

### Book

Moreton Bay *Quandamooka & Catchment: Past, present, and future*

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## Fishers and fisheries of Moreton Bay

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### Abstract

Moreton Bay is one of the most intensively used coastal systems in Australia and supports some of Queensland's most productive fisheries, including Indigenous, commercial, recreational and charter sectors. This paper explores the economic and cultural value of these fisheries to the Moreton Bay region and the challenges they face. Fishing is recognised as one of Queensland's oldest industries. Marine resources were harvested by Indigenous peoples long before European settlement and continue to form an important part of Indigenous culture today. Commercial fisheries operating within Moreton Bay are valued at \$24 M per annum, and target a variety of species groups including prawns, crabs, squid and finfish such as mullet, bream and whiting. Direct expenditure by the recreational sector in Moreton Bay is estimated to be ~\$194 M per annum, with fishers harvesting mud crabs, sand whiting, snapper, tailor and bream, among others. Despite the longevity of these sectors, a number of challenges exist. These include managing risks related to climate change, a growing urban population, and the need to mitigate environmental impacts from fishing and other marine activities. Interactions with other management sectors, including marine park planning and native title rights, will also need to evolve if we are to ensure a sustainable future for the fisheries of Moreton Bay.

**Keywords:** charter fishing, indigenous fishing, industry, prawn, recreational fishing, trawl

### Introduction

Moreton Bay is one of the most intensively fished regions in Queensland. Although it comprises just 3% of the Queensland coastline, it produces about 12% of Queensland's fish catch (1) and supports some of the state's most productive commercial and recreational fisheries (2). Moreton Bay has a long history of exploitation. Archaeological evidence suggests that Indigenous fishers have harvested seafood in Moreton Bay for thousands of years, including finfish such as mullet (*Mugil cephalus*), crustaceans, shellfish (e.g. oysters, *Saccostrea glomerata*), turtles (e.g. green sea turtle, *Chelonia mydas*), and dugong (*Dugong dugon*) (3). Once Europeans settled in Moreton Bay, Indigenous peoples commercially traded fish with settlers, but many traditional methods of fishing were either eventually interrupted or halted (4).

## Indigenous fisheries

Fishing (both finfish and shellfish) and marine mammal hunting form an important part of contemporary Indigenous society and practices within Moreton Bay. A number of Indigenous groups maintain strong cultural connections with this region and make use of, or have aspirations to make use of, the resources within the Bay (Pinner *et al.*, this volume) (3). For example, some of the Aboriginal people of Quandamooka, one of the Indigenous groups with cultural ties to Moreton Bay and made up of Nunukul, Ngugi and Goenpul peoples, continue to catch fish and shellfish as part of their way of life, with mullet being particularly significant, culturally and economically (3). Queensland fisheries regulations dictate that Indigenous peoples living in the vicinity of their traditional land and who wish to fish for traditional or ceremonial purposes using a commercial-sized net, must apply for a permit through Fisheries Queensland (5). Fish traps (defined as a holding area designed for capturing fish and made out of stone or organic material) can be used and, along with recreational fishing gear, do not require a licence. Seasonal closures and size and in-possession limits do not apply to Indigenous peoples who are fishing in their traditionally accessed waters or where permission has been obtained from the Traditional Owners (5).

In addition to state law, many Indigenous peoples with ties to Moreton Bay also recognise and subscribe to customary law, which governs all aspects of their traditional way of life, including communal ownership rights over their native estate (6). In 2011, the Federal Court recognised the Quandamooka Peoples' non-exclusive native title rights over 29,505ha of Moreton Bay and adjacent ocean beaches. These include 'the right to be present on the area, including by accessing and traversing the area, and take, use, share and exchange traditional natural resources and seawater for any non-commercial purpose'. This seaward boundary extends up to 200m from the high-water mark along North Stradbroke Island and the southernmost tip of Moreton Island, and encompasses an area inside of Moreton Bay (7). Because these are non-exclusive rights, the Quandamooka group exercises these rights alongside the rights of others including other Indigenous groups, and non-Indigenous recreational and commercial users.

## Commercial fisheries

A number of historical commercial fisheries no longer operate in Moreton Bay, with some exhibiting a boom-and-bust pattern as a result of heavy exploitation. By the 1830s, Europeans had started fishing for dugong (which were exploited for centuries prior by Indigenous peoples) and this developed into a cottage industry for dugong oil that existed until 1920 (2). After a resurgence in the need for this oil after World War II, dugong declined in the Bay (2). Since this period, dugong numbers have increased and continued to be harvested in small numbers by Indigenous peoples, who have imposed their own moratoria in the past when they deemed the population was too low to sustain hunting (8). In the 1950s, a commercial whaling industry commenced on Moreton Island. The Australian whaling industry contributed to a rapid decline in the humpback whale population, forcing the Moreton Island operation to close in the early 1960s (2). A commercial fishery targeting turtles for meat and soup existed in Moreton Bay from the late 19th century, but declined in the early 20th century (9).

