Mapping Queensland's Coastal Fishing Resources:

Interactive and updateable maps of Queensland's key fishing areas, closed waters and port and marina infrastructure; documenting the timing and basis for fishing closures.

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Australian Government

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2014/208: Interactive and updatable maps of Queensland's key fishing areas, closed waters and port and marina infrastructure; documenting the timing and basis for fishing closures.

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OBJECTIVES:

1. Research, accumulate and place in a central geoserver database all publically available spatial data on fishing catch and/or effort for major fisheries species in Queensland waters.
2. Research, accumulate and place in a database all publically available historical information on fishing closures in Queensland waters or adjacent Commonwealth waters: why the closure was implemented and the sequence of any changes to the closure.
3. Research, accumulate and place in a central geoserver database publically available spatial data on regulation and use of the marine environment: in particular State and Commonwealth marine parks, aquaculture zones, ports and marinas.
4. Provide up to date spatial data that is readily available to the general public, and allows quantitative spatial analysis and facilitates resource planning, around the cumulative effect of spatial management on access to high-profile fishing areas along the Queensland coast.

OUTCOMES ACHIEVED TO DATE

The Mapping Queensland's Coastal Fishing Resources (MQCFR) web portal electronically maps the major components of Queensland's coastal fishing resources: commercial and recreational fish catch and effort; spatial restrictions on extractive fishing, and some significant coastal infrastructure that supports fishing endeavour. The portal is available to the general public at **www.mqcfr.csiro.au**. The footprint of the portal can be extended to other State jurisdictions.

The history of Queensland fishery management closures was obtained by collaborative fishing industry surveys undertaken by the Queensland Seafood Industry Association. As well, Queensland's Department of Agriculture and Fisheries provided complementary information for trawl closures. These data are publically available via the web portal display. Each closure is linked to the specific implementation and history information acquired by the MQCFR project. Easy public access to a summarised history of coastal closures in Queensland has not been achieved before.

The portal can be integrated with spatial analyses tools or coastal production models to explore and predict key locations of high productivity; critical inshore habitats and offshore fishing grounds, or the optimal co-location of built-environment relative to productive biodiversity assets. As well, in January and December 2016 CSIRO staff used MQCFR to calculate the areas of Queensland closures by marine bioregion and State jurisdiction; and to calculate ratios of seabed area available to be trawled vs closed to trawling (Australia-wide), respectively.

ISBN

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In submitting this report, the researcher has agreed to FRDC publishing this material in its edited form.

Contents

Tables

Figures

Acknowledgments

The commercial fishers of Queensland cooperated with this project by providing historical information on the establishment of Queensland Fishing closures. The Queensland Seafood Industry Association was a collaborator on the project as a conduit to the commercial industry. They employed staff with specific part-duties to conduct the research to summarise information of the reasons for the establishment of fishing closures in Queensland.

Colleagues from the Department of Agriculture and Fisheries Queensland were instrumental to the project, providing advice from inception. As well, they provided key fishery closures and catch-and-effort data to support the portal. Colleagues from CSIRO Oceans and Atmosphere supplied closure data that had been acquired during work for other projects.

Executive Summary

CSIRO Oceans and Atmosphere created a web portal that electronically maps the major components of Queensland's coastal fishing resources: commercial and recreational fish catch and effort; spatial restrictions on extractive fishing, and some significant coastal infrastructure that supports the fishing endeavour. The portal is available to the general public at **www.mqcfr.csiro.au**. A year of negotiation with data custodians enabled the acquisition of spatial data to assemble and display the data via the portal. Though previously much of the data was publically available, it was available as raw data files, or as static print form in publications that were limited in distribution. The ''MQCFR' portal provides a single source, multi-layered electronic display that allows visualisation of several data themes simultaneously to better understand and plan current and optimal fishery management. The portal should be expanded to cover other states and/or updated with spatial data that are either new data or new themes (e.g. to provide economic value density estimates). Importantly, the portal should be a first step towards integrating spatial analyses tools or coastal production models to explore and predict key locations of high productivity; the links between critical inshore habitats and offshore fishing grounds via crucial immigration pathways, or the optimal co-location of built-environment relative to productive biodiversity assets. By 2016 the MQCFR portal already had made impact. CSIRO staff used MQCFR to calculate the areas of Queensland closures by marine bioregion and State jurisdiction; and to calculate ratios of seabed area available to be trawled vs closed to trawling.

In 2013, Queensland's Fisheries Research Advisory Board recognised the disparate nature of map data representing fisheries catch, closures to fishing, and relationship of offshore fishery activity to coastal ports and marinas. QFRAB's number one research priority was to "Development of interactive and updateable maps of key fishing areas and all waters closed to fishing, including links to explanations for the timing and basis for closure introductions".

At the same time, CSIRO's Oceans and Atmosphere (O&A) had created the Australian Marine Resource Spatial Management Atlas (AMRSMA) web portal that electronically mapped legislated spatial management around the total Australian coastline; especially areas closed to extraction, including fishing. O&A proposed a research project that duplicated the concept of the AMRSMA portal to create a Queensland-jurisdiction map portal with new themes. The intent was to add fishery catch and effort in the form of geographically referenced data, and to map some coastal infrastructure that supports fishing activity. Data acquired for the AMRSMA portal provided a head start.

The inventory and electronic mapping of a broad spectrum of historical spatial data to support current management and model future possibilities has received considerable attention over the last 10 years (see Risien *et al*. 2009, Best *et al*. 2012, Touraivaine *et al*. 2013). The over-arching aim of many current electronic mapping initiatives is to support management agencies and commercial operators to work towards capacity for Ecosystem Based Management (EBM) of productive coastal natural systems. EBM integrates bio-systems with human economic systems to support resilient commercial and recreational fisheries. We identified strategic value in mapping the spatial relationship between:

- Coastal infrastructure that may impact the nursery and adults habitats of fishery species,
- Coastal infrastructure that supports access to fishing locations and hot-spot areas,
- Marine areas that support fisheries and locations of high fishing intensity, and
- Areas and locations closed to extraction.

A need for a whole-of-system approach is reinforced by recent literature on a similar theme from long-time researchers in the Great Barrier Reef province "Guiding principles for the improved governance of port and shipping impacts in the Great Barrier Reef" (Grech *et al*. 2013). Three of their principles which would be enabled by access to spatial data were:

- Port developments that maximize biodiversity outcomes consider ecological implications early in the design process;

- A strategic and integrated approach to port planning maximizes biodiversity outcomes whilst maintaining efficient transport networks for industry;
- Active monitoring and adaptive management ensures the health of the ports and shipping governance system, with a particular emphasis on enhancing principled leadership.

These researchers suggest that only by good planning can port development minimise exposure of species and ecosystems to impacts; and maintain ecosystems and ecosystem services as close as possible to natural function (Grech *et al*. 2013). The same principles apply to maintaining ecosystem services that sustain the productivity of coastal fisheries while protecting habitats and biodiversity, including all the life history stages of the stocks that sustains the fisheries.

The objectives of the project were:

- Research, accumulate and place in a central geoserver database all publically available spatial data on fishing catch and/or effort for major fisheries species in Queensland waters.
- Research, accumulate and place in a database all publically available historical information on fishing closures in Queensland waters or adjacent Commonwealth waters: why the closure was implemented and the sequence of any changes to the closure.
- Research, accumulate and place in a central geoserver database publically available spatial data on regulation and use of the marine environment: in particular State and Commonwealth marine parks, aquaculture zones, ports and marinas.
- Provide up to date spatial data that is readily available to the general public, and allows quantitative spatial analysis and facilitates resource planning, around the cumulative effect of spatial management on access to high-profile fishing areas along the Queensland coast.

Fishery catch and effort spatial data were obtained by liaison with State and Commonwealth agencies responsible for fishery management. Both commercial and recreational State-managed fishery data were targeted. As well, Commonwealth-managed fishery data were acquired. Data were manipulated and summarised prior to display (usually annual summaries), to display meaningful data at the smallest spatial scale without violating the caveat that data will not be displayed unless ≥ 5 vessels per spatial unit contribute to the resultant density map.

Port and harbour extent and 'pilotage limit areas' were obtained from Maritime Safety Queensland. Marina point locations and extents were digitised from Google Maps. The capacity of each marina was obtained from websites that provided information to boat operators to support their boating activities.

The history of Queensland fishery management closures was obtained by collaboration with the Queensland Seafood Industry Association (QSIA). O&A provided QSIA a template that laid out a format for the collection of historical data. The template ensured a standard array of questions and responses to achieve a consistent data sets across all closures. These data are available via the web portal display. Each closure is linked to the specific implementation and history information acquired by MQCFR.

Maps of multidisciplinary geographical datasets are displayed via the MQCFR portal. They are available for simultaneous and multi-layered display via a tick-box legend. The development of the MQCFR portal should be seen as the first step on a pathway that facilitates the use of the acquired data in higher-level analyses, likely incorporating other data sets and allowing data download of inventoried data to support other researchers. Increasingly worldwide, a framework of integrated spatial decision support via geographic information systems, multicriteria evaluation and integrated datasets are being used to identify priority management scenarios that aim to sustain ecosystem services while promoting biological and economic production.

Keywords

Geographic data; portal display; closure to extraction; fishery catch; closure histories.

Introduction

In 2013, Queensland's Fisheries Research Advisory Board (QFRAB) recognised the disparate nature of map data representing fisheries catch, closures to fishing, and relationship of offshore fishing activity to coastal ports and marinas. That year, QFRAB's number one research priority was "Development of interactive and updateable maps of key fishing areas and all waters closed to fishing, including links to explanations for the timing and basis for closure introductions".

