.13 Ecological groups retained by major commercial fisheries in the Great Barrier Reef in 2007, 2012 and 2017
Predators and particle feeders make up the majority of the harvest retained by commercial fishing in the Region. Particle feeders includes species that are primarily filter feeders, detritivores and scavengers. Data are for commercial retained catch only. Discarded catch and bycatch are not included. Source: Department of Agriculture and Fisheries (Qld) 2019[885]

Table 5.4 Estimated proportion of marine species catch released by recreational fishers in Queensland over a 12-month period

Catch was recorded between 1 November 2013 and 31 October 2014. Source: Department of Agriculture and Fisheries (Qld) 2015[883]

Proportion of catch released (per species)			
0–25 %	**25–50 %**	**51–75 %**	**76–100 %**
• Garfish • Herring and pilchard • Mullet • Prawn • Yabby (marine)	• Cobia • Coral trout • Finfish (other) • Mackerel • Parrotfish • Tailor • Threadfin and Australian salmon • Whiting	• Bream • Emperor • Flathead • Javelin • Jewfish • Pearl perch • Pike • Morwong and sweetlip • Snapper • Trevally and amberjack • Tropical snapper and sea perch • Wrasse	• Barramundi • Catfish • Cod and Queensland grouper • Crab • Shark and ray • Non-fish (marine reptiles)

Recreational fishers generally release a significant proportion of their catch due to catch-and-release practices or the catch being undesirable, too small or outside the legal size limit. For a large number of species, more than half of the catch is released (Table 5.4). Sharks and rays are not generally targeted by recreational fishers; an estimated 90 per cent are released because they are unwanted.[883] Catch-and-release practices presume the fish is likely to resume normal behaviour and survive.[984] However, stress or injury from fishing interactions can lead to post-release mortality and behavioural impairments can increase the released fish's susceptibility to predation.[985] Recreational fishing can be a significant pressure on coastal fish stocks, with recreational harvest exceeding commercial harvest for some species.[883,986]

Incidental capture, entanglement and death of **species of conservation concern** as a result of commercial fishing continues to have a major ecological impact on the Region's values. It is important to consider the interactions additively across multiple fisheries.[340] For species of conservation concern, such as inshore dolphins, dugongs, sawfishes and some marine turtles, loss of even small numbers of individuals may have a substantial effect on population status, resilience and rate of recovery from past impacts.[292,308,401,404,987] Despite mandatory reporting of these incidents, many interactions go unreported, so the magnitude of the impact is underestimated.[988]

Fish **spawning aggregations** are recognised as a natural phenomenon that contributes to the Reef's outstanding universal value.[307] They are protected to some extent by the current zoning arrangements. However, other than for barramundi, spawning aggregations of inshore species (for example, golden snapper and black jewfish) are not protected by seasonal closure periods. Loss of fish spawning aggregations leads to declines in fish populations through reduced recruitment, with negative ecological consequences.[989]

Physical damage to the seabed and reef habitats occurs as a result of some fishing activities. Line fishing gear can cause direct physical damage to live coral tissue and coral colonies, and contribute to increased coral disease.[990] Physical damage to reefs and shoals can be caused by the grounding (and in some cases sinking) of commercial and recreational fishing vessels in the Region (Figure 5.18). Use of electric outboard motors with automatic positioning system capability (an alternative to physical anchoring) in the commercial and recreational fishing sectors is estimated to have risen since 2014, based on anecdotal reports. Trawling has physical impacts on habitats in the Region and can remove or damage seabed plants and animals. While risk for seabed biodiversity has been reduced by trawl management actions[114], some concerns remain. For example, an area in the southern Reef has been identified as being among the national hotspots for risk from trawling and is the area at highest potential risk within the Region.[110,894] High trawling effort levels and a poor understanding of the habitat in this area contribute to the risk. At-risk long-lived deep-water elasmobranch species are known to occur in this area, and to be taken and killed in trawl bycatch.[147] Further information on the risk to these species is needed.[147] The impacts of trawling on upper continental slope habitats must also be better understood.

Discarded fishing line and loss of fishing gear contributes to **marine debris** (Section 6.5.1), causing entanglement and ingestion by marine species.[337,991]

Illegal recreational fishing in the Region is of increasing concern. The number of reported offences has averaged around 500 each year since 2012–13, with a trend of gradual increase to the 653 reported offences in 2017–18. Illegal recreational fishing accounts for approximately 55 per cent of the 1189 fishing and non-fishing possible offences reported in 2017–18.[868] The increasing trend in non-compliance reports may reflect improved surveillance efforts and technologies, such as new high-speed patrol vessels armed with technology for detection at night. Rate of change in recreational fishing effort (and therefore, likelihood of offences) is not well known, but is generally expected to correlate with population growth in the Catchment and long-term increases in recreational vessel registrations (Section 5.5.1).

Understanding of the spatial and behavioural patterns of fishers is growing, and indicates poaching is more likely to occur at some locations than others.[992,993,994] In 2017, 50 per cent of all reported poaching occurred in just ten no-take zones.[993] Similarly, over the period 2010 to 2018 most poaching in no-take zones was concentrated in just 20 per cent of those zones.[993] Reported offences tended to occur in no-take zones that also attracted high levels of legitimate activity, a finding that provides insight into the opportunity factors that increase the risk of poaching.[993]

While the majority of recreational fishers consider poaching to be personally and socially unacceptable[995], the use of different social survey techniques has found that between three and 18 per cent of recreational fishers will admit to having fished in no-take Marine Park zones during the past year.[992,996] In the Palm Island and Whitsundays areas, accumulation rates of derelict fishing gear entangled on reefs suggests some no-take zones are subject to levels of fishing pressure similar to those in areas legally open to fishing.[992] Even low levels of poaching can have substantial impacts on fish populations and ecosystem health.[297,997]

The number of **commercial fishing offences** in the Region has fluctuated but shows a declining trend over recent years — from almost 100 reported in 2014–15 to around 40 in 2017–18. Commercial line fishing offences, including fishing dories unattached from their primary vessel in no-take zones, were the most frequent non-compliant activity over that period (despite considerable variability between years). Offences in other commercial fisheries are generally less frequent and include illegal activity in the net, trawl, crab, lobster and coral fisheries. Some commercial and recreational fishers employ counter-surveillance tactics to avoid detection of their illegal activity. Therefore, the actual extent of illegal fishing by both sectors is considered to be much greater than the number of detected offences suggest. The expansion of commercial fishing vessel tracking under the *Queensland Sustainable Fishing Strategy 2017–2027* to include line, net and crab fisheries from 1 January 2019 and all fisheries by the end of 2020 (Box 7) is expected to substantially improve commercial fishing compliance rates and the efficiency and efficacy of the multi-agency surveillance program.

BOX 7

Expanding use of vessel tracking technology in fisheries management

No-take zones offer a range of benefits (Section 7.3.3 Box 11), including rebuilding of depleted fish populations[998] and faster recovery of fish and coral communities following cyclones and coral bleaching.[756] However, many commercial, charter and recreational fishers continue to operate in contravention of the *Great Barrier Reef Zoning Plan 2003 (*for example, fishing illegally). Given cumulative pressures are affecting the Reef's resilience, the benefits of protecting no-take zones by enhancing compliance are now more important than ever.

Electronic vessel tracking (also known as vessel monitoring systems or VMS) has been widely adopted in Australia and around the world, and is used very successfully as a means to monitor commercial fishing vessel activity. The vessel tracking units fitted to vessels transmit regular positional information via a satellite network to a computer system. The positional information can then be displayed and analysed.

Vessel tracking became mandatory in the Queensland East Coast Otter Trawl fishery in 2001. Monitoring and analysis of vessel tracking data led to a number of successful prosecutions and significantly reduced the number of instances of vessels fishing within no-take zones. The *Queensland Sustainable Fisheries Strategy 2017–2027* was released in June 2017. Its reform commitments included an expansion of vessel tracking to all commercial fisheries by 2020, including installing vessel tracking units in the net, line and crab fisheries (including tenders and dories) by the end of 2018.[892] Implementing this component of the strategy led to a legal requirement for vessel tracking in these fisheries coming into effect on 1 January 2019.[999] Improved compliance with Marine Park zoning is expected as a result.

5.5 Recreation (not including fishing)

5.5.1 Current condition and trends of recreation

The Reef is vital to the wellbeing of Queensland's coastal communities[1000,1001] and an important contributor to the wellbeing of other Australians[843] and the broader international community. Aside from commercial operations and tourism, people use the Region for a wide range of recreational activities, including relaxation, stress reduction through access to natural settings, and exercise through snorkelling, boating and diving (Figure 5.14). The benefits recreational users derive from the Region are a critical part of their lifestyle and, as a result, many local residents are attached to, and depend on, the Reef.[783,851]

Recreational use continues to grow in the Region

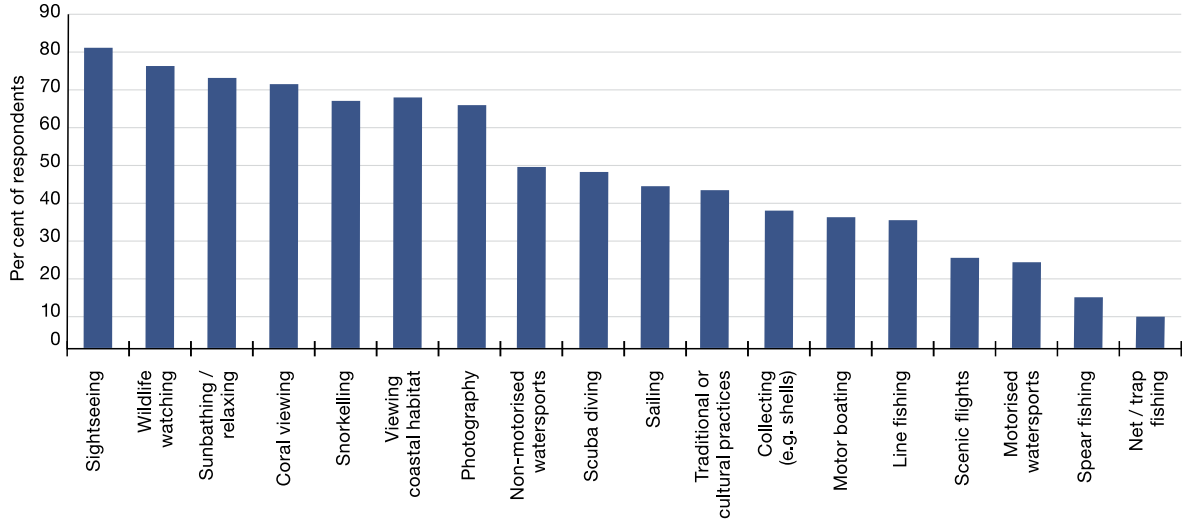


Figure 5.14 The most important activities contributing to coastal residents' use and enjoyment of the Region
Responses from 1933 residents. Activities were not rated exclusively. Source: Marshall *et al.* 2019[785]

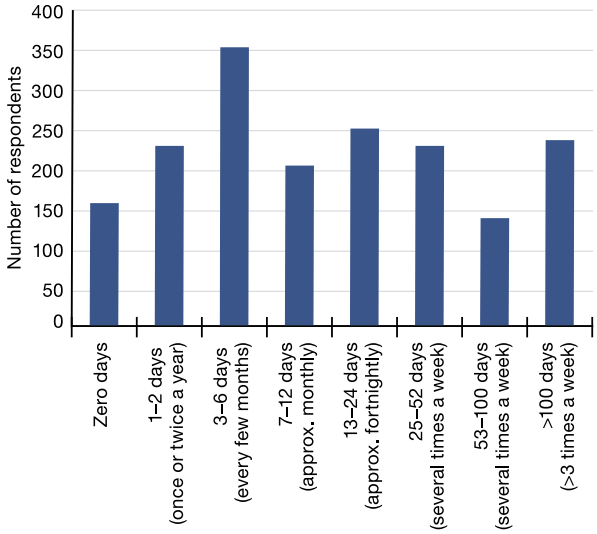


Figure 5.15 Number of days residents visited the Reef in a 12-month period
Responses from 1933 residents. Source: Marshall *et al.* 2019[785]

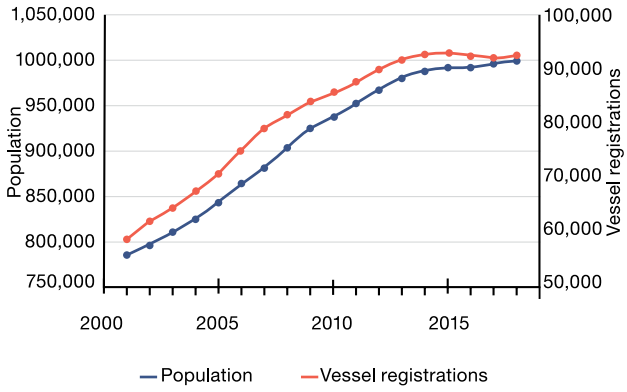


Figure 5.16 Number of recreational vessels registered and population in the Catchment, 2001–2018
Source: Department of Transport and Main Roads (Qld) 2018[1004], Queensland Government Statistician's Office 2018[1005], adopted from Hughes *et al.* 2015[1006]

The Reef is an extremely well-accessed resource. Local residents spend a significant portion of their leisure time along the Reef coastline, primarily along its beaches.[785] In 2013, over 40 per cent of local residents (from 3181 residents surveyed) indicated that they lived in the Catchment because of the Reef.[851]

Residents of the Region spend from one to more than 100 days on the Reef per year, with short multi-day trips being the most common (Figure 5.15).[785] People mostly travel less than 10 kilometres from land to access the Reef (39 per cent), while 32 per cent of people travel 10–50 kilometres.[785] Residents have high aspirations to protect the Reef and would like to do more to protect it (such as improving water quality). But they felt their capacity to do so was low to moderate because they lacked the necessary knowledge, skills, time and/or opportunity.[785]

Infrastructure supports managed recreational access to islands in the Region.
© Matt Curnock

Population growth and economic development will increase the demand for recreational activities within the Region (Section 6.2).[1002] The Queensland coastal population is growing rapidly, with the state population expected to nearly double from 4.7 million (in 2015) to 8.2 million by 2050.[1003] The number of recreational vessel registrations in 2014–2018 is the highest recorded (Figure 5.16).