During the 19th century increasing numbers of oysters (*S. glomerata*) were extracted for food and for lime (10). By 1886, oyster banks covered 2,036ha of Moreton Bay (10), and at its peak at the turn of the 20th century this fishery harvested oysters for consumption as far away as Sydney and Melbourne (10). From the 1920s, landings from the Moreton Bay oyster fishery began a decline that continued throughout the 20th century. This resulted from a combination of factors, including flood events and poor water quality in the Bay (11), which was compounded in later decades by diseases (12) and competition from oyster growers in other regions (West *et al.*, 2019, this volume) (13,14). Oyster farms (still comprising *S. glomerata*) exist today within Moreton Bay but at a reduced scale, covering 435ha in 2008 (14). Commercial fishing for prawns (Penaeidae) in Queensland commenced in the Brisbane River in the 1840s using scoop nets and scissor nets (15). However, it was not until the 1950s when a ban on otter board trawling was lifted, that a prawn trawl fishery developed in Moreton Bay (Fig. 1a). In recent years, grid W37 (a fishing area within Moreton Bay) has received more trawl fishing effort than any other coastal water in Queensland.

The ocean beach and inshore commercial fisheries have also operated since the 19th century. The Queensland Fish Board assumed responsibility for the control of statewide fish marketing in 1936 (16). After this period, and until the dissolution of the Fish Board in 1982, all fish landed for sale had to be sold through the Board and the quantities of fish sold were made available in annual reports. An unknown quantity of this catch was landed by non-commercial fishers, who for part of this period were lawfully permitted to sell their excess catch. Non-commercial fishers wanting to sell fish to Fish Board depots were required to purchase a permit, and this practice was encouraged by the government and Fish Board at the time as a means of increasing the local supply of fish. A number of distribution centres existed around Moreton Bay, which, when totalled, provide us with estimates of fish landed within the Bay. Some fish were undoubtedly landed but not processed through the Board, but these quantities are unknown.

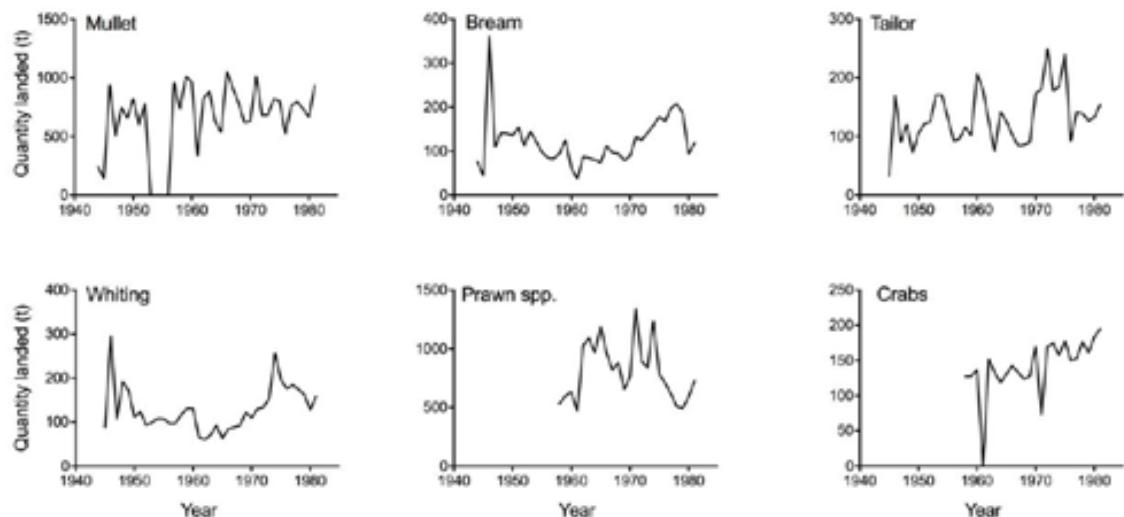
From 1944–1981, the species landed in the greatest commercial quantities from the Moreton Bay region comprised mullet, sea bream (e.g. yellow-finned bream, *Acanthopagrus australis*), whiting (*Sillago* spp.), tailor (*Pomatomus saltatrix*), prawns and crabs (e.g. blue swimmer crab, *Portunus armatus*) (Fig. 1a). Historically, mullet was the finfish landed in the greatest quantities from the Moreton Bay region, with 651t landed per year on average, although annual landings could vary by >500t (Fig. 1a).