At the same time, CSIRO's Oceans and Atmosphere had created a web portal that electronically mapped legislated spatial management around the total Australian coastline; especially areas closed to extraction, including fishing. The Australian Marine Resource Spatial Management Atlas (AMRSMA) portal provided about 50% of the data to meet the QFRAB priority. O&A proposed a project that met 100% of QFRAB's aim by building on the scope of the AMRSMA portal by adding to a Queensland-only portal- fishery catch and effort data, and mapping coastal infrastructure that supports fishing activity. The outcome is the "Mapping Queensland's Coastal Fishing Resources" portal (MQCFR) that maps fishery closures, fish catch and effort, and coastal ports and marinas along the Queensland Coast.

From inception, the primary focus of the AMRSMA project has been interactive and updateable maps of waters closed to extraction or navigation. It was postulated that the AMRSMA portal would provide facilitating infrastructure to expand the electronic map display with new themes. A clone of the AMRSMA portal forms the basis of the MQCFR portal; with fish catch and effort data added.

The ability to overlay and compare the spatial extent of fishery catch data for a range of fishery species ('key fishing areas') was an original request as part of the FRAB priority. The project objectives reflect these two priorities: mapping fishing closures and key fishing areas. A third objective was to document the reasons-for and history-of fishing closures along the Queensland coastline.

The key recognition of the project was that the target spatial data already existed. It was the inventory and centralisation of these data that was a main task of the MQCFR project. The display of these data in a coherent form followed. Outside the MQCFR portal, the data were available in raw form downloadable from a website, or as a static map representation published by a managing authority. The multiple sources of the data were disparate and required significant searching to assemble key information summaries. The data were not available as a multi-layer, interactive visual display from a single source. Neither were numerous data layers able to be manipulated via tick-box call up. There was a need for an interactive portal publishing electronic maps of Queensland's coastal fishery resources where key datasets had been acquired, inventoried and displayable for simultaneous selection.

The concept of providing open access to archived spatial information has established over the last 10 years or so. Worldwide Open Geospatial Consortium (OGC) standards deliver geographic information in a systematic format that is interoperable among Geographic Information System (GIS) facilities. They provide Web Map Service (WMS) and Web Feature Service (WFS) allowing geographic information as a simple map representation or derived data (respectively) to be displayed on dynamic maps (de la Beaujardiere 2006). Unlike historical static maps, arrays of multidisciplinary data support real-time maps that can be updated with added parameters and newly calculated values.

International examples of maps and data applications served by geographic portals include a New Caledonian fire risk portal; the NANOOS Visualisation System (NVS) that publically serves and displays aggregated estuarine, oceanographic and meteorological data; and a portal that maps the optimal habitat for cetacean species based on modelled parameters and historical sightings.

The New Caledonian fire risk portal integrates multidisciplinary data sets and a model that estimates the risk of fire start and spread (see http://grimm.univ-nc.nc/geoportail/login/auth) (Touraivaine *et al*. 2013). The Northwest Association of Networked Ocean Observing Systems' (NANOOS) Visualisation System (NVS) (part of the US Integrated Ocean Observing System) displays and serves aggregated estuarine, oceanographic and meteorological data near real-time. The data are derived from buoys, gliders, tide gauges, HF Radar, meteorological stations, satellites and shore based coastal stations (Risien *et al*. 2009). The NVS incorporates model forecast information in a meaningful way to assist researchers and coastal operators; e.g. Tuna Fishers

(see http://nvs.nanoos.org/TunaFish). The cetacean mapping portal maps the optimal habitat by species for cetaceans based on modelled parameters such as water depth, distance to shore, distance to continental shelf break and sea surface temperature; overlaid with animal sighting data since 1985. The model predicts the seasonal distribution of cetaceans by species to assist with conservation and management measures (Best *et al*. 2012; see http://seamap.env.duke/prod/serdp/serdp_map.php).

In Australia, national agencies tasked with scientific research, data inventory and the provision of decision support are developing electronic map display of inventoried data and data download. Geosciences Australia (GA) provides geoscience information, capability and service outcomes to Australia Government and Industry to contribute to economic, social and environmental management of national resources. Under GA's 'Marine and Coastal' project, two specific initiatives provide maritime boundaries advice (Law of the Sea and Maritime Jurisdiction Project) and seabed mapping to assist coastal management (Seabed Mapping and Coastal Management Project).

Under GA's Marine and Coastal 'Scientific Topic' their "Australian Marine Spatial Information System" (AMSIS) portal assists to define Australian marine jurisdiction and boundaries. GA describes AMSIS as a "web based interactive mapping and decision support system that improves access to integrated government and non-government information in the Australian Marine Jurisdiction" (see http://www.ga.gov.au/imf-amsis2/ and http://www.ga.gov.au/scientific-topics/marine/jurisdiction/amsis/australian-ocean-governance-and-relevant-legislation). However, GA display the data for which they have custodianship and may not necessarily accumulate and display the full suite of spatial data that may be useful to a researcher or natural resource manager.

Australia's Exclusive Economic Zone (EEZ) in the coastal and marine realm is the world's third largest. Australia has sovereign rights over 11.38 million square kilometres of ocean (excluding the Antarctic Territory) together with the fishery, mineral and petroleum resources in that spatial realm. For the EEZ, the AMSIS portal recognises the need to define and map the legislated jurisdiction, allowed-use and boundaries as critical management capability to support coastal economic use and the preservation of biodiversity. The portal assists with others of GA's aims: "marine physical and biological datasets along with new data will be collated" and integrated to "develop models that describe linkages between seabed physical features and ecological processes that sustain biodiversity".

The AMSIS portal maps some data with similar themes to MQCFR and AMRSMA; e.g. fisheries boundaries and aquaculture zones, but does not provide detail of closures within fisheries, such as gear-specific or species-specific closures.

The Terrestrial Ecosystems Research Network (TERN) (see http://www.tern.org.au) enables ecosystem scientists to collect, contribute, store, share and integrate data across disciplines and to span geographic location. From a national perspective, ecosystem science targeting management to achieve sustainability currently faces problems that are too big and too complex to deal with in any other way. TERN is supported by the National Collaborative Research Infrastructure Strategy. The TERN Data Discovery Portal (http://portal.tern.org.au/) provides in inventory of data with associated metadata Australia wide. Much of the data inventory are survey results over a broad spectrum of investigations. TERN suggests that its ability to connect scientists and managers benefits industries including agriculture, forestry, mining, environmental management, insurance, eco-tourism, health and education.

The Australian Coastal Ecosystems Facility (ACEF) is a similar data portal that is hosted as a collaboration between TERN, CSIRO and the Department of Industry, Innovation, Science, Research and Tertiary Education. ACEF collects, displays and distributes 'key coastal datasets for use in policy and management decisions about the protection and use of Australia's coastal assets, both marine and freshwater' (see http://acef.tern.org.au/). It addresses data collection needs from fine scale to satellite collections of flora, fauna and biophysical properties of coastal ecosystems.

The ACEF Coastal Data Portal (http://acef.tern.org.au/portal/) allows investigation of datasets and mapping of spatial data. The portal allows download of some datasets. Similarly to the TERN portal, the ACEF portal supports a multidisciplinary approach to coastal management and data sharing between researchers and managers.

Whether Australian or international portals, the overarching aims of this array of web-based spatial mapping and data inventory infrastructure is to:

1. centralise multidisciplinary spatially referenced data in electronic format,
2. map those data either as standalone maps or as descriptions of location and coverage of relevant datasets, and to
3. enable access to those data via download of maps or the actual datasets.

These aims are common with the aims of the MQCFR portal. MQCFR maps fishing effort, resultant catch and both the infrastructure that supports access to marine resources and the spatial management that may impede un-feted access. It allows quick and manipulable visualisation of multiple data layers to create maps that enhance understanding of the linkages between access, effort and catch outcomes. At this stage MQCFR does not support the download of data.

Objectives

The objectives of the project were:

- Research, accumulate and place in a central geoserver database all publically available spatial data on fishing catch and/or effort for major fisheries species in Queensland waters.

- Research, accumulate and place in a database all publically available historical information on fishing closures in Queensland waters or adjacent Commonwealth waters: why the closure was implemented and the sequence of any changes to the closure.

- Research, accumulate and place in a central geoserver database publically available spatial data on regulation and use of the marine environment: in particular State and Commonwealth marine parks, aquaculture zones, ports and marinas.

- Provide up to date spatial data that is readily available to the general public, and allows quantitative spatial analysis and facilitates resource planning, around the cumulative effect of spatial management on access to high-profile fishing areas along the Queensland coast.

Methodology

The project methodology had three major components. The first was a data gathering/ acquisition activity which involved wide-ranging liaison with State and Commonwealth Government agencies, as well as the commercial fishing industry. These activities identified data sets relevant to project aims that were available to be mapped. The datasets were acquired and appropriate legal arrangements to support their display put in place. A key facet of this component of the project was that it acquired pre-existing data. That is, the datasets or raw data from which appropriate datasets were developed existed external to FRDC 2014-208. The project acquired, inventoried and displayed these data.

The second methodology component was the building of GeoServer and GeoNetwork and web portal infrastructure to house and display spatially the data acquired. The ultimate data receptacle was a Postgres database that is integrated in Geoserver. The MQCFR portal provides a platform for the management and publication of geospatial data. It brings together open-source software projects under a consistent and easy-to-use interface allowing non-specialized users to share data and create interactive maps. Data management tools allow for integrated creation of data, metadata, and map visualizations. An eventual option is that each dataset in the system can be shared publicly or restricted to allow access to only specific users.

The third component of the project also was a liaison/ data gathering activity. However, a key difference was that it created new data via targeted interview with commercial fishers. This component determined the history of and reasons for Queensland's fishing closures. It was largely conducted by the Queensland Seafood Industry Association as a project collaborator. The data were acquired via telephone interview with key fishers in regional areas who had keen local knowledge having operated in a region for many years. These data were entered into a 'closures-history' database that is linked to the closures displayed on the portal. A mouse-click on the closure will bring up the advocacy and history data for that closure.

MQCFR also acquired and added to the closures-history database a history of the Queensland trawl closures compiled by the Department of Agriculture and Fisheries (see Anon 2011). These data were sourced from a comprehensive written report that summarised the timing, reasons for implementation, and history of trawl closures derived from a management perspective. The information format easily fitted the format of the data compiled by QSIA.