Management A number of Australian and Queensland government agencies are responsible for managing recreational use. Recreational use (not including fishing) is one of the major direct uses in the Region.[1007] Recreational activities can be undertaken in almost all parts of the Region; exceptions are the Preservation Zones (which cover less than two per cent of the Marine Park), and Restricted Access Areas.

The Zoning Plan and plans of management (for the Cairns, Hinchinbrook and Whitsundays areas) help to manage multiple uses. These management tools aim to protect the environment while providing for a range of uses, particularly in high-use areas. The plans of management cap the number of tourism operations and define maximum group and vessel sizes at specific locations, and where motorised water-sports can take place. These approaches were developed in part to better provide for recreational use in these areas.

Since 2014, management initiatives have increased the number of reef protection markers (which show no-anchoring areas) and public access moorings in the Region (Figure 5.17). These management initiatives continue to protect coral communities under threat from recreational boating damage by raising awareness and influencing the distribution of recreational activities within the Region.

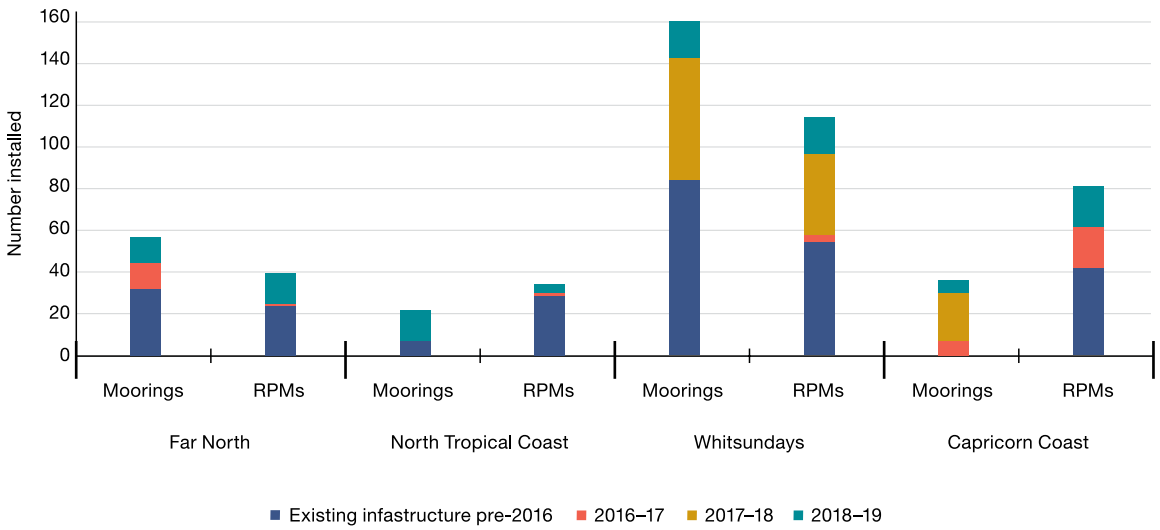


Figure 5.17 Investment in reef protection markers (RPMs) and public moorings within the Region, 2016–17 to 2018–19
Source: Queensland Parks and Wildlife Service 2019[1008]

In 2017, local residents were moderately confident in, and supportive of, Reef management approaches (48 per cent). They were also generally supportive of the rules, regulations and governance in place[785], although less so than in 2013.[1009] Only 24 per cent of local residents in 2017 believed that enough was being done to effectively manage the Reef.[785] Twenty-seven per cent of residents felt that they did not have fair access to the Reef compared with other user groups. Only about one third of residents felt that future generations had been adequately considered in the management of the Reef.[785]

5.5.2 Benefits of recreation

Residents feel the Reef contributes to their quality of life and wellbeing

The Reef provides constantly evolving opportunities for people to engage with it. This allows them to develop a sense of identity based on living within the Region, pride in the World Heritage Area and an appreciation of its outstanding natural beauty and biodiversity. The recreational and lifestyle opportunities provided, mean that people develop a distinct culture that depends on the Reef.[783] This cultural relationship defines who they are as a community and provides a day-to-day sense of meaning and feeling of belonging, which are critical for emotional and mental wellbeing.[852] Survey results suggest that the cultural value of the Reef has significantly increased for residents since 2013 despite the loss of corals from climate change.[1009]

Recreational activities support an active way of life and wellbeing.
© Ross Miller 2019

The Reef's outstanding universal value, encapsulated by its biophysical and natural heritage value, is one of the primary reasons why people visit the Reef for recreational purposes. As well as being a key part of people's identity in the Region and more broadly, as an Australian, the Reef is woven into the society of coastal communities and generates significant regional economic value.[783] Economic value of the Reef was the most important value identified by residents in 2017.[1009] Quantifying and monitoring recreational use of the Reef in terms of numbers of people and locations is difficult, although it was estimated that the Reef received 3.9 million visits in 2016.[846] Gaps remain in our understanding of trends and locations of recreational use in the Region.

In 2017, 81 per cent of residents stated that the Reef contributed to their quality of life and wellbeing, and the majority loved that they live beside the Reef. However, only 48 per cent were optimistic about its future.[785] Declines in Reef condition are interlinked with human wellbeing.[843,850,1010] Most users have a strong positive association with the Region believing that the Reef makes them feel better physically and/or mentally.[785] Conversely, depression and anxiety are feelings that have been linked to environmental decline.[1011] The Reef is highly valued by residents of the Region for its beauty, the seafood and lifestyle it provides, and by Traditional Owners for its rich Indigenous heritage and spiritual importance.

In 2015–16, recreational activities (including recreational fishing) was one of the prominent direct uses of the Region, generating $346 million (value-added) to the Australian economy, a 41 per cent increase on the $244 million (value-added) estimate for these activities in 2011–12 (Section 5.1 Table 5.2).[846] In Australia, recreational activities generated the equivalent of 3200 full-time jobs, approximately 20 per cent higher than the 2011–12 estimate of 2700.[846] The greatest contribution associated with recreational activity is attributed to expenditure on equipment, including the purchase of boats and repair of recreational equipment.

Recreational users contribute to the long-term protection and management of the Region's values by collecting valuable information on Reef condition, marine animals and incidents through programs, such as Eye on the Reef, Reef Guardians and the Strandings Hotline. These community-based programs are built to empower people to understand trends in condition and reduce threats to the Region. For example, more then 4000 people were involved in the marine debris project between 2014 and 2016.[316]

5.5.3 Impacts of recreation

Most recreational impacts are concentrated around major population centres

Few studies have investigated the impact of recreational uses (excluding fishing) on the Region, probably because it is not regulated by any permit system and recreational users can be transient. Recreational uses can affect the Reef through direct localised impacts, such as **anchor damage**, litter, vessel groundings, handling marine organisms (such as sea stars), **boat strikes** on marine organisms, **disturbance of shipwrecks** and other heritage sites, disturbance by personal drones of wildlife and human

enjoyment[1012], **damage to corals** from snorkelling and diving fins, and negative **interactions between different users** especially in relation to vessel, speed and noise (for example, jet skis).[785,1007,1013] Indirect impacts include encroachment of structures on the Region, such as those that provide access and facilities for recreational users (for example, boat ramps and moorings). Most impacts are minimal and concentrated around major population centres. However, given the sheer number of recreational users in the Region, the cumulative effect of many small impacts concentrated in certain areas can be significant.

Recreational activity in the Marine Park can be influenced by the state of the ecosystem, weather, water quality, access, socio-demographic factors, visual amenity, social interaction, and health and wellbeing of individuals.[843,1014] The current and future implications of climate change, poor water quality and coastal development on the values of the Reef are key sources of uncertainty and community concern.[843] In 2017, residents' knowledge of the current ecological predicament of the Reef was higher than in 2013, with residents' understanding of climate change increasing from 53 per cent in 2013 to 68 per cent in 2017.[1009]

Underwater reefscape view of diver on Patches 3 Reef.

Impacts from recreational users are predominantly managed by public education and public infrastructure, such as signage. Because of the vast size of the Marine Park, management focuses heavily on ensuring users are aware of the impacts of their activities, thereby fostering self-management. Providing information about threats caused by recreational activities, and how they can be managed, plays a major part in managing recreational use and encouraging stewardship through responsible reef practices. Well-known avenues for providing information include zoning maps, mobile phone apps and signage.

Recreational users may interrupt the connection Traditional Owners have to their sea country by **removing or damaging significant artefacts** or sites of cultural significance (whether intentional or unintentional).[1007] High recreational use in culturally significant areas can also displace Traditional Owners by preventing them from accessing these sites and practising their culture (Chapter 9).

Damage to the environment from tourism, commercial fishing and recreational vessels does occur in the Region due to accidental **groundings**, human error and severe weather. The number of incidents from tourism and recreational vessels are likely to rise with increasing visitation. From 2013 to 2018, recreational vessel groundings were more common than either tourism or commercial fishing vessel groundings (Figure 5.18). The spike in recreational vessel incidents in 2017 is probably due to cyclone Debbie resulting in vessels being washed up on nearby islands, fringing reefs and the coast. It is assumed that the number of incidents occurring in the Region are higher than what is reported to managing agencies.

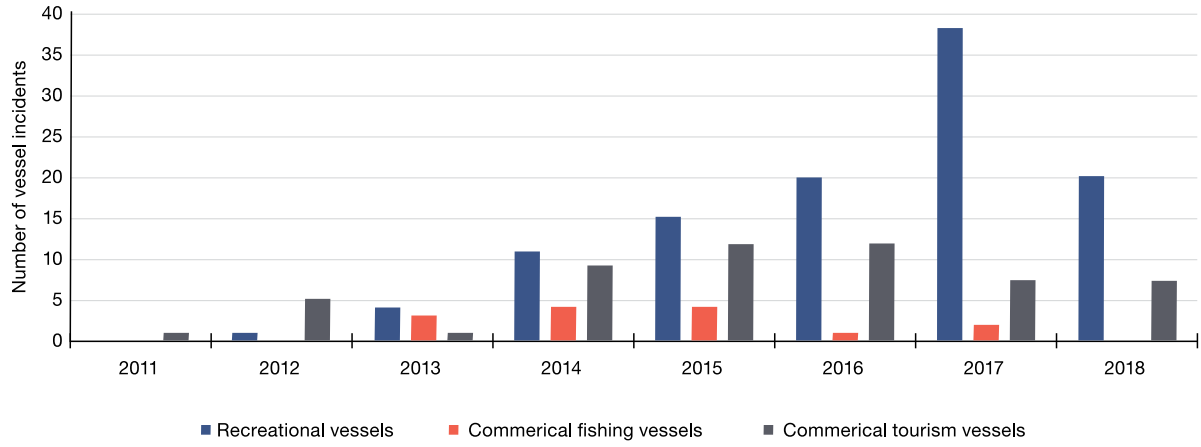


Figure 5.18 Number of groundings of recreational, commercial fishing and commercial tourism vessels in the Marine Park, 2011–2018
Recreational vessels include recreational yacht, sail and powerboats. Commercial fishing vessels include foreign fishing vessels. Commercial tourism vessels include tourist and charter vessels. It is unknown how many recreational vessels are active in the Region per day or year. These groundings are only a small proportion of the total vessels that operate in the Marine Park on any given day. Total vessel registration numbers for Queensland are shown in Figure 5.16. Source: GBRMPA 2019[1015]

The majority of vessel access to the Region is via public launch facilities (such as boat ramps) maintained by local and state governments. Construction and maintenance of launch facilities can directly affect the Region through clearing of coastal habitats, dredging and disposal (capital and maintenance). Encroachment of permanent human-made structures in the marine environment can also affect the aesthetic value of the area. Up-to-date data are lacking on the extent of this infrastructure (within or adjacent to the Region) and its impact on the Region. Infrastructure continues to be upgraded, and new infrastructure built, to keep up with demand for this ongoing direct use of the Region.

Introduced species, including weeds, marine pests or feral animals brought into the Region by recreational users, pose a threat to the Region (Section 3.6.3). For example, international yachts entering the Region are a high-risk vector. Other disturbances from recreational use include oil and chemical spills, sewage discharge and disturbance of wildlife, particularly on beaches and islands.[1007]

5.6 Research and educational activities

5.6.1 Current condition and trends of research and educational activities

The Region is highly valued for research and educational activities

The Reef is of strong scientific interest due to its high biological and ecological diversity, geomorphology, and Indigenous heritage value and social value. Scientific research has made, and continues to make, a critical contribution to the way the Region is understood, managed and used.[2,6,24]

Research on reef restoration and adaptation has increased rapidly since 2014 and will continue to grow. Interest has increased in undertaking localised pilot studies for restoration activities based on techniques used internationally.[1016] For example, some non-profit organisations and tourism operators are investing in coral nursery and propagation studies in an effort to help high-value tourism sites recover from tropical cyclone damage and recent mass coral bleaching events. The response of coral reefs to climate change has continued to be an important area of active research, its pertinence highlighted by the significant temperature-related damage to coral reef habitat across much of the Region in the summers of 2015–16 and 2016–17. It has generated new insights into the relationship between heat exposure, bleaching and coral mortality, as well as shifts in coral assemblages and the resilience of recruitment processes.[88,91,96,141,501]

A network of six island research stations located at Lizard Island, Low Isles, Green Island, Orpheus Island, Heron Island and One Tree Island continue to be integral to the conduct of research activities on the Reef. Scientific Research Zones around these stations are intended to provide areas for research and education, generally free from extractive activities of other users.