Quantities of fish processed by the Board were recorded by place of landing, rather than where at sea they were caught, hence the spatial resolution of these data are vague and no information on fishing effort exists. In addition, similar species were often grouped together. Despite their deficiencies, these data are the only consistent source of historical landings data for this period, and they provide a record of landings trends, year-to-year variability in landings, as well as an indication of when particular fisheries commenced.

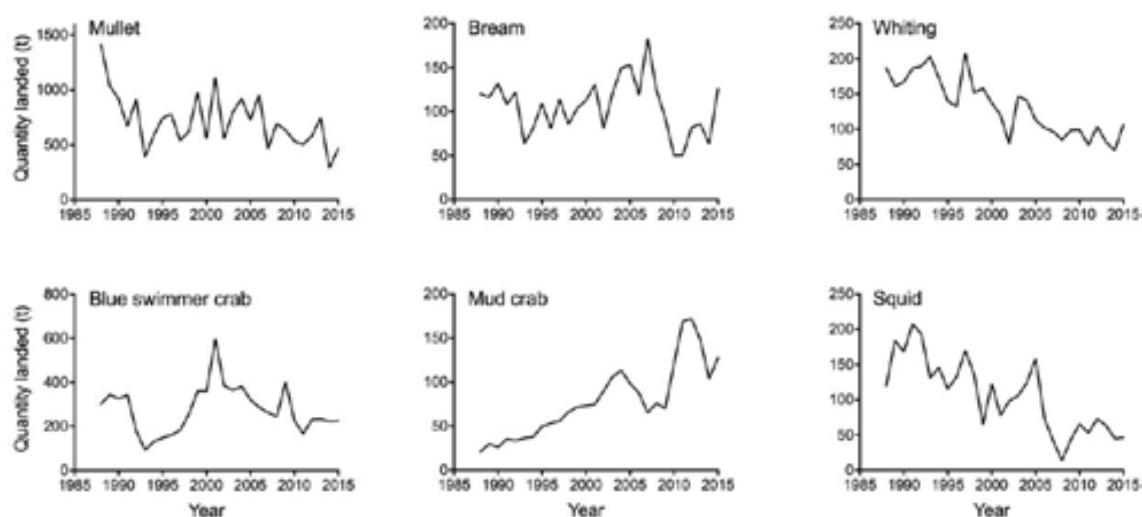
Moreton Bay fisheries today are regulated under the *Fisheries Act 1994* (Qld), which aims for the ‘economically viable, socially acceptable and ecologically sustainable development of Queensland’s fisheries resources’. To address the limitations of Fish Board records, the

Queensland Government implemented a mandatory logbook database program for all commercial fishers to record both landings and fishing effort. Since the establishment of the logbook monitoring program in 1988, fishers have reported catches to 30-minute grids (i.e. 30 nautical miles by 30 nautical miles). Two 30-minute grids, W37 and W38, encompass the sheltered waters of Moreton Bay, as well as a limited area to the east of Moreton and North Stradbroke islands.

a) Quantities of selected species/species groups received by the Fish Board depots, 1944-1981



b) Quantities of selected species/species groups landed from Moreton Bay, 1988-2015

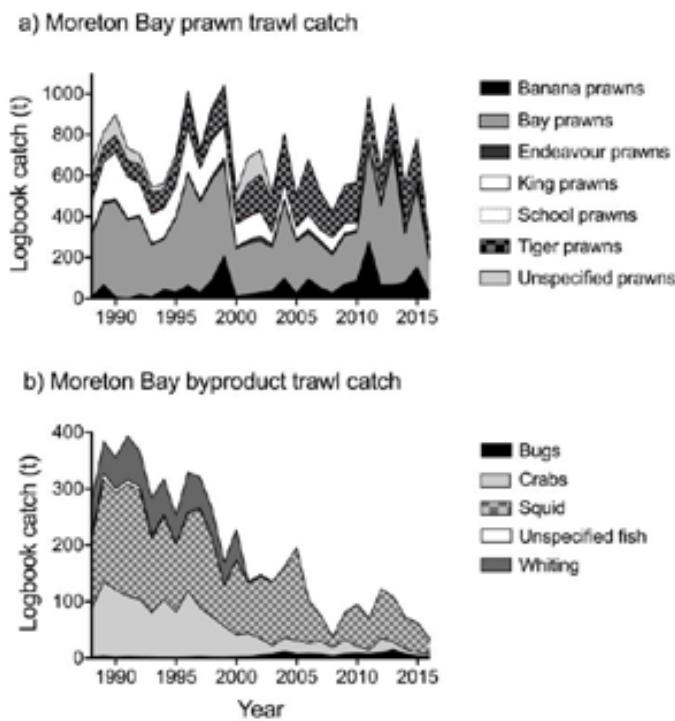


**Figure 1.** (a) Quantities of fish received by the Fish Board at branches and depots from fishing districts within Moreton Bay, 1944–81 (Bribie Island, Brisbane, Cleveland, Doboy Creek, Redcliffe, Sandgate, Scarborough, Wynnum). The top six species landed (ranked by total quantity throughout the time series) are shown. (Source: Queensland Fish Board reports); (b) Quantities of individual species landed from within Moreton Bay (grids W37 and W38; data sourced from the Queensland Government (1)). Note that the axes differ in scale.