Fishery Catch and Effort Data

We obtained fishery catch and effort data from both State and Commonwealth agencies.

State managed fisheries

From the inception of the project, DAF Queensland has been involved with the project. Nadia Engstrom (Senior Fisheries Resource Officer, Data and Logbooks) has been the main contact. Prior to the actual project, initial meetings took place between Ross Quinn (Manager, Licencing and Fisheries Information, DAF) and Nadia, and key members of the project team. The meeting scoped the range of data available to be acquired and displayed on the portal. Nadia attended major project meetings over the operational year of project development and delivered key fishery catch and effort data that are now displayed on the MQCFR portal.

Nadia was also a key contact for the Queensland fishery closure shapefile data that was acquired by the Australian Marine Resource Spatial Management Atlas project (AMRSMA) and then displayed on the MQCFR portal.

Commercial fishing data

Nadia Engstrom managed the DAF commercial fishery data. Rob Kenyon visited DAF during November 2014 and subsequent liaison with Nadia ensured we obtained commercial catch data for 29 species or species-group of fish and crustaceans along the Queensland coast (see Results in the report).

The data were targeted at both 30 and 6 nautical mile grid scales, depending on the density of the data and subject to the rule that ≥ 5 vessels contribute to the resultant catch or effort density map. The data have been obtained grouped by fishery, gear-type and species.

Recreational fishing data

James Webley (Senior Fisheries Scientist, Recreational Fishing Monitoring) managed the DAF Queensland recreational fishery data. Together with MQCFR team members, James identified the existence and availability of recreational fishing data for the Queensland coast. We discussed the acquisition of these recreational catch data with DAF. We obtained data for 2010 and 2013; the 2013 data are displayed on the MQCFR portal. Recreational catch data for 48 species or species-group of fish and crustaceans along the Queensland coast are available via the portal (see Results in the report). The point-locations of the recreational fishing catch data are obscured within a 6 nm circle.

A summary of the State-managed fishery data that we targeted and a record of what we successfully acquired is provided in Table 1.

Table 1 State-managed fisheries on the east coast of Queensland and the Gulf of Carpentaria coast.

State Fishery	*Spatial extent*	*Species*	*Data availability*	*Data acquired*	*Data scale*
Commercial Prawn Fisheries	East Coast	Prawns	DAF, Qld.	Yes	6 nm
Commercial net fisheries	East Coast, GOC	Scalefish	DAF, Qld.	Yes	6 nm
Commercial pot fisheries	East coast, GOC	Crabs	DAF, Qld.	Yes	6 nm
Recreational fishery	East coast, GOC	Scalefish, crabs	DAF, Qld.	Yes	6 nm
Coral Sea Fishery	Cape York to Sandy Cape	Lobster	DAF, Qld	Yes	6 nm

Commonwealth managed fisheries

Commonwealth fisheries data was acquired via liaison with AFMA, independent fishery consultants and CSIRO colleagues. Three main fisheries were targeted: the Northern Prawn Fishery (Shane Fava, manager); the Torres Strait Fishery (Selina Stoute, manager; Lisa Cocking, senior manager), and the Eastern Tuna and Billfish Fishery (ETBF, Stephanie Martin, manager). A Deed of Data Licence has been put in place between AFMA and CSIRO to publish AFMA data via the MQCFR portal. The spatial scale of publication of fishery data ensured that only catch data from ≥5 fishers were displayed. Spatial scales of 6 nm and 60 nm were deployed.

NPF data were obtained from the CSIRO Northern Prawn Fishery assessment team and published after consultation with AFMA. The data were published for several prawn species at a spatial resolution of 6 nm squares.

Torres Strait lobster and prawn data were obtained from the Clive Turnbull (fisheries consultant) after consultation and establishing a licencing agreement with AFMA. The data were published for tiger prawns, endeavour prawns and king prawns and the tropical lobster at a spatial resolution of 6 nm squares.

ETBF data were obtained from CSIRO colleagues and Steve Auld (AFMA) and published after consultation with AFMA. The data were published for several tuna and billfish species at a spatial resolution of 60 nm squares.

Table 2 Commonwealth fisheries adjacent to the Queensland coast.

Commonwealth Fishery	*Spatial extent*	*Species*	*Data availability*	*Data acquired*	*Data scale*
Northern Prawn Fishery	Gulf of Carpentaria	Prawns	AFMA/ CSIRO	Yes	6 nm
Torres Strait Lobster Fishery	Torres Strait	Tropical Lobster	AFMA/ CSIRO	Yes	6 nm
Torres Strait Prawn Fishery	Torres Strait	Prawns	AFMA	Yes	6 nm
Eastern Tuna and Billfish Fishery	Coral Sea and south	Tuna, swordfish	AFMA/ CSIRO	Yes	60 nm
Coral Sea Fishery	Cape York to Sandy Cape	Lobster	DAF, Qld.	Yes	6 nm
SESSF	South of Fraser Island	Scalefish	Not targeted	na	Na

Port, Harbour and Marina Location and Capacity Data

Rob Kenyon liaised with Wayne Bagnell from Maritime Safety Queensland (MSQ) to scope the availability of port location and port extent data. MSQ provided MQCFR with three spatial data sets: Port Limit Areas, Pilotage Limit Areas, and Compulsory Pilotage Limited Areas.

Marina location data along the Queensland Coast in the form of point locations and marina spatial extents were digitised from Google Maps. Marina features (e.g. vessel capacity, fuel outlets etc.) were obtained by interrogating the Websites of each marina identified. Both port and marina data are displayed on the MQCFR portal.

Fisheries Management Closure History Data

The history of Queensland fishery management closures was obtained by collaboration with the Queensland Seafood Industry Association (QSIA). A contract with QSIA to acquire and document historical closure data was signed on 21st May 2015. The contract listed the tasks to be undertaken by QSIA and includes "document

the history of and changes to Queensland fishing closures through discussions with long-standing fishing industry representatives and local boating patrol officers (by 31st August 2015)".

The contract listed three sets of closures for which history data could be acquired. They were targeted to be obtained in a monthly stepped approach:

- Fisheries Regulated Waters (63 FRWs, by 31st May 2015),
- Fisheries Closed waters (52 FCWs, by 30th June 2015), and
- Waters regulated under the Trawl Management Plan (64 CWTMPs, by 31st July 2015).

During the project the timelines for the acquisition of these data were not adhered to; but by January 2016 the closure history dataset will be complete.

CSIRO developed an updatable survey form to capture standardised history data using protocols derived during a previous closure survey (see Appendix). In the mid-2000s, CSIRO undertook a review of the closures implemented under the auspice of the Northern Prawn Fishery (NPF) (Kenyon *et al*. 2005). As part of the NPF closure documentation, a data form was developed that captured relevant information. It comprehensively described header-information, instigation and objectives of fishing closures and provided an opportunity for a descriptive narrative. This form was updated to reflect the needs of the Queensland fishing closure data-capture.

Initially, the document was sent to key commercial fishers and together with telephone-facilitated encouragement by QSIA, closure data have been captured. Over time the strategy changed; stand-alone telephone-facilitation of data capture was employed. Over the duration of the project, QSIA has taken on two part-time employees (Ayesha Plant and Elaine Lewthwaite), a portion of whose time involves liaison with fishers via the telephone to engage their interest and capture data.

The closure history document contained the key header information about the closures: the context under which they were instigated, the reason they were instigated; any research outcomes or data that supported the closure, and a short narrative that described the consultation and instigation progress. The document has been individualised for each closure by incorporating a short closure description in a header and a map of the closure to ensure no misunderstanding about the particular closure to document. Sixty three documents were created for the FRWs, fifty two for the FCWs and sixty four for the CWTMPs.

When received, the closure histories were read and categorised by context and objective and these summary data were compared across the FRWs, FCWs and CWTMPs. Closure history data were entered into an ORACLE database and they will be linked to the maps of the closures displayed on the portal. The closure histories provide explanatory data for each closure.

Results

The MQCFR portal has been constructed and populated with data representing State and Commonwealth fishery management closures, closures to protect biodiversity and ecosystems, port and marina locations and State and Commonwealth fishery catch and effort data (Figure 1). The portal displays multiple layers of data to produce maps showing (for example) an array of closures, plus banana and tiger prawn trawl catch along Queensland's east coast (Figure 2).