The majority of permitted educational activities are focused on learning about the natural and cultural values within the Marine Park and associated field research methodologies. These educational programs are generally based at the island research stations; more than 60 per cent of the education permits issued between July 2014 and March 2018 were for education classes visiting the Heron Island Research Station.[1017] Permitted educational activities also include courses for recreation or professional activities, such as sail training or occupational dive certification.[1018]

Management The Zoning Plan and the Marine Park regulations set out the way in which research and educational activities are managed. Limited impact research may be conducted by accredited research institutions in accordance with the zoning plan and the Marine Park regulations. All other research and educational activities are managed through permits issued jointly by the Marine Park Authority and the Queensland Parks and Wildlife Service.[1018] The *Guidelines for Managing Research in the Great Barrier Reef Marine Park*[1019] complement the statutory framework by providing further definitions, examples and best environmental practice guidance for researchers, particularly when conducting extractive research. Additional guidance (developed in the last few years) is provided by the *Guidelines: Permit applications for restoration/adaptation projects to improve resilience of habitats in the Great Barrier Reef Marine Park*.[24,1020]

Scientific monitoring and question-driven research for key processes, habitats, species and use patterns, particularly when maintained long-term, enable early detection of trends and changes in a range of the Reef's values and factors affecting them. The *Reef 2050 Integrated Monitoring and Reporting Program*[1021] is being developed to inform management of the Reef and to track the progress of the Australian and Queensland governments' long-term plan (Reef 2050 Plan) to protect the Reef (Section 7.4.3 and Section 10.3 Box 16). This initiative will help refine existing monitoring and research and improve adaptive management.

5.6.2 Benefits of research and educational activities

Research and monitoring of the Reef contribute to global knowledge about individual species, coral reef systems and tropical marine ecology. For example, research within the Region has contributed significantly to climate change science, including advancing understanding of the resilience and adaptation potential of habitats, species and human communities.[163,219,501,850,1022,1023,1024,1025] Improved understanding of the Region's values and how components interact and respond to changing conditions contributes to its protection and management.

Research underpins management of the Region and has economic, social and cultural benefits

Targeted and applied research provides information that helps managers assess the outcomes of various management initiatives, including the effectiveness and potential impacts of innovative reef intervention actions. A significant policy shift is being progressed in terms of increasing use of deliberate and pro-active intervention approaches to restoration and adaptation, rather than relying solely on supporting a resilient ecosystem and allowing natural recovery after disturbance.[24,1020] The first phase of a multi-agency reef restoration and adaptation research and development program, led by the Australian Institute of Marine Science, is underway.[1026] The program aims to investigate options to support the Reef using cost-effective and scalable prevention and repair interventions, including both engineering and biological approaches.

Knowledge derived from research related to the Region also supports management in many other ways, including advancing understanding of resilience components and cumulative impacts, refining modelling used to predict Reef processes (including hydrodynamics and biogeochemistry), and improving efficiency and effectiveness of crown-of-thorns starfish control measures.[88,423,757,758,1027,1028,1029,1030]

A range of academic institutions and government agencies undertake research on the Reef, providing income and employment in regional communities. A recent study suggested scientific research and Reef management was worth an estimated $182 million to the Australian economy in 2015–16.[846] This represents a doubling in both value-added economic contributions and full-time employment in this sector since 2011–12 (Section 5.1 Table 5.2).

5.6.3 Impacts of research and educational activities

Research and educational activities can affect ecosystem and heritage values. These impacts are generally minor or locally constrained, given current management arrangements. Little is known about the cumulative impacts of research and educational activities undertaken in the Region. The concentration of research and educational activities around research stations has the potential to locally deplete some species, **disturb wildlife** and cause some minor, localised **physical damage** to habitats. Over 70 per cent of all research permits granted between July 2014 and January 2018 include access to at least one of the Scientific Research Zones, with the majority of these programs basing their fieldwork at Lizard Island, Orpheus Island or Heron Island research station.[1017] Impacts are managed, in part, through the local management of research station directors. Directors have the mandate to influence the spread of activities in space and time so as to reduce conflicts and minimise local depletion. The Marine Park Authority's new online reporting portal has improved access to information on permitted research take (for example, numbers of specimens collected).

Research and educational activities are often concentrated around research stations

5.7 Ports

Twelve ports are located in the Region (Figure 5.20) and are within the World Heritage Area. Of these, only the ports of Cooktown and Quintell Beach in Cape York are located wholly within the Marine Park (Box 8). Port development can be described as in-water areas (maritime port infrastructure) or areas above low water mark (land-based port infrastructure). While port activities will continue to have localised adverse impacts on the marine environment, changes to the regulatory framework have reduced the potential for impacts from capital dredging and associated disposal of dredge material in the Region. These regulatory changes, in conjunction with a cooperative approach to managing the impacts of port development and changed market conditions, have seen a reduction in maritime port development activities (in-water areas) since 2014.

Ports form an integral part of the maritime supply chain supporting industries, trade and local communities. Maritime port infrastructure, including shipping lanes, channels and berths, are critical to the ongoing operation of many trade industries. In the same way that roads and rail must be maintained, the upkeep of maritime port infrastructure is essential for the efficient flow of trade.[1031]

BOX 8

What is a port?

The limits of the Region's 12 ports (Figure 5.20) are defined by the *Transport Infrastructure (Ports) Regulation 2016* (Qld). Multiple jurisdictions regulate port operations, making port governance complex. **Port exclusion areas** (operational areas) exclude port areas from the Great Barrier Reef Marine Park. Ten of the 12 ports (all except Cooktown and Quintell Beach) have exclusion areas. The operational areas of the priority ports are located outside the Commonwealth and state marine parks. The ports at Cape Flattery, Lucinda and Port Alma (Rockhampton) have small parts of their operational areas in the state marine park.

Port management involves inter-connected jurisdictions, each with their own definitions and key concepts. Four ports are **priority ports** under the *Sustainable Ports Development Act 2015* (Qld) (the Ports Act) — Gladstone, Mackay/Hay Point, Abbot Point and Townsville. The ports of Mackay and Hay Point are referred to as one priority port; the Port of Cairns is not a priority port but is considered under the Ports Act. The **major trading ports** are the ports of Gladstone, Mackay, Hay Point, Abbot Point, Townsville and Cairns. Smaller trading ports are community or **minor ports**.

5.7.1 Current condition and trends of ports

The current condition of ports is measured by the trend in port-related activities that influence the values of the Region (such as dredging and dredge material disposal and the location of that disposal) and the level of activity generated (trade throughput).

Dredging and disposal at ports has a long history, with dredging first occurring at Townsville and Cairns in the early 1880s.[1032] This activity remains an essential operational requirement at all ports in the Region[1033] and is undertaken in two forms: capital and maintenance dredging. Capital dredging creates new, or improves existing, channels and berths to accommodate increased traffic and larger ships (Section 5.8).[1034] In contrast, maintenance dredging involves removing the build-up of mainly fine sediments that accumulate in existing channels and berths.[1035] Once marine sediments are dredged, the material is either disposed of at sea in offshore disposal areas or beneficially reused (for example, in land reclamation, beach nourishment or restoration purposes).[1036]

The volume of sea disposal of capital dredge material across the ports in the World Heritage Area has reduced significantly since the last Outlook Report (Figure 5.19). In 2013, the annual combined capital and maintenance dredge material disposed of in the World Heritage Area was about 1.7 million cubic metres. At that time, a further 30+ million cubic metres was proposed for marine disposal.[2] However, limited sea disposal of capital dredge material has actually occurred since 2013. The average annual total for combined capital and maintenance dredging disposal in the World Heritage Area was 1.5 million cubic metres for 2013 to 2016.

All ports require maintenance dredging. However, some ports have greater maintenance dredging requirements as a result of local port characteristics (for example, a shallow harbour). The ports of Cairns and Townsville are both shallow harbours, and have higher levels of sedimentation due to natural sediment transportation and coastal storm events.[1034] Maintenance dredging across the Region was limited in 2015 and 2016; some maintenance dredging occurred in Cairns, Townsville and Gladstone between 2014 and 2017 (Figure 5.20).

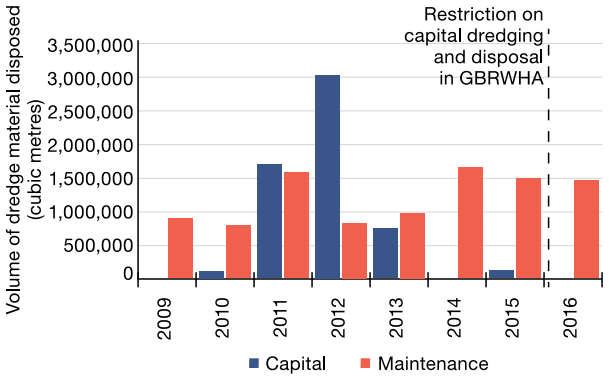
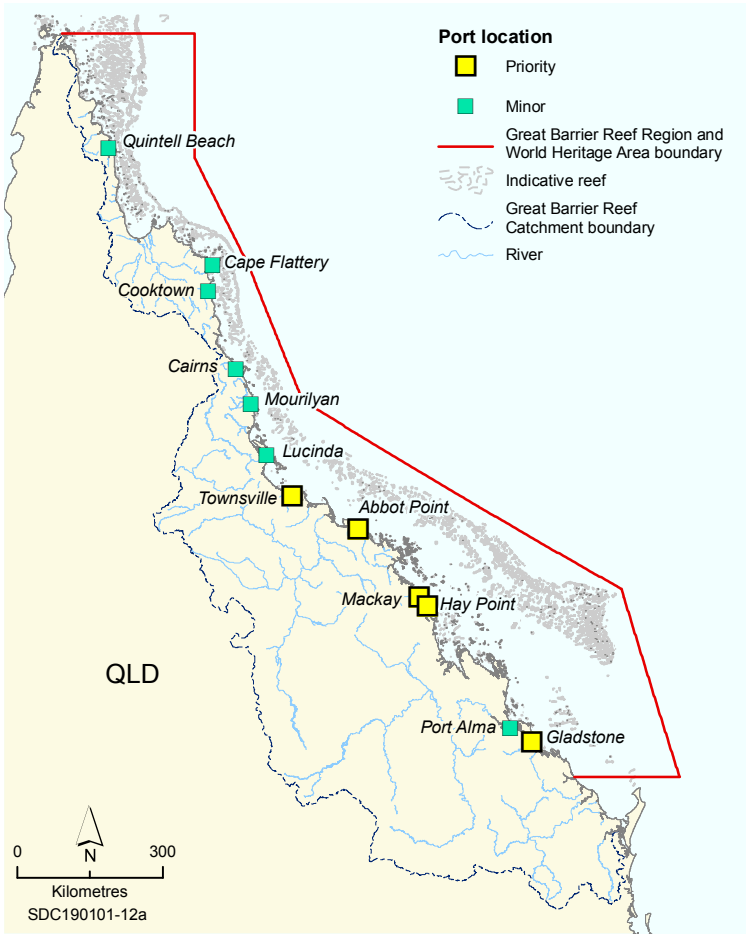


Figure 5.19 Dredge material disposal (capital and maintenance) in the Great Barrier Reef World Heritage Area, 2009 to 2016
The data shown include permitted works issued under the Environment Protection (Sea Dumping) Act 1981 (Cth) and do not include dredge campaigns in internal waters. Ports are the largest contributors; smaller volumes originate from other marine access facilities. Disposal within port limits (including port exclusion areas) is included. Commonwealth and Queensland regulatory changes in 2015 combined to impose restrictions on capital dredging and disposal in the World Heritage Area. The data inform annual reports to the International Maritime Organization[1037].
Source: Department of Environment and Energy 2018[1038]

Aerial view of the Port of Townsville and the Ross River.
© Matt Curnock 2019



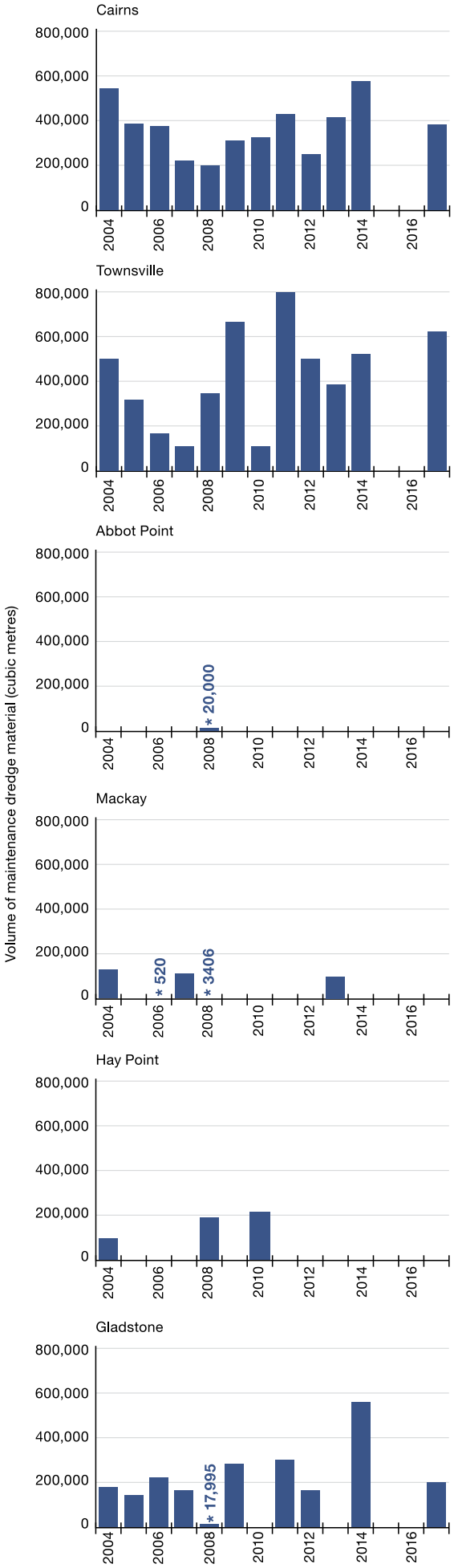


Figure 5.20 Maintenance dredge volumes in the Great Barrier Reef World Heritage Area, 2004 to 2017

The map shows the 12 ports in the Region. The graphs show volumes of material dredged for maintenance purposes at the six major trading ports. Asterisks with numbers are used to show data when bars are small and difficult to discern. Source: Department of Transport and Main Roads 2018[1034], Queensland Ports Association 2017[1039] and 2018[1040]

Port of Townsville receiving a ship for unloading. © GBRMPA

Approved sea disposal areas (or dredge material placement areas) offshore from ports in the Region cover approximately 66 square kilometres (or less than 0.02 per cent of the Region). About half of these areas are in the Marine Park (that is, adjacent to the ports of Cooktown, Cairns, Abbot Point and Hay Point) and include sea disposal areas located near the marine access facilities at Port Douglas and Rosslyn Bay. Since 2014, only maintenance dredge material has been relocated to these sea disposal areas. While some data are available (mainly in reports associated with statutory environmental impact assessments), condition and trend data on the retentive capacity and impacts on adjacent habitats are not collected and collated across all ports in the Region.