Commercial fisheries are now monitored using daily catch and effort logbooks and biological data collection (e.g. length, age and sex) of key fish species. The Department of Agriculture

and Fisheries (DAF) quantitatively assess the status of major fish stocks every 2 to 10 years. Where data are available, time series of catch and catch per unit effort (CPUE) are examined more frequently, although stock status is not assessed spatially at the Moreton Bay regional level. The main gear types used in Moreton Bay are otter trawl, net, pot and line (1). The commercial harvest of particular species may be regulated using a range of both input (e.g. licensing, limitations on fishing gear, limiting the time and place people can fish) and output controls (e.g. minimum or maximum size restrictions), which vary by fishery.

In 2013–14, Queensland's wild-catch fisheries produced nearly 21,000t of product with a gross value of production (GVP) of \$191m (17). Moreton Bay fisheries caught 2,254t of that total (1), and prior to the 2009 rezoning of the Moreton Bay Marine Park, contributed an estimated \$24–\$30m per annum to the economy (18), making Moreton Bay the most important region in the state by volume and value of fish per unit area. At this time an estimated 1,000 people were employed in the commercial fishing sector (17).



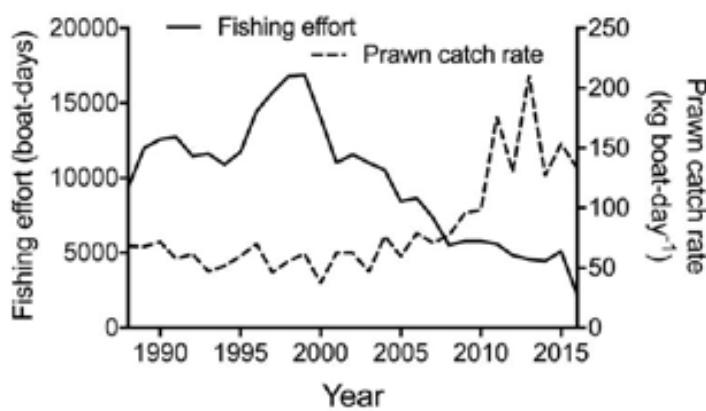
**Figure 2.** Reported annual catches of (a) prawns and (b) byproduct from the Moreton Bay (grids W37 and W38) otter trawl fishery, based on CFISH logbook data (1). The decline in byproduct after 2000 is largely due to the implementation of the Trawl Fishery Management Plan, which prohibited retention of whiting and introduced catch restrictions on blue swimmer crabs and other byproducts (2016 data incomplete). Note that the axes differ in scale.

*merguiensis*), endeavour prawns (*Metapenaeus endeavouri* and *M. ensis*) and school prawns (*M. macleayi*) are also caught in Moreton Bay.

Since 1988 when mandatory logbooks were introduced, the species groups caught in the greatest quantities are prawns, mullet, bream, whiting, blue swimmer (*P. armatus*), mud crab (*Scylla serrata*), and squid (1) (e.g. *Sepioteuthis* and *Ommastrephes* spp.) (Fig. 1b). In more recent years these are identified to species level, but not necessarily throughout the whole logbook time series. Bay prawns, which are mainly composed of *Metapenaeus bennettiae*, have dominated prawn trawl landings throughout the available historical record (Fig. 2a). Brown tiger prawns, *Penaeus esculentus*, are the largest prawn species caught in the Bay, and because they command higher prices, account for the majority of the prawn catch value. Eastern king prawns (*Melicertus plebejus*), banana prawns (*Fenneropenaeus*

In addition to these commercial target species, several non-target species can be retained and sold. These byproduct species can provide significant additional income for fishers. For example, the amount of byproduct retained by otter trawl fishers peaked at about 400t in the 1990s, but has declined since, mainly due to management changes (Fig. 2b).