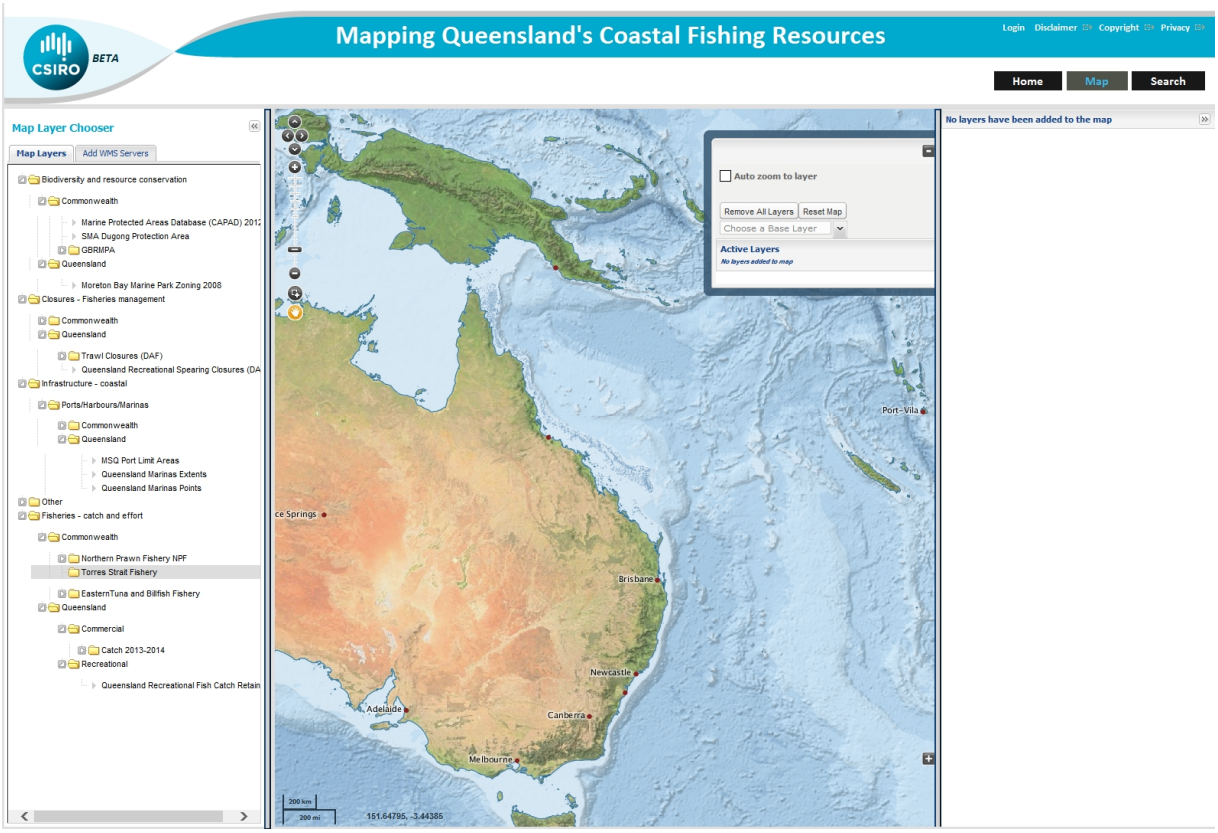

Figure 1. A typical MQCFR display showing the legend of biodiversity and fishery management closures, coastal infrastructure and commercial and recreational fish catch along the Queensland coast.

The MQCFR portal provides a single source of collated coastal spatial data available to the general public to improve knowledge of Queensland's coastal biotic resources. It also maps restrictions to the access of these resources, as well as coastal infrastructure that enhances access to the resources. The mapping of ports, port limits and marinas demonstrates the spatial relationship between productive fishing grounds, areas closed to fishing and the footprint of significant coastal infrastructure with the vessel-support capacity to impact biotic resources.

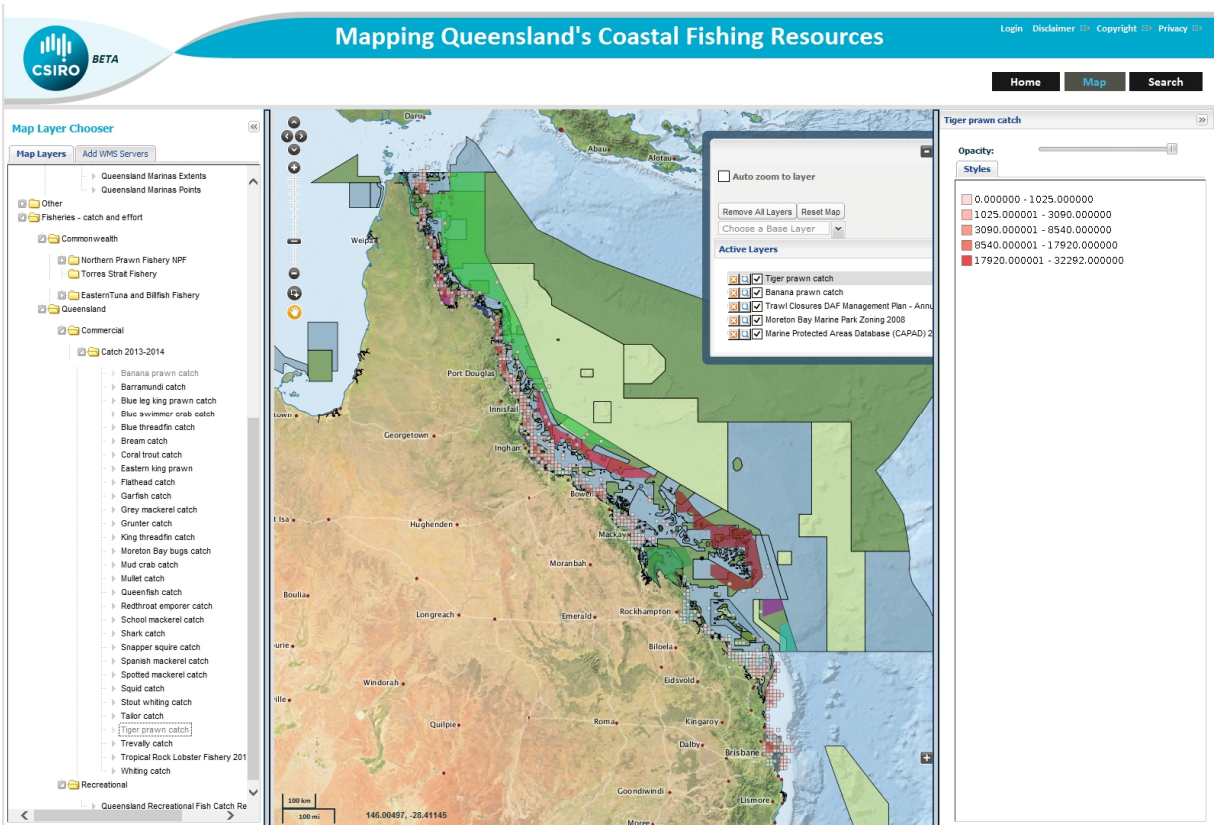

Figure 2. A typical MQCFR display showing the location of Commonwealth biodiversity and State fishery management closures and commercial tiger and banana prawn catch along the Queensland coast.

The centralisation of and access to these spatial data is a significant step towards public access to a broad array of geographically-referenced data that can be mapped and displayed simultaneously and interactively to enhance public understanding Queensland's biological resources. MQCFR maps Queensland's fishing resources and the limits on their exploitation. Moreover, researchers and managers can use the maps to overview forward planning and optimisation to support a range of economic and industrial activities while maintaining biodiversity and ecosystem integrity which underpin coastal productivity and therefore fishery resources.

Whilst data licencing limits the transfer of most data to a third party, CSIRO has access to the original data and the capacity to incorporate these data in further analyses and modelling. Improved licencing arrangements that allow the download and third-party transfer of data would improve the services provided by the portal (as discussed in "Further Development").

Fishery Catch and Effort Data

We obtained fishery data from both State and Commonwealth agencies.

State managed fisheries

Commercial fishing data

MQCFR obtained commercial fishery catch and effort data for 29 species or species-group of fish and crustaceans along the Queensland coast (Figure 3). These data were obtained from the Department of Agriculture and Fisheries, Queensland. The data coverage is Queensland wide and is displayed as six (6)

nautical mile grid squares colour-graded by density of catch or effort. The data screening rule meant that meaningful data could be displayed for only 29 species of a larger range available.

An example of the MQCFR display for mud crab catch from the Gulf of Carpentaria and northern Queensland east coast is provided in Figure 4. It shows hot spots for mud crab catches in the south east Gulf of Carpentaria, in the Hinchinbrook Channel, and in the vicinity of Ayr, Proserpine and Mackay.