Since 2014, sea disposal of capital dredge material has been reduced

Land reclamation occurs when an area is restricted from tidal influence and converted into land above the high water mark. While land reclamation has occurred in the Region since European settlement for port and other purposes, the extent is difficult to quantify. A reclamation area can be filled with dredged material or other fill. It is not known how much dredge material from the Region's 12 ports has been disposed on land or used beneficially (for beach nourishment or environmental restoration purposes) since 2014.

Management Before 2014, port development and operations in the Region were in the national and international spotlight, with the UNESCO World Heritage Committee recommending threats from ports be avoided by prohibiting development within and adjoining the World Heritage Area.[1041] Significant management changes have since taken place, and the effectiveness of these changes is addressed in Chapter 7. In June 2015, the Marine Park regulations were amended to prohibit sea disposal (greater than 15,000 cubic metres) of capital dredge material in the Marine Park. Also, in November 2015, the Queensland Government enacted the *Sustainable Ports Development Act 2015* (Qld) (the Ports Act) to provide for the protection of the World Heritage Area through managing port-related development in and adjacent to the area.[1041,1042] The Ports Act applies to all 12 ports in the Region; it prohibits sea disposal of capital dredge material and restricts capital dredging in the World Heritage Area, subject to exceptions.

Priority port master planning is also a substantial management initiative under the Ports Act. The master plan for the Port of Gladstone was the first to be released in late 2018. It provides strategic direction for future development, including widening and deepening of shipping channels.[1043] The Port of Townsville released its draft master plan in late 2018.[1044] In 2016, the Queensland Government adopted the *Maintenance Dredging Strategy for Great Barrier Reef World Heritage Area Ports*[1034], which sets out a framework to monitor maintenance dredging and disposal volumes at all ports.

Regulatory controls provide avoidance and mitigation measures to reduce the scale of impacts from dredging, disposal and sedimentation. Managers also apply mitigation measures, such as environmental windows (periods of go-slow or, in some cases, no dredging).[1045] Such measures aim to minimise impacts during periods of coral spawning, seagrass recruitment[1046], and turtle breeding, and immediately following severe weather events.[1034,1047]

5.7.2 Benefits of ports

Ports provide critical support services and help maintain and grow the economy. Ports enable the export of agricultural and mineral commodities and the import of goods, such as fuel, cars and household items that support regional communities. Combined trade throughput at the priority ports in the Region (Townsville, Abbot Point, Hay Point/Mackay and Gladstone) exceeded 262 million tonnes in 2016–17. This trade represents a 3.4 per cent decrease from the previous year.[1048] The Port of Gladstone experienced steady growth since 2014 (3.6 per cent), exceeding 120 million tonnes of total trade throughput in 2016–17. In the same period, the steepest decline in total trade throughput was observed at the Port of Townsville (about 25 per cent reduction).

Combined trade throughput at the priority ports exceeded 262 million tonnes in 2016–17

Historical growth in throughput and marine access at ports (including cruise ships and defence vessels) helped drive the Queensland economy and led to the development and growth of adjacent towns. This growth has increased the demand for goods, employment and infrastructure to service the expanding population.[1049] While comprehensive data on direct and indirect employment across all ports in the Region are not available, in 2016–17 it was estimated that the priority ports generated employment of 960 full-time equivalent jobs. This number represents a 0.6 per cent increase from the previous year.[1048,1050]

James Cook University's Seagrass Ecology Group at Abbot Point conducting annual seagrass monitoring funded by North Queensland Bulk Ports. © JCU Seagrass Ecology Group, Cairns

A further indicator of the economic stimulus generated by ports is the scale of capital works they undertake. Across the priority ports since 2014, such works include:

- Townsville — construction of the $40.7 million Berth 4 upgrade project, completed in early 2018[1051]
- Gladstone — completion of the $29.5 million Stage 1A East Shores precinct in 2014, with Stage 1B expected to begin in 2019.[1052]

Ports sustain jobs indirectly through ongoing industrialisation and commerce in their local communities, sometimes reaching well beyond the local area of the port. Between 2011 and 2016, the greatest population increases adjacent to priority ports were in Townsville and Gladstone, which grew by about seven and four per cent, respectively.[1053,1054] Economic prosperity in the catchments' surrounding ports has driven the development of other support infrastructure, such as railways, roads and power networks.

The contribution made by ports towards long-term monitoring programs for seagrass, coral, benthic communities and water quality, provides a benefit by expanding the scientific knowledge of the Region. Recognition and partnerships with Traditional Owners has also improved in some locations.[1055]

5.7.3 Impacts of ports

The operation and expansion of ports exert a mix of pressures on the environment.[1056] These pressures range from direct removal of habitat (by dredging the seafloor) through to indirect environmental impacts, such as intermittent noise pollution (from a concentration of ships, dredging, pile driving or constructing revetment walls). Dust, cargo and pollutant spills, and light pollution from port infrastructure can all affect the marine environment and are monitored and managed within port areas.

Impacts from ports are generally localised

Dredging activities (**dredging** and **disposal of dredge material**) affect the values of the Region. Disposal of capital dredge material at sea is an activity with potential to harm the marine environment.[1032] However, regulatory changes since 2014 have reduced current direct threats associated with this activity (Sections 5.7 and 7.3.4). Limited capital dredging may still be permitted at priority ports in some circumstances, and small-scale capital dredge disposal (up to 15,000 cubic metres) can be dumped in the Region.[1057] Further, sea disposal of maintenance dredge material and reclamation remain activities that can be permitted.

The intensity of impacts from dredging and disposal are affected by: the type of dredging undertaken (capital or maintenance); the volume of material dredged or dumped; local sediment and benthic characteristics (such as the depth of the harbour); prevailing winds and currents; extreme weather events; and the configuration of port infrastructure. These characteristics can influence the spatial and temporal scale of the impacts. Understanding how these factors interact is key to managing the impacts of maritime port development.

Increased suspended sediment concentrations from dredging activities can have broad impacts: increased turbidity may smother organisms that live on the bottom (such as corals[1058,1059] and seagrasses[60,517]) and reduce light availability.[1060,1061] The effects on mobile species in the marine environment from increased turbidity and reduced light is an ongoing concern.[1047,1062,1063] These effects can occur as a result of active dredging, and also because of natural resuspension of existing sediments over time, which can affect adjacent habitats and species.[1061] In combination, consideration of local environmental conditions[1064], regulations and mitigation measures are intended to reduce the magnitude of impacts from dredging and disposal activities.

In some locations, sea disposal is more viable than land-based disposal.[1065,1066] Factors that contribute to the viability of a dredge material placement area include local hydrodynamics, the retentive nature of the marine environment, distance from sensitive areas, jurisdiction and cost-benefit considerations.[1067] Because sea disposal sites are situated in the active coastal sedimentary system, the material will gradually reassimilate.[1035]

Impacts from dredging are estimated to be localised, with contemporary modelling in Australia suggesting dredge-related turbidity and associated impacts may be restricted to within 0.5 to five kilometres of a dredging site.[1061,1068] Until recently, it has been difficult to identify the origins of suspended sediments present in the Region, such as distinguishing sediments from dredging activities and river inflows (Section 3.2.4)[43,467,473] from background sediments and the influence of local hydrodynamics[1046,1068,1069]. Understanding the relationship is an expanding field.[1035,1070]

Reclamation and land-based disposal are alternatives to sea disposal of dredge material. Environmental impacts will, in the main, be transferred from the marine ecosystem to the land or adjacent waters, or the Catchment. The impacts on the marine environment from land-based disposal of dredge material can be more readily managed, observed and mitigated than the impacts of easily dispersed sediment in the water column.[1032,1065,1071] Associated impacts on intertidal and coastal ecosystems above low water mark are assessed in Section 3.5. Weighing up the degree of impacts from each type of disposal method requires a site-specific assessment.[1070,1071,1072] Land-based disposal is often not the preferred option for disposing of dredge material from port development for a range of reasons. For example the sediment from maintenance dredging is generally too fine or poor in quality for the construction of

land.[1032,1067,1073] Fine dredged sediments can also remain highly unstable when on land, potentially re-entering waterways through run-off and seepage through armour walls.[1032,1065,1074] The total extent of reclamation (legacy and current) and land-based disposal across the Region, remains a knowledge gap.

Curtis Island, Port of Gladstone. © Aerial Media Gladstone 2019

Other impacts, such as heavy metal **contamination**[1075], marine debris and impacts on the Region's aesthetic values can also result from port operations and associated shipping (Section 5.8). Coal and coal seam gas exports have historically been and remain the largest driver of port expansion in the Region. Direct impacts continue to occur from coal dust contamination, which escapes as coal is transferred between train and ship, and large coal rocks dislodged from ships during adverse weather. Hydrocarbon markers from coal have been identified up to 180 metres offshore from Mackay,[1076] with concentrations of coal dust higher in inshore sediments and decreasing offshore.[1075,1077] Coal particles have the potential to affect corals, fishes and seagrasses through light limitation, direct smothering and reduced feeding efficiency.[1078,1079] However, some knowledge gaps remain regarding the effects of coal contamination on marine organisms *in situ*.

Noise pollution can be created by various port activities above and below water. Since 2014, observations have demonstrated that juvenile fishes may suffer lethal impacts from noise pollution associated with port activities, such as pile driving.[1047] **Light pollution** produced by port infrastructure, shipping (Section 5.8), marine tourism (Section 5.2) and coastal development (including island resorts; Section 6.4) can interrupt the navigation ability of marine species and influence ecological processes, such as predation and recruitment.[1080] For example, bright lights can disrupt the sea-finding ability of turtle hatchlings[1081], with glow from port infrastructure on Curtis Island (near Gladstone)[327] potentially affecting turtles some 15 kilometres away.[1081]

Ports are an established use of the Region and, as with any other use, their presence and ongoing operation continue to pose a range of threats to habitats and species. Some impacts associated with the operation of the 12 ports in the Region have been reduced since 2009, while others persist. Of the impacts that remain, some could not be mitigated even with significant additional intervention (for example, effects on aesthetic values or permanent removal of intertidal and inshore marine habitats).

5.8 Shipping

5.8.1 Current condition and trends of shipping

In this report, shipping includes vessels greater than 50 metres in overall length, including cruise ships and large recreational or commercial superyachts. Shipping also includes vessels carrying specialised product regardless of length (for example, oil tankers and chemical or liquefied gas carriers). While cruise ships are a commercial marine tourism use, their size and management are more aligned to shipping in this chapter than commercial marine tourism (Section 5.2). Shipping within Torres Strait, which is outside the Region, does not form part of this assessment, unless relevant to the Region (for example, where ships enter the northern part of the Region).

Given Australia is an island nation, shipping provides a critical servicing role and supports the economy through both imports and exports. Compared with other areas around Australia (and internationally), shipping traffic through the Region is relatively limited. In Singapore, more than 130,000 ships are processed annually[1082], compared to approximately 3000 individual ships that transit the Region annually (Figure 5.22).[1083] Around 11,000 voyages were made through the Region in 2018, with some ships stopping over at major and minor ports.