Most bream (99%), mullet (99.5%) and whiting (73%) are landed by net, while blue swimmer (88%) and mud crabs (99.6%) are landed by pot gear. Landing trends vary across species. Mullet, whiting and squid have exhibited an overall decline throughout the time series, whereas bream is more stable. Fishing effort is not shown for individual species because the available data do not detail which species were being targeted from day to day. However, the number of fishing licences and number of days fished have declined overall, with the most marked declines occurring in the otter trawl fleet (Fig. 3). Reasons for the decline in the otter trawl fleet include reduced profitability as a result of increased operational costs (i.e. fuel and labour), the introduction of a fishing effort unitisation scheme aimed at limited trawl fishing effort, restrictions on byproduct, as well as increased imports of aquacultured prawns that have largely displaced the bay prawn market and depressed prawn prices. Based on these reasons, a recent economic study of the Moreton Bay trawl fishery concluded that it was economically unsustainable (19). Despite these issues, the decline in fishing effort since 2000 has been associated with a significant increase in annual prawn catch rate (Fig. 3). This may be attributed to smaller, less-efficient vessels exiting the fishery, or reducing their annual effort, resulting in higher mean catch rates from the remaining, larger vessels. There is also evidence to suggest that increased catch rates may be partially due to a recovery of the brown tiger prawn population from recruitment overfishing (i.e. significantly reduced recruitment to the exploitable stock) in the 1980s and 1990s (20).



**Figure 3.** Annual fishing effort (boat-days) and prawn catch rates in the Moreton Bay (grid W37) otter trawl fishery, based on CFISH logbook data (1). Note the declining trend in effort and the increasing trend in catch rate since 2000 (2016 data incomplete).

## Recreational fisheries

Recreational fishing has taken place within Moreton Bay for more than 130 years, when the *Queensland Fisheries Act 1877* implemented commercial licensing for fishers who wished to sell fish caught using large nets, thus clearly distinguishing commercial from recreational fishing activities. Recreational catch data are derived from fishing surveys conducted by DAF in 2000, 2010 and 2013<sup>21</sup>. The 2013 survey estimated there were approximately 642,000 anglers in Queensland, who harvested 8,500t of fish, crabs and prawns. Of these, approximately one-third lived in the Brisbane region around Moreton Bay (21). The economic value of

Queensland recreational fishing is \$400m per year (22) and estimates of direct expenditure from this sector in South East Queensland (including Moreton Bay) range from \$156m to \$194m (23). Recreational fishing thus contributes significant economic benefits, especially to the local area, with boating, bait and fishing tackle industries heavily reliant on this activity (21).

Participation rates for recreational fishing activities within Moreton Bay and Queensland are unknown prior to the start of state-wide surveys in 2000. Recreational fishing was common prior to World War II, with some fishing clubs recording their fishing activities within and just outside of Moreton Bay as early as the 1870s (24). Initially, these clubs were independent of each other, but in 1949 the Queensland Amateur Fishing Clubs Association (QAFCA) was formed as a ‘major representative sporting body for competitive angling’, to promote recreational fishing and organise inter-club competitions (25). The post-war period saw greater participation in recreational fishing activities, due to the increasing affordability and accessibility of personal motor vehicles, powerboats and fishing technology, although participation rates are unknown. Club competition angling remained the most affordable way to fish productive areas and people increasingly joined clubs to participate in recreational fishing activities (26). Today the QAFCA acts as a parent body and representative for over 100 recreational fishing clubs throughout Queensland (27), a number of which regularly fish in Moreton Bay. The Australian National Sportfishing Association (Queensland Branch) was formed in the late 1960s and has several clubs actively fishing in Moreton Bay. Game fishing clubs and underwater (spearfishing) clubs have also been active in Moreton Bay, but to a lesser extent than sport fishing clubs. Despite the large number of fishing clubs, the vast majority of recreational fishers today do not belong to fishing clubs.

Since the start of state-wide recreational fishing surveys in 2000, participation rates within Queensland have declined. In 2000, just under 25% of Queenslanders surveyed stated that they participated in recreational fishing. By 2013 this had declined to 15% (21). Despite declining participation rates, recreational fishing is still a popular leisure activity for those residing in the Brisbane and Moreton Bay areas. With approximately 3 million people living in the area around Moreton Bay and population growth in South East Queensland expected to continue to increase to 4.4 million by 2031 (28), it can be expected that greater numbers of recreational fishers will enter the fishery over the coming years.

Recreational fishers primarily use lines to harvest finfish, but pots are also commonly used for crab fishing and cast nets to target prawns (21). In 2013, Brisbane’s resident recreational anglers reported catching 74 species (harvested and/or released), with trumpeter whiting (*Sillago maculata*), yellow-finned bream and sand whiting (*S. ciliata*) the most commonly harvested finfish. For many species, similar numbers of individuals are released as are harvested, with significantly greater quantities of yellow-finned bream, snapper (*Pagrus auratus*) and mud crab released than harvested (21). The most recent survey estimated that recreational anglers fished 240,000 days over a 12-month period in the Moreton Bay catchment fishing region, and that they expended more boat-based fishing effort than shore-based (21). Trumpeter whiting and yellow-finned bream were the most commonly caught fish species

within the Moreton Bay catchment region, with >200,000 individuals of each species estimated as being harvested or released by recreational fishers throughout 2011. Over 100,000 snapper and mud crab were estimated to have been either harvested or released. From these surveys, it is thought that the recreational harvest of snapper and yellow-finned bream by weight (throughout Queensland) is similar to that of the commercial sector (21).