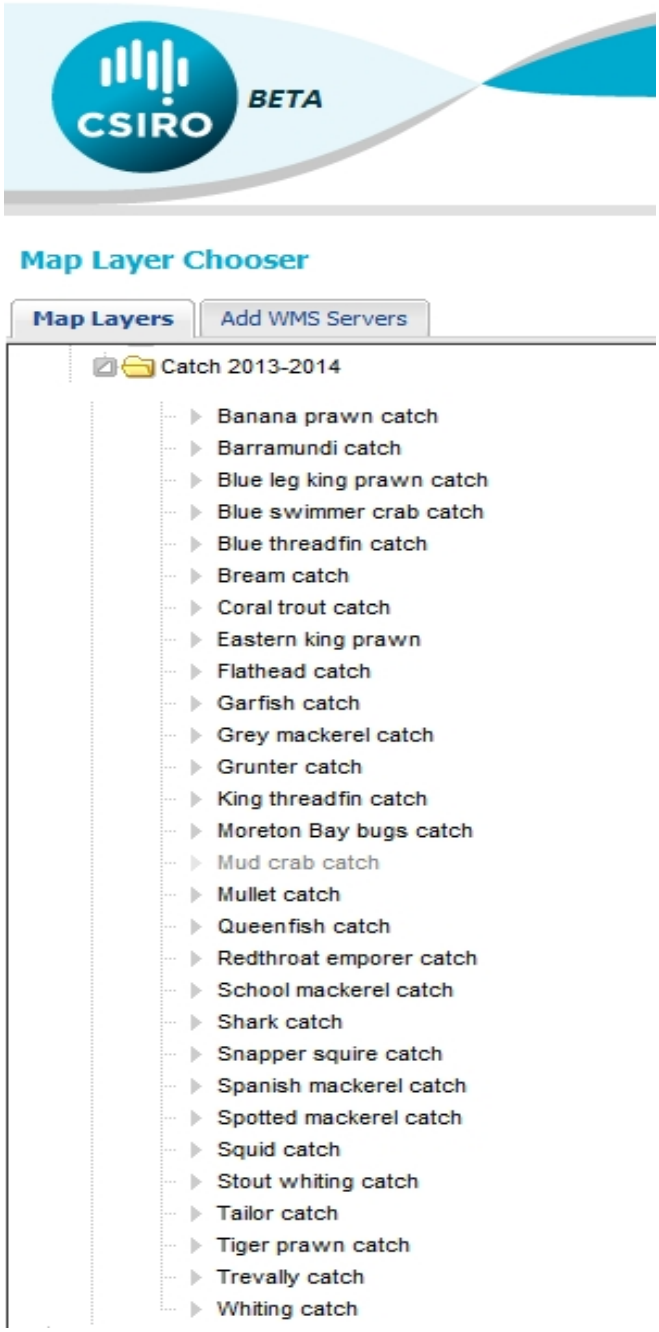

Figure 3. List of commercial fish species displayed on MQCFR

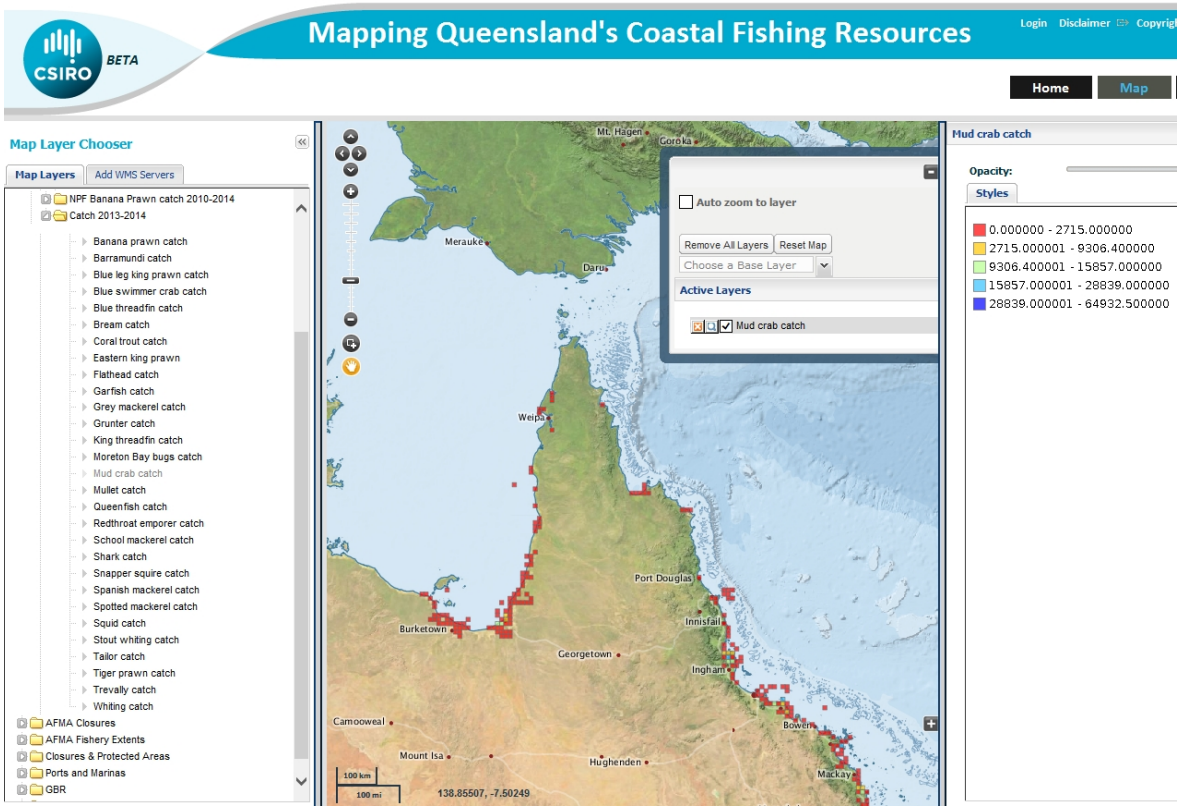

Figure 4. Commercial mud crab catch displayed on MQCFR

Recreational fishing data

Recreational catch data for 48 species or species-group of fish and crustaceans along the Queensland coast are available (Table 3). These data were obtained from the Department of Agriculture and Fisheries, Queensland. Data for 2010 and 2013 have been acquired. The recreational fishery catch data are compiled via structured telephone survey of DAF staff. Fishers with whom DAF staff establish an ongoing contact relationship are telephoned monthly or more often and they provide catch details. The data-gathering methods are described in detail by Taylor *et al*. (2012).

The data are displayed via a tick-box legend as typical in Figure 5. The data screening rule meant that meaningful data could be displayed for only 48 species of a larger range available.

The recreational fish catch report one or more of that species of fish caught at a location specified by the recreational fisher. The location often is descriptive (e.g. a coastal town or feature (e.g. an estuary)) nearby where or within which the fish was actually caught, rather than a precise latitude and longitude. To avoid locating exact fishing positions and breaching fisher confidentiality, the catch location is represented by a circle with a 6 nm radius within which the location is randomly allocated.

The MQCFR portal display for three recreational fish species are shown in Figures 6 to 8. Barramundi in the Gulf of Carpentaria, Golden Trevally on the tropical east coast, and Hussar in south east Queensland are displayed.

Table 3 Recreational fish species displayed on MQCFR

Species		Species		Species	
Barramundi	Fork-tail Catfish	Mangrove jack	Pearl Perch	Sand Whiting	Spotted Mackerel
Barred javelin	Garfish	Moses Snapper	Pike	School Mackerel	Stripey snapper
Blue threadfin	Giant Trevally	Morwong Sweetlip	Pikey Bream	Shark - unspecified	Trevally - unspecified
Cobia	Golden Snapper	Mud Crab	Prawns	Shark - whaler	Trumpeter Whiting
Cod / Grouper	Golden Trevally	Mullet	Queenfish	Shovelnose	Tuskfish
Coral trout	Grass emperor	Mulloway	Rays / skates	Snapper	Yabbies
Dusky flathead	Hussar	Northern Sand Flathead	Red Emperor	Spangled Emperor	Yellowfin Bream
Eel-tail catfish	King Threadfin	Parrot Fish	Redthroat Emperor	Spanish Mackerel	Whaler/ Weasel Sharks

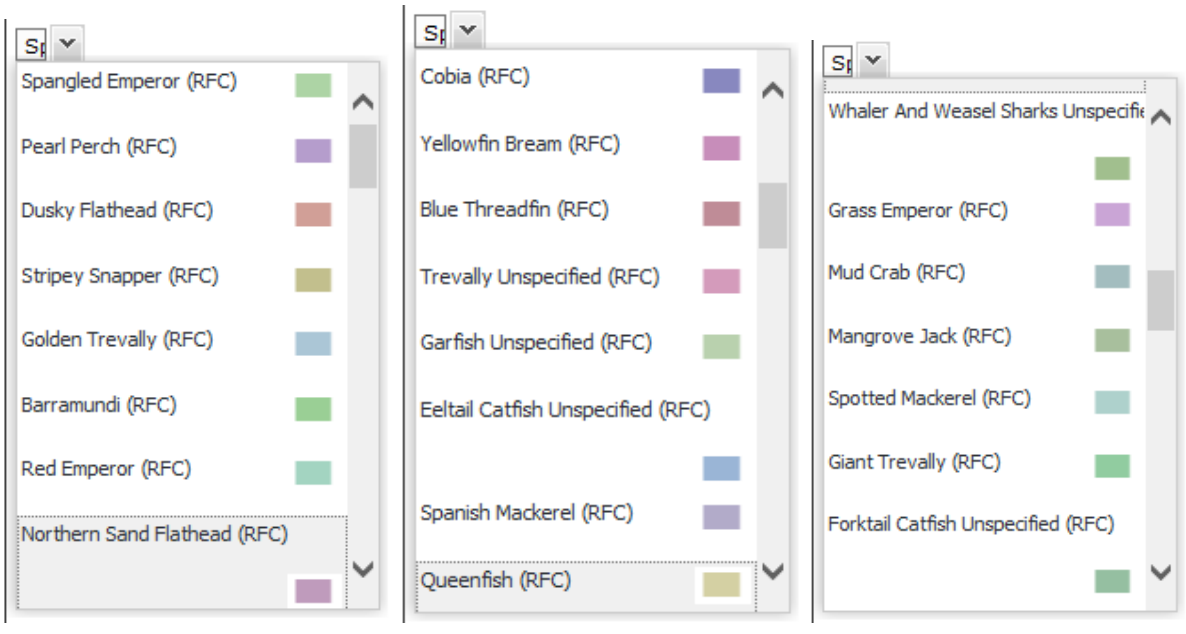

Figure 5. Typical display of recreational fish species as seen on MQCFR

In the Gulf of Carpentaria, the hot spots for barramundi caught recreationally are along the eastern coastline (the west coast of Cape York). In part, this distribution may be influenced by access near small population centres between Karumba and Weipa.

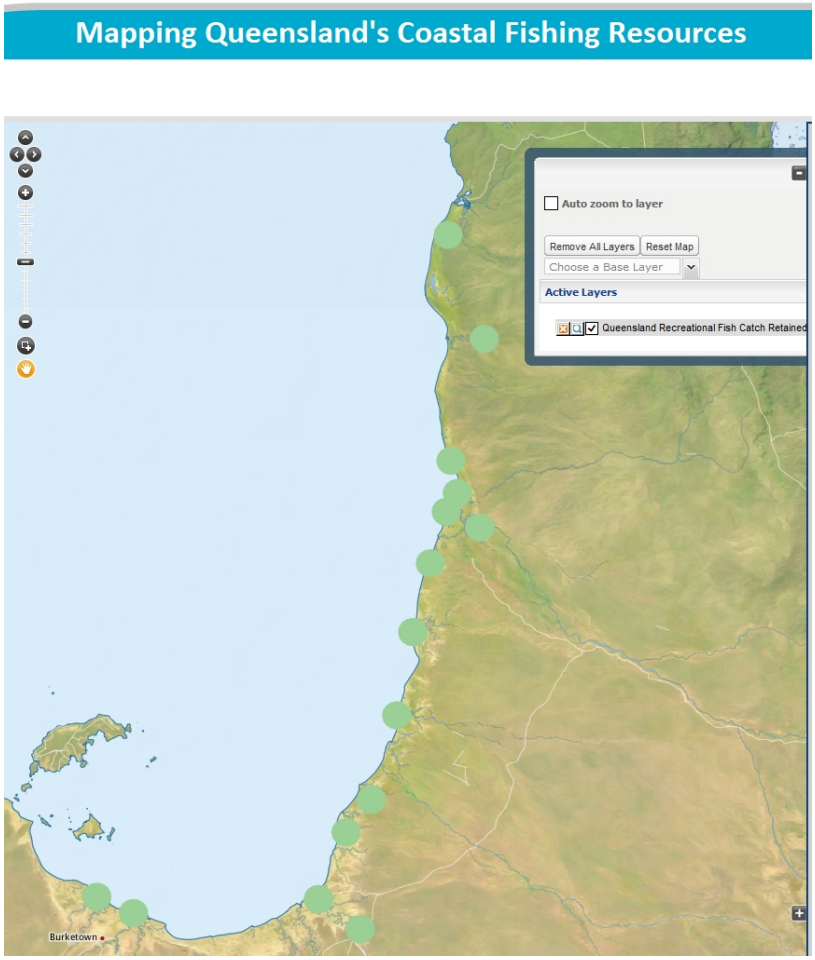

Figure 6. The reported recreational fishery catch of Barramundi in the east and south east Gulf of Carpentaria, Queensland.