In 2014, a projected 250 per cent increase in shipping traffic through the Region was predicted to eventuate over the next 20

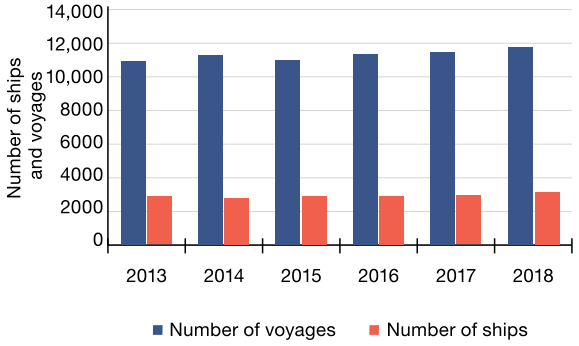


Figure 5.21 Ships visiting the Region, 2013–2018
Total number of ships visiting the Region per calendar year and the total number of voyages made by those ships. The ships include coal carriers, bulk carriers, container carriers, vehicle carriers, general cargo ships, tankers, liquefied natural gas ships, cruise ships and superyachts >50 metres (fishing, other tourism and recreational vessels are not included). Ships using the Great North East Channel are excluded, as these generally cross Torres Strait without entering the Region.
Source: Maritime Safety Queensland 2018[1085]

years. Based on port industry forecasts in 2012, approximately 5800 ships were expected to dock at Reef ports in 2017.[1084] However, Queensland port throughput in 2016–17 had decreased by 0.9 per cent from the previous year, with a 6.3 per cent decrease in coal exports on the previous year.[1048] While the rate of shipping growth projected in 2014 has not eventuated, ship voyages through the Region are slowly increasing (Figure 5.21).[1085,1086]

Ships may transit the Reef using the shallower inner route, or transit around the outer barrier reef using the outer route. In 2014, a two-way shipping route in the Great Barrier Reef and Torres Strait was formalised by the International Maritime Organization to encourage shipping traffic to use established lanes and separate northbound and southbound traffic. Ships that transit the Reef enter using one of six major shipping channels (or passages) (Figure 5.22). The Prince of Wales Channel, which enters at the tip of Cape York, is the busiest, followed by the inner route, which enters to the north of Cooktown.[1085] Fewer ships enter the Reef through the Whitsunday and Grafton passages.

The number of ships entering the Reef through the northern two channels decreased from 2014 to 2017, but increased slightly in 2018 (Figure 5.23). Hydrographers Passage and Palm Passage, offshore Townsville, have seen the greatest increase in shipping traffic since 2013.

The shorter and shallower inner route is favoured by most vessels with shallower draught (less than 12.2 metres) or larger unladen ships returning without cargo, which sit higher in the water.[1089] In the outer route, there is no restriction on the draught of ships (hull depth) as water depth can extend to more than 1000 metres.[134,135] There is a global trend towards longer ships with deeper drafts.[1086] This may result in a net reduction in the number of small ships transiting the inner route of the Region. Since 2013, the average ship length has increased by approximately 20 metres (from 196 metres to 214 metres in 2018).[1085] This will have flow-on effects to shipping lanes and future port infrastructure requirements.[1043,1044] Older vessels, which are more expensive to operate, are being retired.

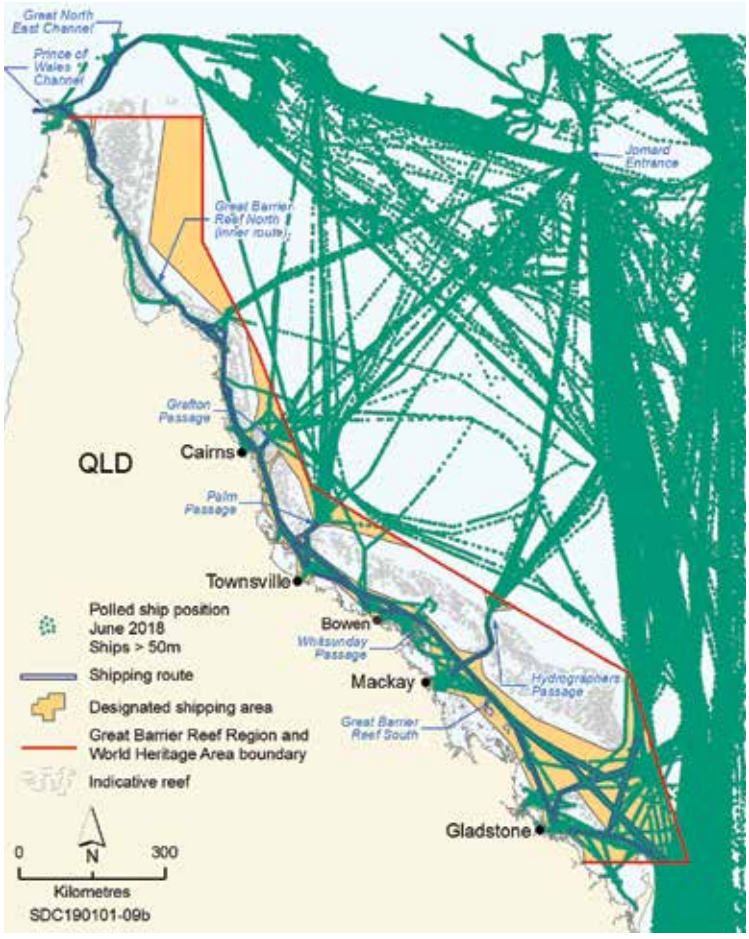


Figure 5.22 Major shipping channels and ship movement patterns over a 30-day period, June 2018

Ship positions (polled by satellite) for the selected period are similar for different times of the year and have been chosen to illustrate general shipping patterns within and outside the Region. Source: Australian Maritime Safety Authority (Cth) 2018.[1087] The data have been used in the Outlook Report with the permission of the Australian Maritime Safety Authority (AMSA). However AMSA have not evaluated the data as altered and incorporated within the Outlook Report, and therefore, gives no warranty regarding its accuracy, completeness, currency or suitability for any particular purpose.

Liquefied natural gas (LNG) production is expected to reach full capacity in 2018–19, which may result in an increase in the size of LNG ships visiting Australia.[1089] In April 2018, the International Maritime Organization adopted an initial strategy to reduce greenhouse gas emissions from international shipping. Under this strategy, international ships are urged to reduce carbon emissions by 40 per cent by 2030 (compared to 2008 emission levels), pursuing efforts towards a 70 per cent reduction by 2050.[1090] In addition, mandatory energy efficiency measures to reduce greenhouse gas emissions have been adopted under international regulations since 2013.[1091] This will mean that ships transiting the Region in future are more energy efficient.

While cruise ships comprise a minor component of the commercial ships transiting the Region, the number visiting the Region has increased gradually since 2015. Cruise ships are getting larger and carrying more passengers. With a cruise ship terminal being developed in Brisbane, growth in traffic along the Region's coastline is expected to increase from 2020.[1086] Cruise ships can transit through the Region via the designated shipping area, and they have the option of port stopovers (Cairns and offshore Whitsundays being the most common) or anchoring within designated cruise ship anchorages. The number of cruise ship bookings to designated anchorages in 2018 exceeded the previous four years and was the second highest on record since the booking system began in 2012 (Figure 5.24). Areas between Townsville and the Whitsundays have consistently received the highest level of cruise ship activity, concentrating around the Whitsundays.

Superyachts greater than 50 metres in length also visit the Region, with the majority being private, high-value luxury vessels rather than commercially operated. Given the size of these vessels, the threats they pose and the management actions applied are similar to other shipping in the Region. Once superyachts reach 50 metres or more they are required to participate in the Great Barrier Reef and Torres Strait Vessel Traffic Service (see below), and vessels over 70 metres require a ship pilot to be on-board within compulsory pilotage areas. Superyacht numbers are likely to increase in the future, underpinned by an increasing number based in the Asia-Pacific region and by recovering cruising and charter activity across the international market.[1093]

Cruise ships are getting larger, carrying more passengers and increasing in number

Management The Reef is designated as a Particularly Sensitive Sea Area by the International Maritime Organization, and shipping is closely managed by multiple government agencies. Since 2014, shipping management has been coordinated and strengthened by implementation of the *North-East Shipping Management Plan*, revised in 2019.[1086] The plan sets out protective measures to further reduce some of the environmental impacts from shipping activities (Section 5.8.3). These protective measures include further investigation of the impact of ship anchorages, resuspension of sediment generated from ship propellers and habitat restoration techniques following damage from a ship grounding.

Ships are restricted to areas of operation in the Region based on the Zoning Plan and designated shipping areas. For ships over 70 metres, such as loaded oil tankers, chemical carriers and liquefied gas carriers (irrespective of length), pilotage is compulsory for the inner route, Hydrographers Passage and within the Whitsundays (Figure 5.22). Pilots, are licenced by the Australian Maritime Safety Authority to help ships safely navigate through the Region. A new two-way route along the length of the Torres Strait and Great Barrier Reef was approved by the International Maritime Organization in 2014. This, coupled with an upgrade to emergency towage capability in the Region and Coral Sea, has improved response strategies and reduced the risk of a potential shipping incident.[1086]

The Queensland Government is the vessel traffic services authority for Queensland and operates five vessel tracking centres for Queensland ports and surrounding waterways. The operation of the Great Barrier Reef and Torres Strait Vessel Traffic Service (established in 2004) provides 24-hour tracking and monitoring of all shipping traffic in the Great Barrier Reef and Torres Strait regions. This service can divert ships if there is a possible traffic conflict, intervene to prevent a maritime incident, monitor maritime incidents and support effective response (Chapter 7).

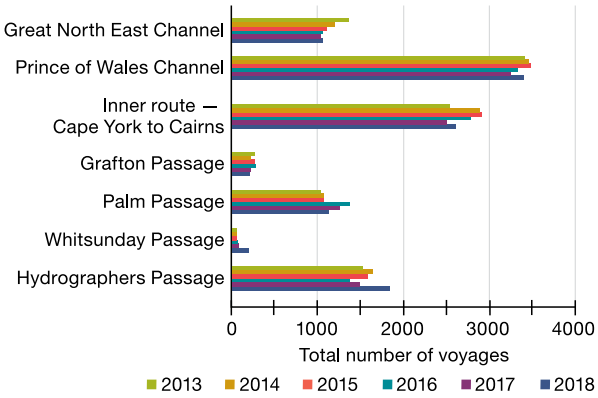


Figure 5.23 Ship voyages through Great Barrier Reef entry passages and the inner route, 2013–2018
Total number of ship voyages passing through the six main entry passages (channels) to the Reef and along the inner designated shipping route. The ships undertaking voyages include coal carriers, bulk carriers, container carriers, vehicle carriers, general cargo ships, tankers, cruise ships and superyachts (fishing, other tourism and recreational vessels are not included). Source: Australian Maritime Safety Authority (Cth) 2018[1088]

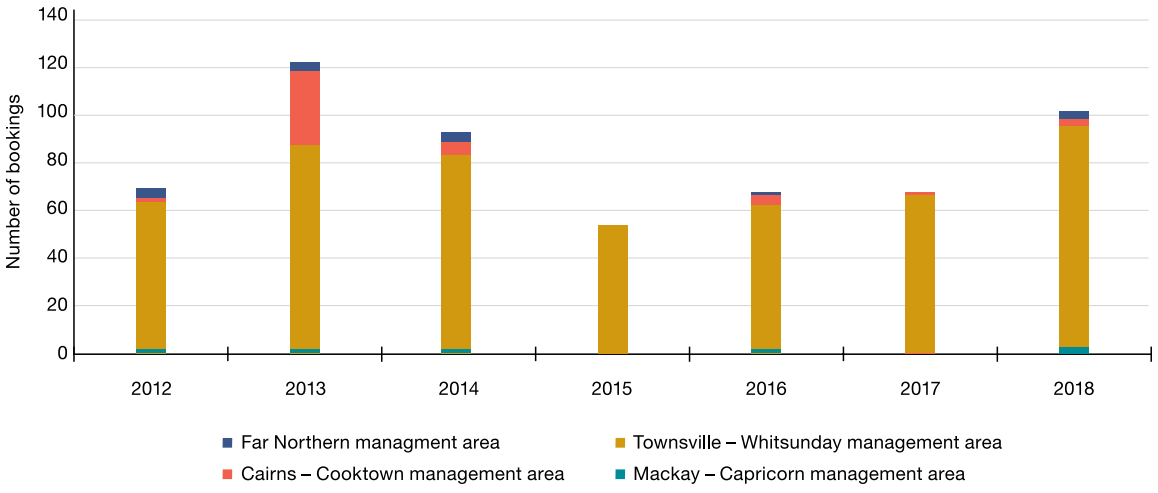


Figure 5.24 Cruise ship anchorage bookings, 2012–2018
Total number of bookings by cruise ships to designated anchorages within the four Marine Park management areas.
Source: GBRMPA 2018[1092]

Ship safety within ports has improved with an increased number of marine surveyors who undertake ship inspections while vessels are in port. Between 2014 and 2017, approximately 5000 inspections were undertaken for 25,785 ship arrivals at ports in the Region.[1088] Many ships visit the same port regularly and most inspection activity occurs in the larger, busier ports, such as Brisbane, Gladstone and Hay Point, which accounted for 81 per cent of all inspections between 2014 and 2017.[1088] Ship safety inspection statistics indicate the standard of shipping arriving in Australian ports continues to improve. This is demonstrated by the steady reduction in the detention rates of unsafe ships from 2011 (nine per cent) to 2017 (five per cent). The average number of deficiencies in ship safety identified per inspection has also remained at a low of 2.3.

The Australian Maritime Safety Authority's safety regulation responsibilities were extended in 2013 to include all foreign ships visiting Australian ports, regardless of the nature or route of the voyages involved. Since July 2013, foreign-flag ships that could previously operate 'intrastate' under Queensland jurisdiction have become subject to the state port control regime implemented by the Australian Maritime Safety Authority. This ensures a consistent standard is applied to all foreign-flag ships using regional ports. Since 2014, the Australian Maritime Safety Authority has issued 13 directions to 12 ships to prevent them from accessing Australian ports owing to repeated breaches.

Ships visiting ports to load and unload cargo may need to anchor near a port to wait for a scheduled berth. Established anchorages are designated adjacent to Cairns, Townsville, Hay Point, Abbot Point and Gladstone ports. Some anchorage areas do not have designated anchorage points (for example, Abbot Point) and there is no single state regulator for designating and approving anchorages, nor are there standard processes to follow.[1094] The total designated anchorage area for all the five ports combined is 2881 square kilometres (less than one per cent of the Region).[1075] Hay Point coal port has the largest and busiest anchorage within the Region, with 100 anchorages, but the number of ships waiting at anchor is generally under half of this.