Recreational fishing is open access in Queensland and fishing licences are not required; however, size, in-possession limits and gear restrictions have been applied to a range of target species since the late 19th century. Major innovations to recreational fishing controls in Queensland occurred in 1993, when recreational in-possession limits were applied to a number of species, a recreational fishing code of practice was formed, and increased enforcement and penalties were introduced for fisheries infringements, among other changes. Since 1877, when minimum size limits were first introduced for eight species and a further eight species groups, there are now size restrictions on 31 species and 18 species groups, and recreational in-possession limits on 18 species and 24 species groups in Queensland, the majority of which occur in Moreton Bay. There are no restrictions on the number of people allowed to enter the recreational fishery and hence no restrictions on total recreational catch. The 2009 establishment and expansion of green (no-take) zones in the Moreton Bay Marine Park has removed recreational fishing effort from 16% of Moreton Bay, but since 2009 seven artificial reefs have been established to provide additional opportunities for recreational and charter fishers, with several of these artificial reefs allowing spearfishing (29).

Research and monitoring of Queensland recreational fisheries and fishing activities is undertaken by the state government, university researchers and recreational fishing bodies. For example, the DAF Keen Angler Program encourages fishers to supply fish frames for age-frequency analysis and subsequent stock assessments. The Queensland branch of the Australian National Sportfishing Association started tag and release activities in the 1970s; recaptures of tagged fish are recorded and the information on movements and growth made available to researchers and managers (30,31). During the past four years, Sunfish Queensland, the state's peak recreational fishing group, and its affiliated members have undertaken scientific studies within Moreton Bay, including incidences and causes of fish injury (32), fish reproductive biology (33), fishery range shifts (34) and management history of recreational fishing.

Traditionally, communication among members of the recreational fishing community, research scientists and fisheries managers has occurred through popular media platforms (e.g. weekly newspaper columns) and formal organisations such as fishing clubs and peak bodies. However, today, communication and monitoring activities are increasingly undertaken via social media. Recreational fishers use a variety of social media platforms to post photographs of their catches and to share information with other fishers; over one-third of Queensland recreational fishers surveyed in 2011 identified government internet sites and social media as their primary methods of finding out about fishing regulations and other fisheries-related information, a proportion which is likely to increase into the future (35). Some researchers have used social media platforms to engage recreational fishing participants in ecological and fisheries sustainability research. For example, Redmap (Range Extension Database and Mapping

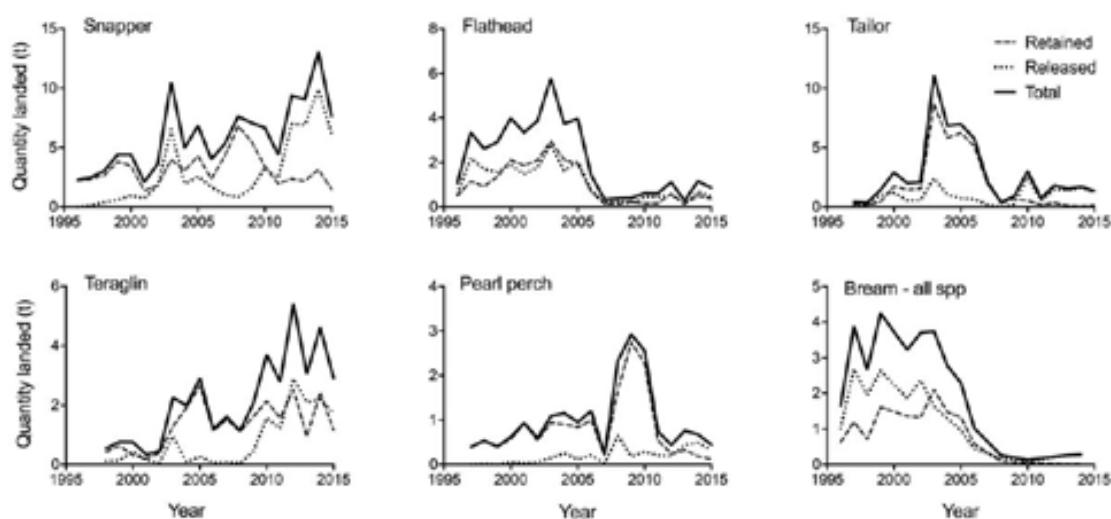
project) (36) aims to document range shifts in marine species, while studies that aim to understand the survivability of caught and released fish and inform best practice catch-and-release fishing have also engaged recreational fishers via social media (37). The recently launched Queensland Sustainable Fisheries Strategy (2017–2027) highlights the potential of social media platforms and government–social media partnerships for collating more comprehensive monitoring data on fishing activities into the future (38).