Golden trevally are caught on the reef complexes of the Great Barrier Reef and in estuaries on the tropical coast.

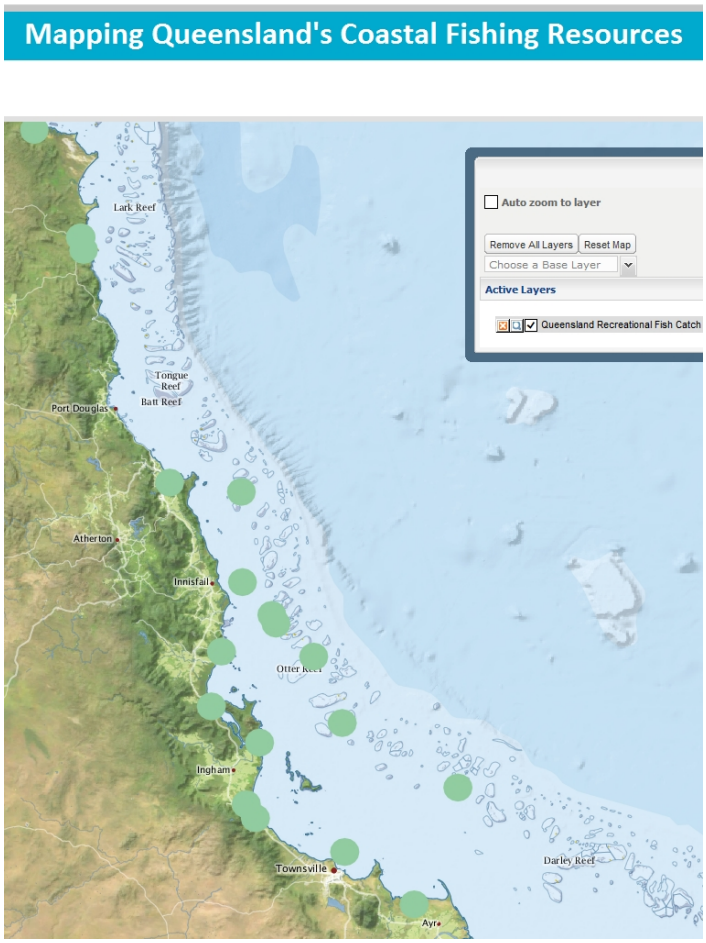

Figure 7. The reported recreational fishery catch of Golden Trevally on the tropical east coast, Queensland.

Hussar are abundant offshore in southeast Queensland.

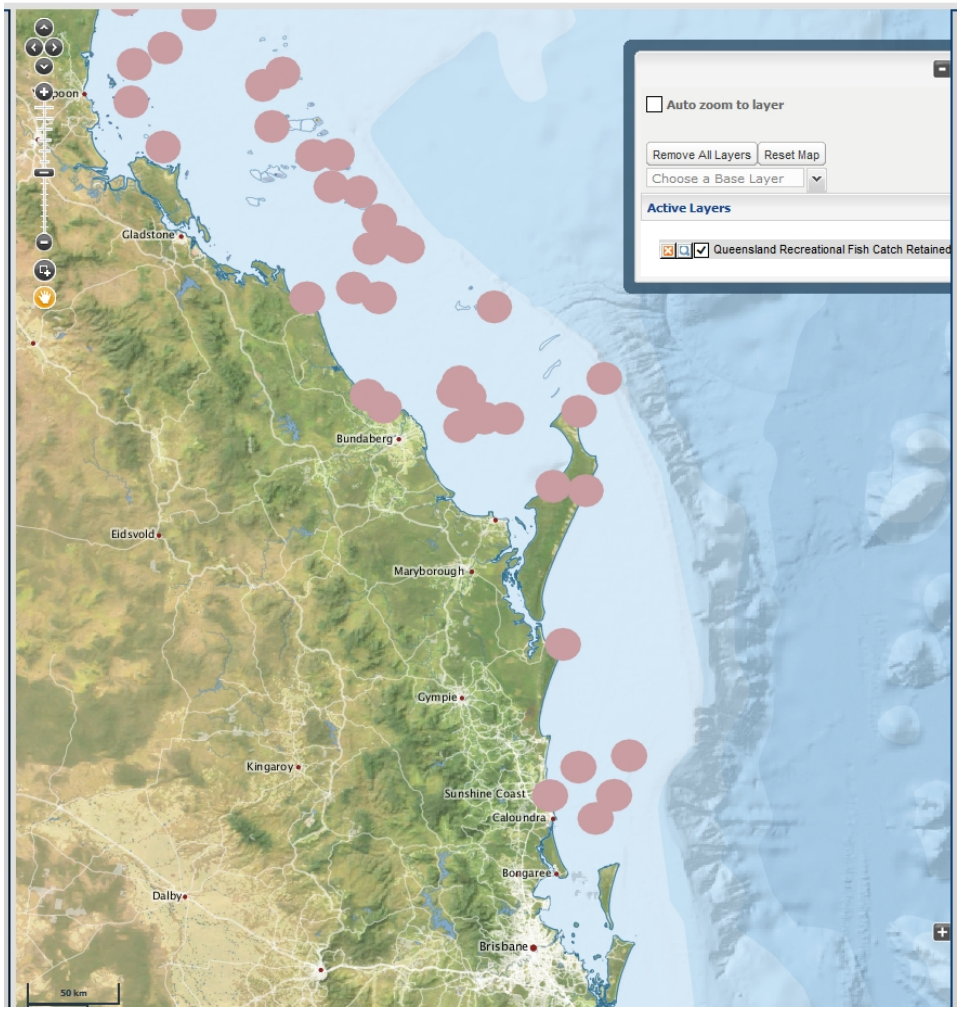

Figure 8. The reported recreational fishery catch of Hussar in south east Queensland.

Commonwealth managed fisheries

Data were acquired for five Commonwealth fisheries: the Northern Prawn Fishery; the Torres Strait Lobster Fishery and the Torres Strait Prawn Fishery; the Eastern Tuna and Billfish Fishery; and the Coral Sea Fishery (data acquired from DAF, Queensland) (Table 4).

Four major prawn species are displayed within the NPF, grooved tiger prawns, brown tiger prawns, banana prawns, and blue-tailed endeavour prawns (*Penaeus semisulcatus*, *Penaeus esculentus*, *Penaeus merguiensis*, and *Metapenaeus endeavouri*, respectively) (Figure 9). Data are available from 2010-2014 and are displayed on a 6 nm grid-scale.

The catches of tropical lobster within the Torres Strait fishery are displayed. Data are available for the 2013-2014 financial year. For Torres Strait prawns, the species groups of tiger prawns, endeavour prawns and king prawns are displayed in Torres Strait waters. Data are available by year for 2005 and for 2013, 2014 and 2015. Both species groups are displayed on a 6 nm grid-scale.

Yellowfin Tuna, Albacore Tuna and Bigeye Tuna are displayed, as well as Broadbill Swordfish and Striped Marlin are displayed in the Eastern Tuna and Billfish Fishery (Figure 9). Data are available on an annual basis from 2010 to 2014 and the four species are displayed on a 60 nm grid-scale.

Table 4 Commonwealth fisheries adjacent to the Queensland coast

Commonwealth Fishery	*Spatial extent*	*Species*	*Data availability*	*Data acquired*	*Data displayed*
Northern Prawn Fishery	Gulf of Carpentaria	Prawns	CSIRO	Yes	Yes
Torres Strait Lobster Fishery	Torres Strait	Tropical Lobster	CSIRO	Yes	Yes
Torres Strait Prawn Fishery	Torres Strait	Prawns	AFMA/ Turnbull	Yes	Yes
Eastern Tuna and Billfish Fishery	Coral Sea and south	Tuna, swordfish	CSIRO	Yes	Yes
Coral Sea Fishery	Cape York to Sandy Cape	Holothuria, lobster	DAF, Qld.	Yes	Yes
SESSF	South of Fraser Island	Scalefish	Not targeted	na	na