Bookings to designated cruise ship anchorages aim to provide an uncongested safe anchorage in places where the seafloor is mostly sand with limited habitat structure and the values of desirable locations can be presented to tourists (for example, around the Whitsunday and Hinchinbrook islands). Access to locations by the support tender vessels that service cruise ships are also managed closely, restricting the number of visits by group size and vessel size in high-use locations. Superyachts greater than 50 metres are also required to book to these designated anchorages.

Ships (including cruise ships) accumulate waste during transit in the form of waste water (oily water, sewage, grey water and waste water associated with on-board equipment) and garbage (for example, food waste and plastics).

A liquified natural gas transport ship moving through the Region. © GBRMPA

Australia is party to Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL)[1095], which regulates garbage pollution from ships. Discharge of plastic into the sea has been prohibited under MARPOL Annex V since 1988, and discharge of all types of garbage into the sea, with very limited exceptions (not related to plastics), has been prohibited since 2013. The 2018 *Threat Abatement Plan for the Impacts of Marine Debris on the vertebrate wildlife of Australia's coasts and oceans*[1096] identifies the need to continue to address the management of ships' waste and the role technology can play in managing waste (for example, shipboard gasification waste-to-energy systems).

Sewage discharges in the Region need to be in accordance with Annex IV of MARPOL[1097] or, for domestic voyages, in accordance with requirements of Marine Park regulations for both treated and untreated sewage. Grey water may be discharged within the Marine Park, but it must be as far as practicable from reefs and islands.

MARPOL obliges ports make available adequate garbage-reception facilities that meet the needs of the ships calling at the port. In Queensland, ships are charged an extra cost in some ports to dispose of their garbage, rather than it being included in their berthing fee. The Australian Maritime Safety Authority works closely with ports to identify, and rectify, any alleged inadequacies with garbage-reception facilities in ports. In 2018, Hay Point trialled recycling certain garbage types from visiting international ships and found it to be feasible.[1086] The provision of recycling facilities encourages proper disposal and reduces the incentive to dispose at sea to avoid waste disposal fees in port. Unreasonable costs associated with garbage disposal in port has the potential to increase the likelihood of at-sea disposal, contributing to marine debris impacts.

5.8.2 Benefits of shipping

Ships that visit ports within the Reef provide important services to communities adjacent to the Region, transporting cargo as well as supporting tourism. International exports of goods from Queensland increased $12.4 billion to $83 billion between February 2018 and February 2019.[1098] The largest value increase in commodity exports was recorded in thermal and coking coal. In 2015, thermal coal exports experienced a decrease, however since that time exports have increased, valued at $35.8 billion between February 2018 and February 2019.[1098] In general, these fluctuations are caused by price, rather than by volume (which has been stable for the past three years).

The economic activity generated by shipping traffic provides a range of social and economic benefits to communities in the Region's Catchment and beyond. Each year, ships and their cargo are processed at ports, with the major trading ports (Box 8) processing over 3000 ships per year (Figure 5.25). Hay Point, one of the largest coal export ports in the world, has loaded approximately 1200 ships each year since 2014. There is currently no reliable estimate of the level of economic contribution (both direct and value-added) from shipping within the Reef. Nor is there an estimate of the economic benefit shipping receives from an intact barrier reef that provides some protection from oceanic swells.

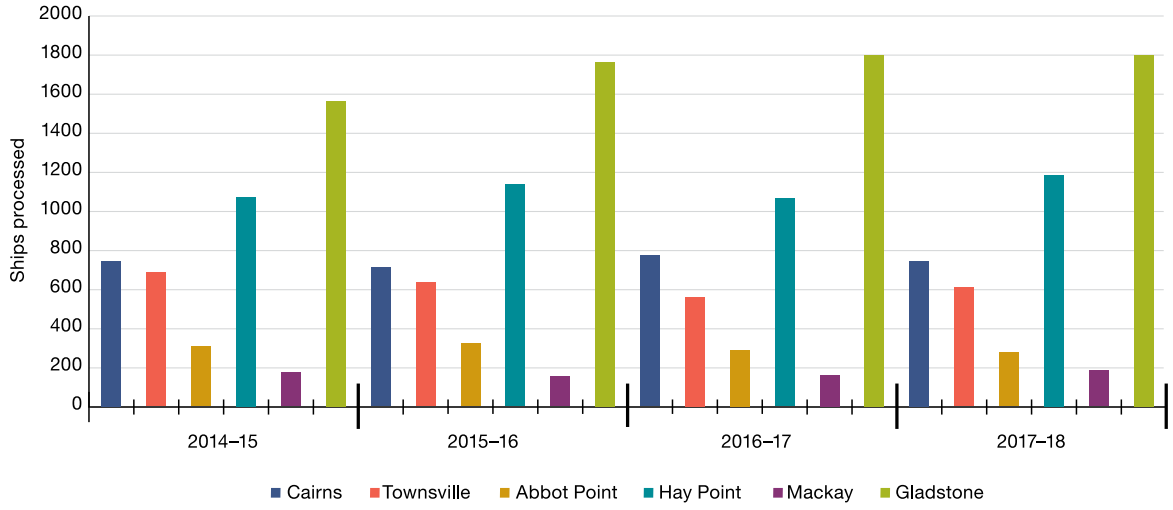


Figure 5.25 Ships processed by major trading ports within the Region
For the ports of Abbot Point and Hay Point only bulk carriers are reported. For the Port of Cairns the ships include bulk carriers and general cargo. All other ports refer to ships or vessels as a total number in annual reports. Source: Ports North[1099], Port of Townsville Limited[1100], Gladstone Port Corporation[1101], North Queensland Bulk Port Corporation[1102]

Cruise ship and superyacht activities bring potential economic benefits to the local tourism and recreation industries, resorts and mainland townships. Cruise ships provide an important platform for presenting the Region's values to both national and international visitors. Cruise tourism contributed $35 million to the Catchment in 2011–12.[858] While an updated analysis of the economic contribution from the Reef cruise ship industry has not been undertaken, there has been a 10 per cent per annum increase in cruise shipping within Queensland over the past five years. This contributed $501 million dollars to the Queensland economy in 2017–18.[1103] Cairns and the Whitsundays continue to be the most popular cruise ship ports within the Region with a small amount of growth occurring in Gladstone, while Townsville also grew from four ships in 2014–15 to eight in 2017–18[1103] (Figure 5.24).

5.8.3 Impacts of shipping

To date, the impacts of shipping have mainly been caused by physical damage and pollution from toxic antifoulant paint as a result of ship groundings, oil spills, resuspension of sediments from propeller wash, damage to the seafloor from ship anchoring[1104], illegal discharge of garbage (food waste and plastics), light pollution (ships at anchor) and underwater ship-generated noise. Whales being struck by ships is an added impact, with approximately 15 per cent of whale strikes reported to the International Whaling Commission occurring in Australian waters (547 total reported worldwide up to 2010)[392]. While the data are not specific to the Region, the number of whale strikes has increased since 1874 (when reporting began), with the majority of strikes since 1997 being concentrated on the east coast.[392] The risk of **whale strike** increases during the whale migration season and may increase further if an increase in shipping, ship size and other large vessel traffic is coupled with an exponentially increasing humpback whale population (Section 2.4.14). Some risk of whale strike has been reduced through a notification procedure implemented by Marine Safety Queensland, whereby ships are notified when a whale is in one of the port shipping channels and ship movements can be delayed to reduce the chances of whale strike.

Illegal discharge of garbage can reduce water quality and, depending on the type of garbage, create entanglement and ingestion hazards for marine and island species. Since 2014, seven shipping companies and their masters were found guilty of discharging garbage into the sea and were fined, with fines ranging from approximately $3000 to $20,000.[1105,1106]

Antifouling paints are applied to ships to reduce the growth of marine organisms that build up on the hull and reduce ship speed. The paints can contain metal pigments, such as copper, iron or zinc, and biocides that deter growth of fouling organisms.[1075] These compounds have been detected in water and sediment samples within the Region's ecosystem[1075], and concentrations are much higher in ports and near **ship groundings**.[1075]

Shipping incidents include those that have the potential to cause significant environmental harm (such as a near miss) and those that cause environmental harm. A near miss may occur when a vessel becomes disabled, almost runs aground, and requires assistance. It may be the result of mechanical breakdown, negligence or weather. Some near misses have resulted in ships coming very close to sensitive habitats. Twenty incidents have been reported in the Region since 2014[834,1015], comprising groundings, near misses and instances of two ships, or a ship and another vessel, coming into close quarters with one another. The majority occurred in the north, between Cairns and the tip of Cape York (Figure 5.27). Seven close-quarter interactions involved smaller vessels, such as fishing vessels, nearly colliding with ships. Two actual collisions involving ships and commercial fishing vessels have occurred since 2014 (Figure 5.26). No ship groundings on sensitive habitats have been recorded since 2010, when the ship *Shen Neng I* ran aground on Douglas Shoal. However, in 2018, a ship ran aground on mud in the Gladstone Channel following mechanical failure; it was assisted by tugs back into the channel.

Given advances in technology and the level of monitoring of shipping traffic in the Region, near misses should be rare. However, human error and mechanical breakdowns are always a possibility. The most serious of these involved the *Chengyang Eminence* in November 2014 north of Cooktown, while transiting with a Reef pilot on board. The newly built 225-metre bulk carrier's steering gear failed, bringing it to within one vessel length of the reef edge. Significant environmental harm was avoided in that case.

Queensland Parks and Wildlife Service ranger investigating oil spill remains following the Cape Upstart Oil Spill in 2015. © GBRMPA 2015

Since 2014, five **oil spills** have been reported from ships. Four of these were minor and involved small amounts of diesel (estimated to be less than 100 litres). For most of these minor spills, sheens of oil on the water or oil patties on a beach were observed, but could not be linked to a particular ship. In 2015, a moderate-sized oil spill occurred around Cape Upstart (central Great Barrier Reef) that resulted in up to 15 tonnes of oil washing up on beaches from Townsville to Dunk Island, across a distance of approximately 150 kilometres.

Disturbance from ships anchoring is a chronic impact that is more prevalent close to ports and within designated anchorages. An analysis of the impact of ship anchorages and their management in the Reef was

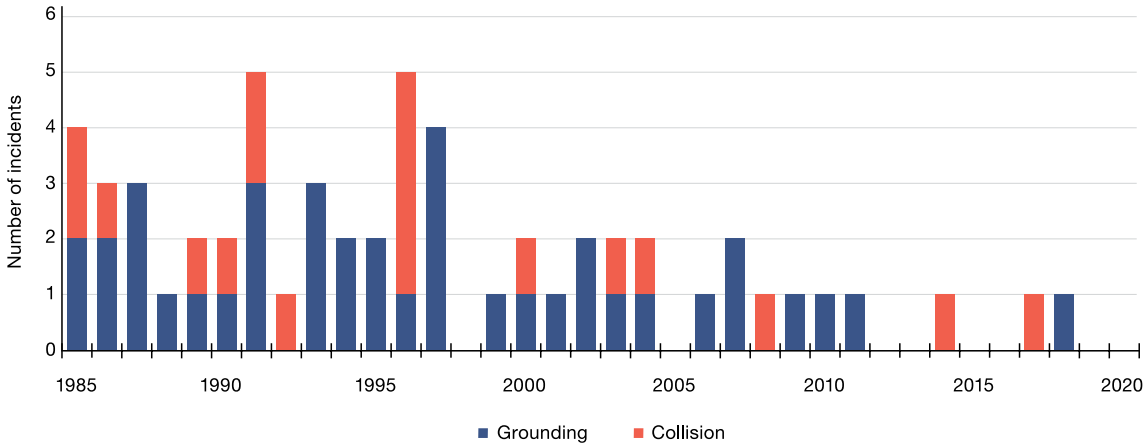


Figure 5.26 Ship groundings and collisions, 1985–2018
Bars represent groundings and collisions reported to the Marine Park Authority, Maritime Safety Queensland and Australian Maritime Safety Authority involving ships within the World Heritage Area. All collisions reported were between ships and smaller vessels, rather than between two ships. Groundings include those within designated port areas. Annual total numbers of ships visiting the Region from 2013 to 2018 are shown in Figure 5.21. Source: GBRMPA 2019[1015]

undertaken in 2013[1104], with no equivalent study undertaken since that time. A reduction in aesthetic values from ship anchoring was rated as a high risk in 2013[1104] and it is likely to remain at that level given shipping traffic has been maintained at similar levels. Additional impacts of ships at anchor include light pollution and interference with species behaviour, marine pest introduction and noise.[1104]

Ship anchoring occurs on a daily basis in the Region. Deployment of a ship's anchor resuspends sediments, creating plumes that reduce water clarity and light penetration.[1094] This sediment can directly smother benthic organisms[1032] or clog fish gills[1047]. Indirect effects may be caused by low visibility conditions, which deter some species of fish[1047] resulting in shifted fish distributions and probable flow-on effects to food chain dynamics. Cruise ships are fewer in number than coal and container ships (trade ships) and generally anchor in different locations. Cruise ships may anchor for nature experiences and shore-based activities, adjacent to islands and the mainland, resulting in similar direct and indirect anchor damage impacts as trade ships (albeit to a lesser extent).

International ships can introduce unwanted **pests and diseases** to Australia through biofouling and in ballast water. The *Biosecurity Act 2015* (Cth) prescribes how ballast water should be managed within Australian waters. National biofouling management guidelines[1108] are available to help vessel operators manage and control biofouling threats to the Great Barrier Reef. The potential impact of introduced marine species transported by ships into ports within the Region is discussed in Section 3.6.3.