### Charter fisheries

Charter fishing is defined as a trip where an operator takes paying passengers to a site to fish. Only offshore charter operators (i.e. those operating beyond sheltered waters) are required to hold a charter fishing licence. Since 1996, offshore operators have been obliged to record their daily fishing activities using the same grid locations as commercial fishers (1). All fishers on board are required to abide by recreational in-possession and size limits.

Charter fishing is popular in offshore areas adjacent to Moreton Bay and in particular around Moreton Island (1). From 1996–2015, logbook records of licensed charters operations fishing this region show the top six species (retained by quantity) to be snapper, flathead (*Platycephalus* spp.), tailor, teraglin (*Atractoscion aequidens*), pearl perch (*Glaucosoma scapulare*) and bream (Fig. 4). On average, these species comprised 76% by weight of the total quantity of fish landed by licensed operators, with snapper caught in the greatest quantities, averaging 30% of total landings (1).

The number of charter licences and days fished within Moreton Bay peaked in 2003 at 44 licences and 2,036 days. As a result of fleet restructuring, both the number of licences and days fished were reduced in 2007 to 21 and 506 respectively. In recent years, the number of charter licences has continued to decline, with 17 licences registered in 2015, but since 2009 the total number of days fished has stabilised at around 600 days fished per year (1).



**Figure 4.** Total landings (retained and released) of the top six species retained by quantity by charter fishers operating within Moreton Bay (grids W37 and W38; data sourced from the Queensland Government (1)). Note that the axes differ in scale.

## **Discussion**

Looking to the future, a number of challenges exist for the fisheries of Moreton Bay. These include managing risks related to climate change and disease outbreaks, a growing urban population, conflict among sectors and competition from imported seafood products, mitigating environmental impacts from fishing, and navigating a changing regulatory landscape.

### **Risks to fishing activities**

Potential risks to fishing activities in Moreton Bay exist from other industries and activities. The population of South East Queensland continues to grow (28), which will not only increase the number of people directly relying on the marine environment for food and leisure (through participation in recreational fishing activities, non-fishing activities or increased demand for seafood products), but will also likely present additional pressures on habitat and water quality through coastal and catchment development.

Destruction of inshore habitats and reductions/alterations in estuarine water flows are known to affect fishery nursery grounds and/or recruitment success (39). In the longer term, commercial and recreational fishing practices will also need to be capable of adapting to the impacts of climate change (40). For example, it is possible that a rise in coastal water temperatures, as predicted for South East Queensland, would depress recruitment of eastern king prawn (41). Extreme or changing weather events may also influence or increase the variability of fishery recruitment patterns, as well as access to fishing grounds, thereby putting the economic viability of current fisheries at risk. Changing conditions and shifting distribution of species may reduce populations of some species but could also encourage the development of new fisheries within Moreton Bay over the longer term.

Infectious diseases can also affect the growth, survival rates and economic value of commercial and recreational marine species (42). While such impacts are more commonly reported in aquaculture, wild populations can also be affected (42). In 2018, prawn and crab samples from Moreton Bay tested positive for white spot disease (*Whisopovirus*), a highly contagious viral infection that affects crustaceans and is primarily spread by contaminated water and movement of affected animals (43). While white spot-infected crustaceans remain safe to eat, the virus causes rapid mortality of affected individuals. The potential spread of white spot disease throughout Queensland and the associated biosecurity risks has necessitated ongoing mitigation efforts including restrictions on fishing and aquaculture activities, restrictions on the movement of certain marine animals, and additional interstate importation requirements (44). To date, significant state and commonwealth resources (tens of millions of dollars) have been invested towards compensation, monitoring and mitigation of white spot disease (45).

In 2015 the Australian Labor Party made an election commitment to sustainable management of Queensland's fisheries through its Sustainable Fishing Policy that was taken to the state election (46). This policy proposed to improve the economic value of Queensland's fisheries resources. To achieve this, the Labor Government committed to adopt a fisheries resource allocation policy based on maximising economic value, recognising tourism-related fishing as a distinct activity, and developing the economic value of tourism-related fishing. In addition,

they committed to review the regulatory structure of commercial fishing, including exploring the establishment of net-free fishing zones within Moreton Bay. While these actions are likely to boost support for the charter industries, at this stage it is unclear to what extent these actions will impact commercial operators within the Bay.