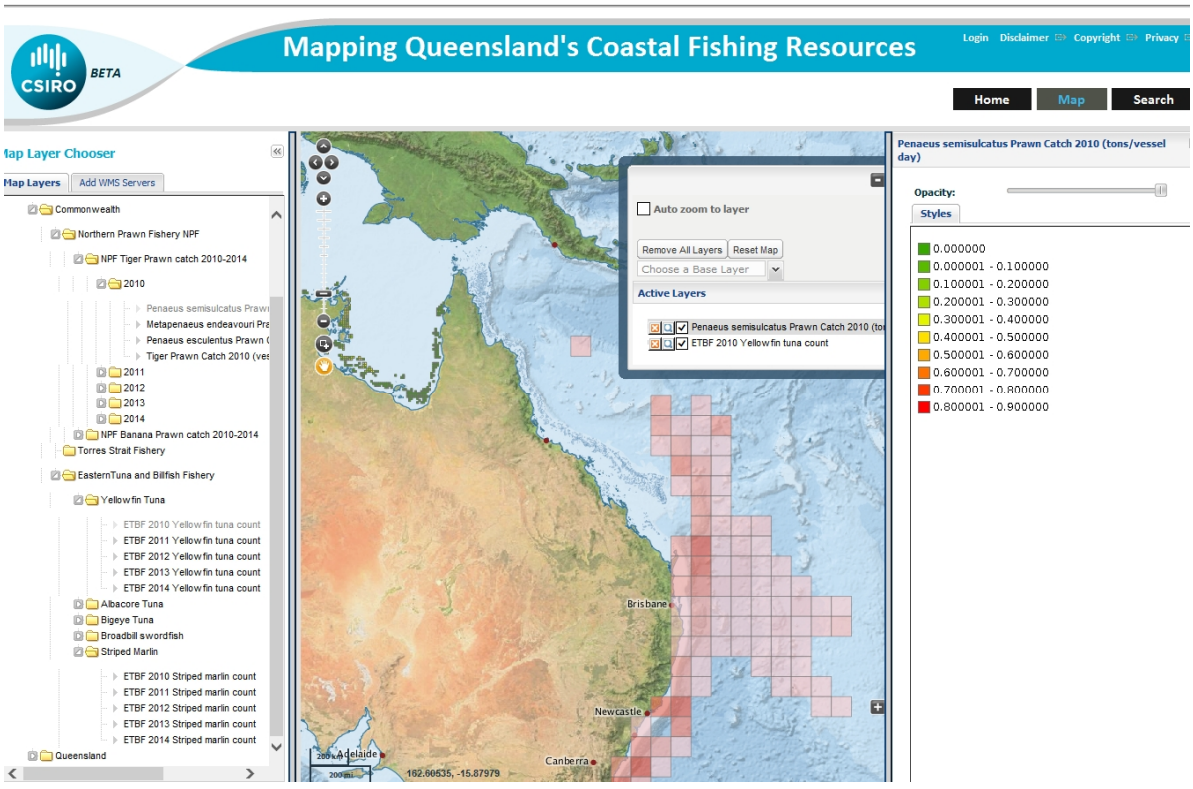

Figure 9. Snapshot of the tick-box legend for Commonwealth fishery species archived for display via the MQCFR portal.

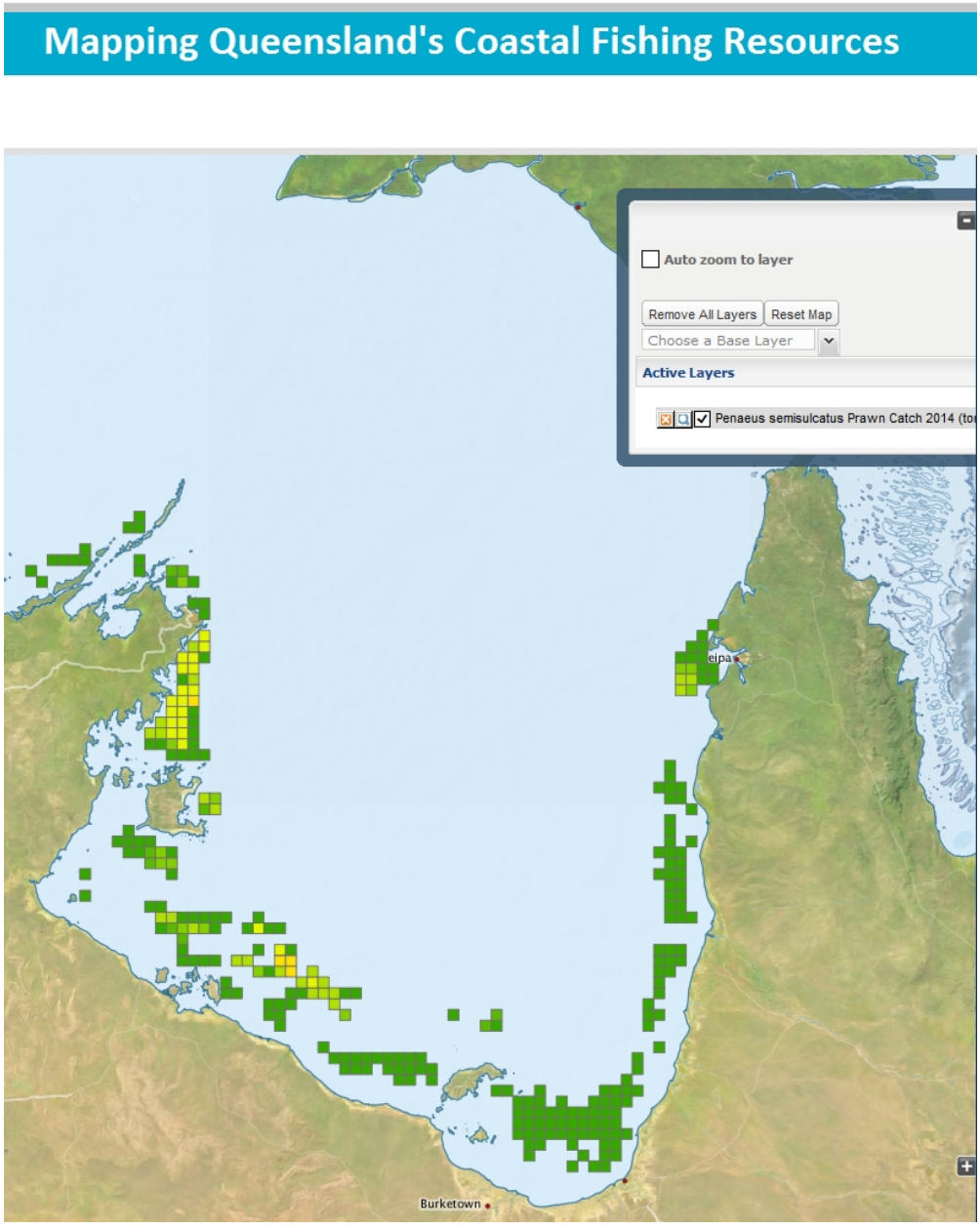

Figure 10 Snapshot of the distribution of grooved tiger prawns (*Penaeus semisulcatus*) in the Gulf of Carpentaria.

The MQCFR portal provides simultaneous display of the allopatric distribution of the two major commercial prawn species in the Gulf of Carpentaria. *Penaeus semisulcatus* are most abundant in the north-west Gulf of Carpentaria and the south-west Gulf (Figure 10). *Penaeus esculentus* are most abundant in the south-east Gulf of Carpentaria and south west of Groote Eylandt (Figure 11).

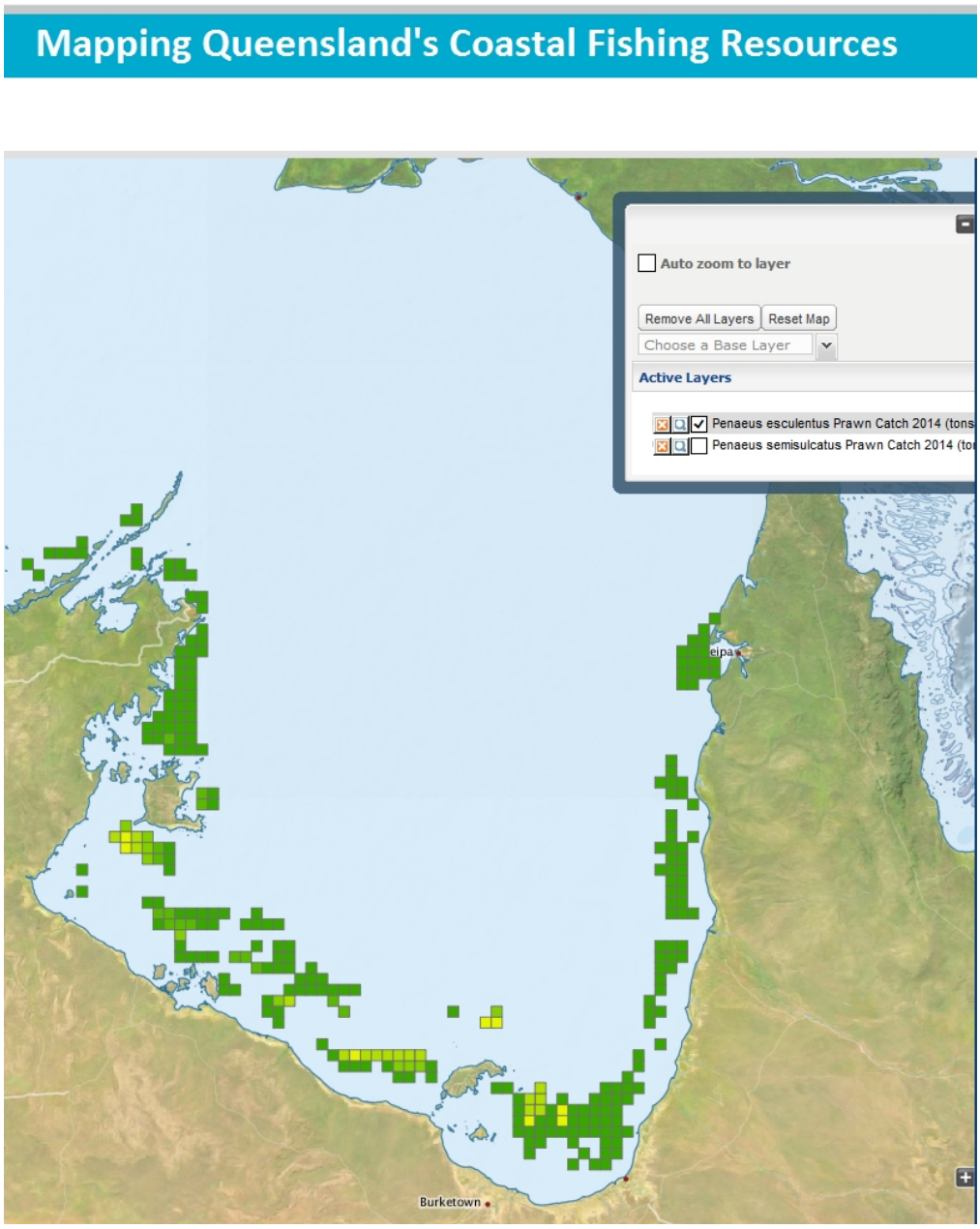

Figure 11 Snapshot of the distribution of brown tiger prawns (*Penaeus esculentus*) in the Gulf of Carpentaria.