Shipping is one of the means by which marine debris enters the Region. Chronic exposure to

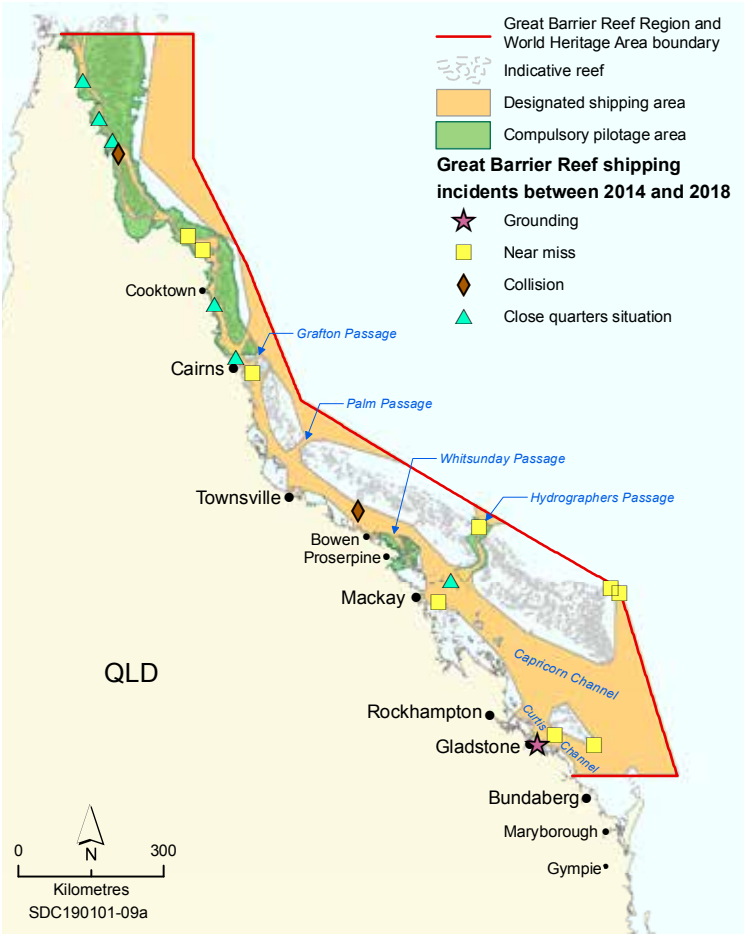


Figure 5.27 Location of shipping incidents, 2014–2018
A shipping incident is defined to include groundings and near misses for ships >50 metres; and collisions and close quarters between ships, or ships and vessels <50 metres. The designated shipping area and areas where a pilot is required to assist the ship to transit the Region are also marked.
Source: Maritime Safety Queensland 2018[1107] and GBRMPA 2018[1015]

marine-based sources of debris on the Reef is most likely in areas frequented by ships and smaller vessels, primarily in ports and marinas, at anchorage areas, at moorings and, to a lesser extent, along shipping lanes.[1075] A regional-scale analysis of marine debris collected by citizen scientists found that collections adjacent to Mackay in the central Reef had the highest proportion of ship-sourced marine debris (accounting for approximately three per cent) (Section 6.5.1 Figure 6.10). Overall, shipping was not found to be the dominant source of marine debris across the Region (accounting for two per cent on average). On average, plastic remnants from other unidentified sources and garbage washed ashore (from undefined oceanic sources) were the most dominant sources (46 per cent and 32 per cent respectively) (Section 6.5.1).

BOX 9

Remediation of Douglas Shoal following 2010 ship grounding

In April 2010, the Chinese-registered coal carrier *Shen Neng I* ran aground on Douglas Shoal in the Great Barrier Reef, near Heron Island. The vessel was grounded for nine days, damaging an estimated 42 hectares of habitat and producing the largest ship-grounding scar ever recorded on the Great Barrier Reef. The 2014 Outlook Report outlined the details of the 2010 *Shen Neng I* incident.

Following the incident, there was no immediate access to the resources needed for clean-up or restoration of the area. In late 2016, the Marine Park Authority negotiated an out-of-court settlement with the ship's owners and insurers, resulting in $35 million being allocated to clean up the site. Surveys and planning are now underway to determine how best to address the three types of damage caused by the ship: toxic antifouling paint particles, unconsolidated rubble and crushed habitat. All three types of damage hinder natural recovery of the site by making it difficult for plants and animals to re-establish. Damaged areas are still visible on satellite images more than nine years after the incident. Monitoring will be focused on assessing the effectiveness of different remediation and restoration methods to support recovery. This will give Reef managers critical knowledge about how best to respond to any future shipping incidents or other events that physically damage the reef, such as cyclones.

Diver surveying an area of gouged reef immediately after the Shen Neng I grounding incident in 2010. © GBRMPA

Ships anchored north of the Port of Abbot Point, February 2019. © Matt Curnock

5.9 Traditional use of marine resources

5.9.1 Current condition and trends of traditional use of marine resources

More than 70 Traditional Owner clan groups maintain connection to sea country within the Region. Traditional use of marine resources is important to Traditional Owners and continues long-established Indigenous heritage traditions. Traditional use of marine resources is broad, and includes undertaking of lawful activities, as part of Aboriginal and Torres Strait Islander peoples' customs or traditions for the purposes of satisfying personal, domestic or communal needs. It includes fishing, collecting (for example, shellfish), hunting (or harvesting), and looking after Indigenous heritage places. Many Aboriginal and Torres Strait Islanders undertake traditional use of marine resources to practise 'living maritime culture', provide traditional food for families and educate younger generations about traditional rules and protocols.

About 25 per cent of the Region's coastline is covered by Traditional Owner agreements

Aboriginal people and Torres Strait Islanders have used the Region's marine resources for thousands of years.[107] Significant advances have been made since 2014 in Traditional Owner-led and partnered monitoring and natural resource management programs relevant to traditional use in the Region, including:

- seagrass surveys
- Reef health surveys and crown-of-thorns starfish control
- marine debris clean-up programs[1109]
- compliance training and increasing participation in compliance patrols on sea country.[1110]

With the release of the Reef 2050 Plan[9], and continuation of the Land and Sea Country Partnerships Program initiatives (managed by the Marine Park Authority), there has been an increased focus on collaborative management and monitoring (Section 7.3.8). Since 2014, while coordinated monitoring of species and habitats (seagrasses, oyster beds and marine megafauna) has continued to expand, limited data have been collated on traditional use. As development of cultural protocols and ongoing investment in monitoring advances, information on the trends in traditional use will be better understood.

Management Traditional use within the Region is managed collaboratively with Traditional Owners. Legislation that governs the Great Barrier Reef Marine Park (Commonwealth) and the Great Barrier Reef Coast Marine Parks (Queensland), provides for the cooperative involvement of Aboriginal communities and partnerships with Traditional Owners in the sustainable management of marine resources through Traditional Use of Marine Resources Agreements. Through the agreement process, Traditional Owners agree on complex matters, such as maritime estates (where lore governs boundaries), protocols, sea country planning, harvest areas, community permits, compliance plans (including addressing unauthorised practices, such as poaching), and Indigenous heritage management. Twenty five per cent of the Region's coastline is covered by Traditional Owner agreements (a small increase of about 0.4 per cent since 2014). Accredited Traditional Owner agreements cover approximately 46,808 square kilometres of the Region (Figure 5.28) comprising nine Traditional Use of Marine Resources Agreement and one Indigenous Land Use Agreement (a voluntary agreement between a native title group and others about the use of land and waters). The Mandubarra Traditional Use of Marine Resources Agreement, accredited for the first time in 2018, covers a sea country area to the south of Innisfail.

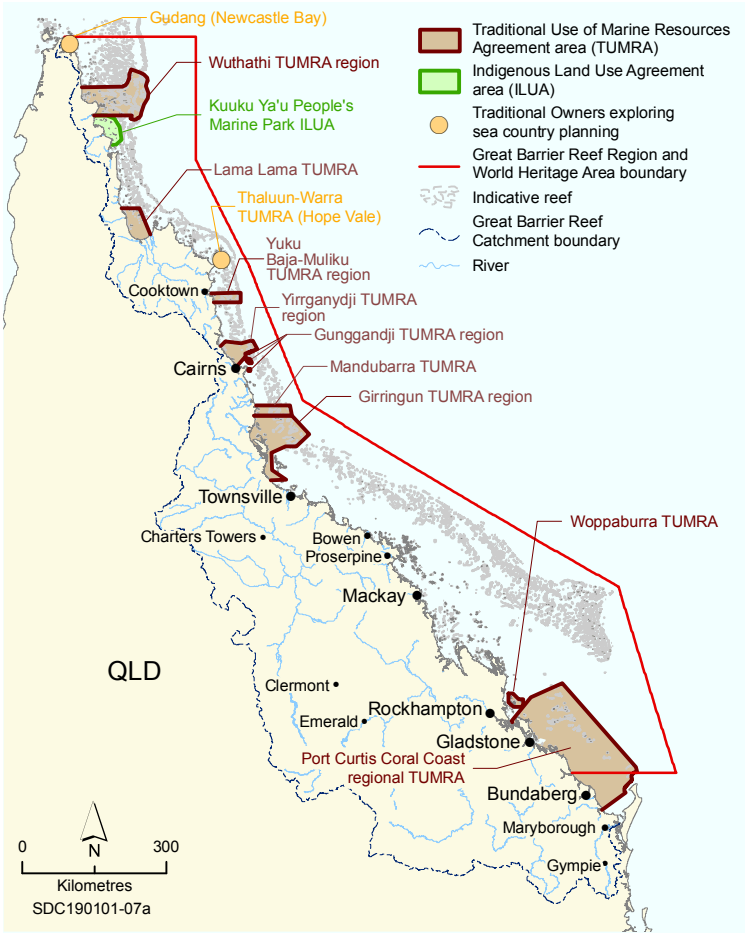


Figure 5.28 Areas of the Great Barrier Reef covered by accredited Traditional Owner agreements, 2018
Some Traditional Owners of the Great Barrier Reef have formalised their aspirations for sea country through Traditional Use of Marine Resource Agreements and Indigenous Land Use Agreements.

Most Traditional Owner groups along the mainland coast of the Region continue to exercise their native title rights, including hunting or collecting under section 211 of the *Native Title Act 1993* (Cth). Many Traditional Owner groups with an accredited agreement, have set a voluntary moratorium on the harvest of turtles and dugongs. For those agreements that include hunting, harvest limits have been negotiated and formally assessed for sustainability prior to an accreditation decision. The accredited agreements enable groups to manage traditional harvest sustainably through a process of permitting, monitoring, recording and supporting compliance actions.

In the Torres Strait a large proportion of the high density dugong habitat is not hunted by Traditional Owners.[1111] This is because traditional use is geographically constrained by culturally-based Turtle and Dugong Hunting Management Plans, the socio-economic status of some Traditional Owners, where people live, access points (such as boat ramps) and the high price of fuel. It is likely that a similar pattern of use exists within the Region, however this analysis has not been completed on a broad scale and remains challenging.

Marine Park Authority compliance officer mentoring a Traditional Owner ranger/Marine Park inspector on pre-surveillance equipment checks. © GBRMPA

Since 2011, the urban coast dugong population and southern green turtle populations are showing signs of recovery, largely due to movements back into 'hotspot areas' with recovering seagrass meadows, including Hinchinbrook Island, Cleveland Bay (Townsville) and Shoalwater Bay.[413] However, turtle and dugong population sizes are much less than in 1981 when the World Heritage Area was declared. Scientists consider that the traditional harvest of large juvenile green turtles is more sustainable than the harvest of adult females. Given that the urban coast dugong population is much less than the southern green turtle stock, traditional harvest of dugongs requires more careful consideration in traditional use agreements. Many Traditional Owner groups recognise this and have placed voluntary moratoria on hunting after extreme weather events.

The types of impacts that affect the practice of traditional use of marine resources have not changed markedly since 2014. However, a greater emphasis is now being placed on the impacts from climate change to sea country management, in particular, how changing weather patterns may affect traditional gathering and customs.[1112]

Since 2014, focus has increased on the delivery of compliance training to Indigenous rangers that work in and adjacent to the Region. Forty nine Indigenous Rangers were trained over three years (28 in 2016 and 21 in 2019). Seventeen Indigenous rangers from the first training intake were then appointed specific Marine Park inspector powers under the *Great Barrier Reef Marine Park Act 1975* (Cth). They now form part of the wider Reef compliance program, and support the management of sea country and Zoning Plan compliance (particularly in remote areas). This short term program is on track to train 75 rangers in total by June 2020, supporting Indigenous people to combine traditional knowledge with conservation training to protect and manage their land, sea and culture.

The Marine Park Authority Board includes a representative specialising in Indigenous matters relevant to the Marine Park. An update to the legislation governing the Region[1113], identifies this membership as an ongoing requirement. An established Indigenous Reef Advisory Committee continues to provide the Marine Park Authority with strategic advice to build a greater understanding of Traditional Owner issues within Marine Park management. An Indigenous representative also forms part of the Marine Park Authority's Tourism Reef Advisory Committee. A key role for these committees is to advise the Marine Park Authority Board in relation to actions that can be taken to address threats to the Marine Park identified in the Outlook Report.