Rising disposable income, together with awareness of the health benefits of seafood, has increased Australian seafood consumption from an estimated 13kg per capita per year in 2000–01, to 15kg per capita per year in 2012–13 (47). Fish consumption is projected to continue to rise, however, competition with aquaculture and cheap imported fish products (currently ~70% of Australian seafood is imported) poses continued challenges to the economic sustainability of Australia’s commercial fishing industries (47).

### **Mitigating the environmental impacts of fishing**

Fishing impacts on the marine environment have occurred, but the level of impact varies greatly depending on the fishing gear used, locations fished (in terms of specific habitat and species interactions) and intensity of use. There also remains a lack of effective catch or effort limits across most of the commercial and recreational sectors. Since 2009, an increase in protective marine park zoning has spatially restricted both commercial and recreational fishing activities in Moreton Bay. Active gears such as those used by the commercial sector have the potential to alter and degrade marine habitats, and capture non-target species (48). However, the magnitude of changes to habitats and fish populations from fishing is often unknown due to a lack of baseline data and the compounding effects of activities such as coastal development (49).

In recent years, regulations and fishery-specific mitigation practices have been implemented to reduce impacts such as bycatch and interactions with protected species. For example, the inclusion of turtle excluder devices has been mandatory for East Coast Otter Trawl fishery vessels since 2002, while commercial interactions with protected species are monitored through records of commercial fishery interactions with ‘Species of Conservation Interest’ in commercial logbooks. Commercial fishing industry associations, such as the Queensland Seafood Industry Association and Moreton Bay Seafood Industry Association, have also worked with the government to reduce bycatch and interactions with vulnerable species, and have developed codes of best practice e.g. the Moreton Bay tunnel net fishery (50) to reduce the environmental issues relating to fishing activities.

Fishing lines and pots, commonly used by the recreational and charter sectors, have minimal impacts on the structure and functioning of marine habitats (21). However, such gear can become broken off or lost, potentially interacting with marine animals and habitats for years afterwards. Bycatch of small individuals of target species or non-targeted incidentally caught species also occurs across all fisheries, and while these fish and invertebrates are often released, poor handling practices may increase their risk of injury and premature death (51,52). In 1995, a non-mandatory National Code of Practice for Recreational and Sport Fishing was developed by recreational peak bodies, supported by the Australian Government (53). This code addresses the need to fish responsibly, treat fish humanely and protect the wider environment.

### **Fisheries management and the future**

An independent review of Queensland fisheries management approaches was undertaken in 2014, with the aim to deliver a policy framework for consideration by government that would, among other things, achieve simplified fisheries management systems, and maintain and improve environmental sustainability. The review provided a number of recommendations, including that the Queensland Government clarify its approach to future management, revise the decision-making framework, be more strategic and transparent in allocating and managing access to fisheries resources, and improve data collection and monitoring protocols (54).

In 2017 the Queensland Government implemented the Queensland Sustainable Fisheries Strategy 2017–2027 (38), which sets out a reform agenda for fisheries management in Queensland. Among other ambitions, the strategy aims to develop sustainable harvest strategies for all Queensland fisheries and set clear harvest limits, improve sustainability and profitability, clarify the regulatory framework, and move to a best practice system of fisheries management and decision-making that is responsive to change and stakeholder needs (38). Major areas for reform include setting catch limits of target stocks at maximum economic yield (generally around 60% of the unfished biomass) by 2027, ensure that no Queensland fisheries are overfished, developing a simpler and more responsible system of fishery regulations for users and improving compliance rates across sectors (54).

The 2014 independent review touched on the interaction between fisheries and marine park planning, highlighting that marine parks have the potential to strongly influence fisheries management goals, both in terms of effecting wider ecosystem functioning and altering resource user behaviour. However, the 2017 strategy did not discuss marine parks. Additionally, while fisheries legislation currently contains provisions for Indigenous fishing activities, this may not be adequate given the recent recognition of native title rights in Moreton Bay and how legal recognition of these rights may evolve in the future. This is a complex and emerging regulatory landscape and it is not yet clear how the legislation will be reconciled, although the Resource Reallocation Policy, which will deliver on the action under the Sustainable Fisheries Strategy, does state that Indigenous sector allocations will be considered as part of this policy (55,54).

### **Conclusion**

Fishing in Moreton Bay has a long history and is one of the oldest Queensland industries. Today, the economic and cultural value of fisheries, and their related industries, to the Moreton Bay region are immense. The next ten years will likely see major reform of Moreton Bay fisheries. If a sustainable future for these sectors is to be assured, these reforms will need to balance demand to access fishery resources with conservation drivers, Indigenous fishing rights, other marine-based activities and increasing demands upon coastal space.

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