5.9.2 Benefits of traditional use of marine resources

The continuing sea country management and custodianship of the Great Barrier Reef by Traditional Owners are important components of the natural and Indigenous heritage value of the Region. Traditional use, and the area-based agreements that support it, plays a constructive role in managing biodiversity and sustaining Indigenous heritage.[1114]

While gaps remain in our knowledge of the total economic worth of traditional use of marine resources, investment in Traditional Owner-led management actions under the Reef 2050 Plan continues to expand. Investment in accredited Traditional Use of Marine Resources Agreements helps to conserve and protect significant species, habitats and ecosystems; restore and maintain waterways and coastal environments; protect world heritage areas (Great Barrier Reef and Wet Tropics); and continue to refine Traditional Owner skillsets, knowledge and engagement in natural and Indigenous resource management. A 2016 study analysed the social return on investment resulting from funded Indigenous governance systems. It found that, for every $1 invested, an equivalent of approximately $2.20 of social, economic, cultural and environmental value is generated for communities and stakeholders.[1115] Traditional Owners are involved in the design and delivery of mitigation strategies for a range of threats to turtles and dugongs (for example, the Nest to Ocean Turtle Protection Program that protects turtle nests from terrestrial predators).

Reef Joint Field Management Program and Indigenous rangers assessing green turtle nests, Raine Island 2018.
© Queensland Parks and Wildlife Service, photographer: Andy Dunstan

While Traditional Owners have Native Title rights to fish and collect, including the harvest of turtles and dugongs, they consider the latest science and traditional lore and custom when considering harvest of these species in their sea country, and voluntarily adjust these figures according to the health of the ecosystem. Traditional Owners hold many spiritual and economic connections to the Region. Establishing effective partnerships helps protect the natural and Indigenous heritage value, conserve biodiversity and enhance the resilience of the Reef.

5.9.3 Impacts of traditional use of marine resources

Traditional use includes fishing and collecting a wide range of plants and animals. Impacts from traditional use can occur when the harvest is unsustainable; this is more likely when the plants or animals taken are already threatened and in low numbers. Green turtles and dugongs have been, and remain, at risk from many human-related activities (Sections 2.4.10 and 2.4.16). Within the Region, the Australian Government's *Marine Turtle Recovery Plan 2017–2027*[308] found climate change, marine debris ingestion and habitat modification (in the southern part of the Region) were the highest risks to marine turtles – and Indigenous harvest was assessed as moderate. Specifically, Indigenous use was a high risk for three turtle populations (all of which are outside the Region), with egg harvest the primary risk within the Region. Scientific modelling of dugong populations in Torres Strait concluded that traditional use of green turtles and dugongs is sustainable.[811,1111,1116] An equivalent understanding of the level take of turtles and dugongs across the entire Region remains a knowledge gap.

Nominated levels of traditional harvest under all accredited Traditional Use of Marine Resources Agreements are assessed by the managing agencies against the most recent research at the time of application, to make sure accredited harvest limits are sustainable. The sustainability of limits is reviewed to encompass the spatial scale of the agreement area and the estimated population status of the regional populations of marine turtles and dugongs likely to reside in, or use, an area. To make sure traditional use remains a low risk, well-designed monitoring in partnership with Traditional Owner groups is required. The ongoing development and revision of management policies and agreements in response to monitoring outcomes will also reduce potential threats.

Reductions in populations of species (particularly those with cultural significance, like turtles and dugongs) from **illegal fishing and poaching** is not considered legal traditional use. Illegal fishing and poaching in this sense becomes an impact on the traditional use of the Region's marine resources. Poaching in this context involves people hunting in areas outside their traditional sea country and without the customary approval or permission of the relevant Traditional Owners. Traditional Owners hunting for commercial purposes (that is, to sell the meat) is also considered to be illegal take. In 2016–17, the Australian Criminal Intelligence Commission undertook an investigation into illegal poaching and the transportation and trade of turtle and dugong meat in Far North Queensland and Torres Strait. The investigation found that the poaching and sale of meat was minimal and usually opportunistic, and that there was no substantive evidence to suggest an organised commercial trade existed in Queensland or the Torres Strait.[1117]

5.10 Assessment summary — Commercial and non-commercial use

Paragraph 54(3)(c) of the *Great Barrier Reef Marine Park Act 1975* requires '*… an assessment of the commercial and non-commercial use …*' of the Great Barrier Reef Region.

The assessment is based on two assessment criteria:

- economic and social benefits of use
- impacts of use on the Region's values.

5.10.1 Economic and social benefits of use

Grading statements — economic and social benefits of use

Very good
Use of the Region provides significant economic and social benefit, in ways that sustain the fundamental value of the natural resource. The Region is strongly recognised, valued and enjoyed by Catchment residents, the nation and the world community.

Good
Use of the Region provides valuable economic and social benefit. The Region is valued by Catchment residents, the nation and the world community.

Poor
There are few and declining economic and social benefits derived from use of the Region. Many do not recognise the value of the Region and do not enjoy their visit to the Region.

Very poor
Use of the Region contributes little or no economic and social benefit. The Region holds little value for Catchment residents, the nation or the world community.

Borderline
Indicates where a component or criterion is considered close to satisfying the adjacent grading statement.

Trend since last report

↑ Improved
↔ Stable
↓ Deteriorated
– No consistent trend

Confidence

● Adequate high-quality evidence and high level of consensus
◐ Limited evidence or limited consensus
○ Inferred, very limited evidence

Grade and trend			Confidence		Criterion and component summaries
2009	2014	2019	Grade	Trend	
	↔	↔			**Economic and social benefits of use:** Economic and social benefits to the Region continue to be in very good or good condition. Commercial and non-commercial use continue to contribute to the Region's economy. The social benefits of fishing and recreation contribute significantly to health and wellbeing. The Reef is of major importance to Traditional Owners.
	↔	↔	●	●	**Commercial marine tourism:** Tourism continues to make significant contributions to the social and economic value of the Reef. Although recent disturbances impacted visitor numbers in Cairns and the Whitsundays, visitation is slowly increasing.
	↔	↔	●	●	**Defence activities:** Periodic visits from Australian and international forces generate short-term economic benefits to the Region. Defence supports cooperative research and management programs in the Region and adjacent estates.
	↔	↔	●	●	**Fishing:** The economic contribution of commercial and recreational fishing increased slightly. Commercial fishers have a high personal connection with the Region. People enjoy recreational fishing for a variety of reasons.
	↔	↔	○	○	**Recreation (not including fishing):** Continued growth in population and economics will increase the demand for recreational activities within the Region. Recreational use of the Region is vital to the wellbeing of Queensland's coastal communities.
	↔	↑	●	●	**Research and educational activities:** Knowledge derived from research related to the Region continues to support management. Contributions to the economy have increased since 2011–12. Research into intervention and restoration activities is increasing.
		↔	●	●	**Ports:** The four priority ports adjacent to the Region provide significant economic and social benefit to the Queensland and national economies. Employment statistics remain a data gap.
		↔	●	◐	**Shipping:** The total number of ships processed through the major trading ports has remained relatively stable since 2014. Cruise shipping had the greatest growth. There is currently no reliable estimate of the level of economic contribution (both direct and value-added) from shipping within the Region.
	↔	↔	○	○	**Traditional use of marine resources:** Traditional ownership continues to provide and receive environmental, social and cultural benefits for Traditional Owners. Since 2014, the proportion of the Region's coastline under Traditional Use of Marine Resources Agreements has increased to 25 per cent.

5.10.2 Impacts of use on the Region's values

Grading statements — impacts of use

Very low impact
Any impacts attributable to use of the Region are minor and localised, with no observable effects on overall ecosystem function or heritage values.

Low impact
The impacts of use are observable in some locations or on some values, but only to the extent that limited additional intervention would be required for the use to be sustainable.

High impact
The impacts of use are obvious in many locations or to many values to the extent that significant additional intervention would be required for the use to be sustainable.

Very high impact
The impacts of use are widespread, to the extent that ecosystem function and heritage values are severely compromised.

Borderline
Indicates where a component or criterion is considered close to satisfying the adjacent grading statement.

Trend since last report

- ↑ Increased
- ↔ Stable
- ↓ Decreased
- – No consistent trend

Confidence

- ● Adequate high-quality evidence and high level of consensus
- ◐ Limited evidence or limited consensus
- ○ Inferred, very limited evidence

Grade and trend			Confidence		Criterion and component summaries
2009	2014	2019	Grade	Trend	
	↑	↔			**Impacts of use on the Region's values:** The observed impacts from direct use of the Region are mainly localised. However, collectively, the impacts of this use are obvious (to varying degrees) in many locations. Fishing is a high-impact use occurring throughout the Region and some aspects remain a concern. Marine incidents involving small vessels have increased. As the population increases, use of the Region and associated impacts are likely to increase. The cumulative effects of direct use of the Region coupled with a deterioration of its natural and heritage values amplifies the identified impacts.
	↔	↔	●	●	**Commercial marine tourism:** While marine tourism extends throughout the Region, its impacts are generally localised to a few intensively managed areas. Impacts from cumulative use will amplify as natural values deteriorate. Vessel incidents and infrastructure damage spike after extreme events and cause localised damage to values.
	↔	↔	●	●	**Defence activities:** Defence activities have localised impacts on the Region. Balancing the Defence requirements for training with conservation of critical environmental values will remain a significant challenge in the future.
	↔	↔	◐	◐	**Fishing:** Fishing occurs in most parts of the Region. The extraction of biomass, interaction of animals with fishing equipment, and discarded catch are ongoing pressures from fishing. Illegal fishing and poaching remain strong concerns. Fisheries management is improving but reforms are yet to be fully implemented and information gaps remain.
	↔	↑	○	○	**Recreation (not including fishing):** Few studies have investigated the impact of recreational uses (excluding fishing) in the Marine Park. Impacts are mainly in the inshore areas around major population centres. Localised damage to habitats by small recreational vessels may be more common than reported.
	↔	↔	◐	◐	**Research and educational activities:** Understanding of cumulative effects of the minor impacts associated with research and educational activities is limited. Activity is often concentrated around research stations.
		↓	●	◐	**Ports:** Many threats from port activities (maintenance dredging and associated disposal of dredge material, artificial light from port infrastructure, noise and other pollution) remain and cause impacts at a localised scale. However, threats associated with capital dredging and associated disposal have decreased since 2014, resulting in the impact grade being considered borderline with low impact.
		↔	◐	◐	**Shipping:** Ships are getting larger. The number of shipping incidents has remained relatively stable. Other impacts caused by ships, such as resuspension of sediments from propeller wash, anchoring, light and noise pollution (from ships at anchor) and whale strike remain ongoing threats.
	↓	↔	◐	◐	**Traditional use of marine resources:** Traditional harvest, fishing and collecting involve a range of marine species (some of conservation concern). Within Traditional Use of Marine Resource Agreement areas, harvest is limited and considered sustainable. Region-wide level of Traditional harvest remains a knowledge gap, but is considered to cause minimal impact compared with other threats.

5.11 Overall summary of commercial and non-commercial use

The Great Barrier Reef contributes significantly to the Australian economy and the wellbeing and lifestyle of the communities that depend on the Reef for traditional use, social and cultural purposes, and livelihoods. The economic and social benefits of commercial and non-commercial use are rated overall as very good.

Use of the Region continues to provide significant economic and social benefits

The observed impacts from direct use of the Region are mainly localised and rated overall as high impact. However, collectively, the impacts of this use are obvious (to varying degrees) in many locations. Fishing is a high-impact activity occurring throughout the Region and some aspects remain a concern. Marine incidents involving small vessels have increased. As the population increases use of the Region and associated impacts are likely to increase. The cumulative effects of direct use of the Region coupled with a deterioration of its natural and heritage values amplifies the identified impacts.

Commercial marine tourism continues to be the most economically significant use of the Reef. Record levels of tourism visitation occurred in 2016 despite coral bleaching events. However, visitation declined in some areas, particularly in the Whitsundays in 2017 following cyclone Debbie. Impacts of commercial marine tourism are generally localised around intensively visited areas.

Cumulative effects of direct use of the Region coupled with a deterioration of its natural and heritage values amplifies identified impacts

Defence activities in the Region directly contribute to Australia's defence capacity and generate economic benefits to the Region. Defence continue to deliver and support environmental monitoring and management. Recreational and commercial fishing continue to be important social and economic direct uses of the Region. Fisheries management and practices continue to improve, with the most significant change being the development of the Queensland Sustainable Fisheries Strategy 2017–2027. Some knowledge gaps and sustainability concerns for some species still exist. Illegal fishing and poaching continue to cause concern.

The Region provides opportunities for many recreation activities beyond fishing. Continued population growth and economic wealth will increase the demand for recreational activities in the Region. Most recreational impacts are minimal (with cumulative impacts largely unknown) and concentrated around major population centres. Research underpins management of the Region and has broad and growing economic and social benefits. Research and educational activities are often concentrated around research stations; there is potential for localised cumulative effects.

Population growth will increase the demand for recreational activities in the Region

Ports provide significant economic and social benefits to the Region. Since 2014, the combined effect of regulatory changes, a cooperative approach to managing the impacts of port development and changed market conditions have seen some of the threats from ports reduce. Localised impacts from ports remain, predominantly from maintenance dredging and associated disposal of dredge material, artificial light from port infrastructure, noise and other pollution.

The number of ships travelling through the Region has remained stable since 2014, except for cruise ships which have continued to increase. Ships are getting bigger, which will increase associated pressures, such as anchoring impacts on benthos and sediment suspension from propeller wash, particularly within the shallow inner route. Shipping safety is well regulated in the Region, and the impacts, being generally known and managed. However, threats remain from ship propellers resuspending sediments, which can affect organisms, water clarity and community benefits. Vessel strikes, light and noise pollution remain ongoing threats that are not well understood.

Some impacts from direct use have been reduced (particularly for ports); room for further improvement remains

Managing agencies continue to work with Traditional Owners to protect Indigenous heritage values, conserve biodiversity, enhance the resilience of the Reef, and maintain connection to land and sea country. In 2018, nine Traditional Use of Marine Resources Agreements and one Indigenous Land Use Agreement were in place, an increase of two agreements since 2014. Combined, these agreements cover approximately 25 per cent of the Region's coastline.

Diving for tropical rock lobster using surface-supplied air. © GBRMPA