AMRSMA-sourced fishing closure data

Queensland's DAF have not completed updating the precision of the shapefile data for the Queensland commercial fishing closures by the submission of this report. In November 2016, Nadia Engstrom (DAF Qld, Senior Fisheries Officer) informed me that the commercial fishing regulated waters (Fishery Closed Waters) had not yet been revised. However, their intention remains to ensure the precision of these shapefiles for publication. The closure files will be loaded in both the AMRSMA and MQCFR portals when they become available. Currently, closure history data cannot be linked to the MQCFR portal for these closures as they are not yet mapped.

These data are the third batch of shapefile data to display the Queensland fishing closures on the MQCFR Portal. Technically, the acquisition of these data is an initiative of the Australian Marine Resource Spatial Management Atlas project (CSIRO), but they are crucial for the MQCFR display.

Port and marina location and extent

Twenty port locations were acquired from Maritime Safety Queensland (Table 5). The legislated port extents and associated compulsory pilotage areas are displayed. Most are adjacent to cities and major towns along the Queensland Coast. A few are in remote north Queensland along the east and west coasts of Cape York.

Table 5 Queensland ports displayed on the MQCFR portal

PORT	REGION OF QUEENSLAND	MSQ REGION	PORT AITHORITY
Port of Brisbane	South east Queensland	Brisbane	Port of Brisbane Corporation Limited
Port of Gladstone	Central Queensland	Gladstone	Gladstone Ports Corporation Limited
Port of Weipa	Far north Queensland - Gulf of Carpentaria	Cairns	North Queensland Bulk Ports Corporation Limited
Port of Townsville	Central Queensland	Townsville	Port of Townsville Limited
Port of Cairns	North Queensland	Cairns	Far North Queensland Ports Corporation Limited
Port of Hay Point	Central Queensland	Mackay	North Queensland Bulk Ports Corporation Limited
Port of Skardon River	Far north Queensland - Gulf of Carpentaria	Cairns	Far North Queensland Ports Corporation Limited
Port of Port Kennedy (Thursday Island)	Far north Queensland - Torres Strait	Cairns	Far North Queensland Ports Corporation Limited
Port of Karumba	Gulf of Carpentaria	Cairns	Far North Queensland Ports Corporation Limited
Port of Bundaberg	South east Queensland	Gladstone	Gladstone Ports Corporation Limited
Port of Cape Flattery	North Queensland	Cairns	Far North Queensland Ports Corporation Limited
Port of Mourilyan	North Queensland	Cairns	Far North Queensland Ports Corporation Limited
Port of Cooktown	North Queensland	Cairns	Far North Queensland Ports Corporation Limited
Port of Mackay	Central Queensland	Mackay	North Queensland Bulk Ports Corporation Limited
Port of Lucinda	Central Queensland	Townsville	Port of Townsville Limited
Port of Quintell Beach	Far north Queensland	Cairns	Far North Queensland Ports Corporation Limited
Port of Rockhampton	Central Queensland	Gladstone	Gladstone Ports Corporation Limited
Port of Burketown	Gulf of Carpentaria	Cairns	Far North Queensland Ports Corporation Limited
Port of Maryborough	South east Queensland	Gladstone	North Queensland Bulk Ports Corporation Limited
Port of Abbot Point	Central Queensland	Townsville	North Queensland Bulk Ports Corporation Limited

Sixty marinas along the Queensland coast were identified, located and basic facilities inventoried (Table 6). They represent infrastructure supporting boating activity and access points to the marine realm along the coast. In general, their location density matches regional populations in coastal cities and large towns.

Table 6 Marina location and facilities as displayed on the MQCFR portal

Marina	Location	Latitude	Longitude	Berth	Power	Water	Fuel
Port Thursday Island	Thursday Island	-10.586	142.22	70			
The Reef Marina	Port Douglas	-16.4861	145.46	115	yes	yes	yes
Closehaven Marina	Port Douglas	-16.4875	145.458	5			
Yorkey's Knob Boating/ Half Moon Bay Marina	Cairns	-16.8019	145.717	197	yes	yes	yes
Bluewater Marina	Cairns	-16.803	145.708	108	yes	yes	
Marlin Marina	Cairns	-16.9194	145.782	261	yes	yes	yes
Cairns Cruising Yacht Squadron	Cairns	-16.9463	145.773	24			
Innisfail Marina	Innisfail	-17.524	146.033	0			
Port Hinchinbrook Marina	Cardwell	-18.2783	146.045	250			
Magnetic Island Marina	Nelly Bay	-19.1582	146.854	106			
Breakwater Marina	Townsville	-19.253	146.824	0			
Townsville Yacht Club Marina	Townsville	-19.2587	146.823	165	yes		
Bowen Marina	Bowen	-20.0165	148.255	0			
Hayman Island Marina	Hayman Island	-20.0605	148.882	0			
Abel Point Marina	Airlie Beach	-20.2674	148.709	507	yes	yes	yes
Shute Harbour Marina	Shute Harbour	-20.2925	148.779	0			
Hamilton Island Marina	Hamilton Island	-20.3472	148.95	245			
Laguna Quays Marina	Whitsundays	-20.6047	148.681	3			
Mackay Marina	Mackay	-21.113	149.226	479			
Keppel Bay Marina	Rosslyn Bay	-23.1615	150.788	500	yes	yes	
Gladstone Marina	Gladstone	-23.8303	151.244	0			
Burnett Heads Marina	Bundaberg	-24.7595	152.401	0			
Bundaberg Port Marina	Burnett River	-24.7612	152.387	180			
Great Sandy Straits Marina	Urangan	-25.2939	152.911	176			
The Boat Club Marina	Hervey Bay	-25.2956	152.91	98			

Mary River Marina	Maryborough	-25.5398	152.708	0			
Tin Can Bay Marina	Tin Can Bay	-25.9067	153.007	172			
Noosa Marina	Noosa	-26.3947	153.042	40			
The Wharf Mooloolaba Marina	Mooloolaba	-26.6837	153.121	47	yes	yes	
Mooloolaba Marina	Mooloolaba	-26.6864	153.13	265	yes	yes	yes
Kawana Waters Marina	Buddina	-26.6999	153.128	130			
Pacific Harbour Marina	Bribie Island	-27.0501	153.143	82			yes
Spinnaker Sound Marina	Bribie Island	-27.0702	153.135	150	yes		
Redcliffe Marina	Redcliffe	-27.1927	153.109	0			
Moreton Bay Boat Club Marina	Scarborough	-27.1938	153.108	118	yes	yes	
Scarborough Marina	Scarborough	-27.1938	153.107	194	yes	yes	yes
Newport Waterways Marina	Newport	-27.2102	153.094	0			
Queensland Cruising Yacht Club Marina	Sandgate	-27.3325	153.082	62			
Rivergate Marina	Murarrie	-27.4448	153.106	105			
Dockside Marina	Brisbane	-27.4728	153.038	0			
Moreton Bay Trailer Boat Club	Manly	-27.4544	153.19	333			yes
Wynnum Manly Yacht Club	Manly	-27.4569	153.188	278	yes	yes	
Royal Queensland Yacht Squadron	Manly	-27.4574	153.192	572			yes
East Coast Marina	Manly	-27.4579	153.19	365	yes	yes	
Raby Bay Marina	Raby Bay	-27.5235	153.268	75			
Weinam Creek Marina	Redland Bay	-27.6196	153.309	0			
Horizon Shores	Steiglietz	-27.7516	153.347	0			yes
Calypso Bay Marina	Jacobs Well	-27.7907	153.373	107	yes	yes	
Couran Cove Island Marina	Couran Cove Island	-27.8243	153.413	102			
Coomera Waters Marina	Coomera	-27.8468	153.369	70	yes	yes	
Sanctuary Cove Marina	Sanctuary Cove	-27.8524	153.364	300			yes
Gold Coast City Marina	Coomera	-27.8623	153.338	0			

Hope Island Marina	Hope Island	-27.867	153.348	0			
Hope Harbour Marina	Hope Island	-27.869	153.377	0	yes		
Ephraim Island Marina	Ephraim Island	-27.8855	153.402	0			
Runaway Bay Marina	Runaway Bay	-27.901	153.403	197			
Bayview Harbour Yacht Squadron	Runaway Bay	-27.9237	153.406	0			
Palazzo Versace Marina	Southport	-27.9671	153.424	90			
Mariner's Cove Marina	Southport	-27.969	153.424	100			yes
Southport Yacht Club	Southport	-27.9726	153.426	20			

Fisheries Management Closure History Data

The history of Queensland fishery management closures was obtained by collaboration with the Queensland Seafood Industry Association (QSIA). A contract with QSIA to acquire and document historical closure data was signed on 21st May 2015. The contract listed the tasks to be undertaken by QSIA and includes "document the history of and changes to Queensland fishing closures through discussions with longstanding industry representatives and local boating patrol officers".

- The FRW closure histories were acquired by 15th June 2015 (59 of 63 acquired).
- The FCW closure histories were acquired by 21st July 2015 (40 of 52 acquired).
- The CWTMP closure histories were acquired by 31st January 2016 (41 of 64 acquired).

Trawl closure history data from DAF's Trawl Spatial Review (Anon 2011) were entered into the database in late 2016. These data were interpreted from the report in a format to fit the database.

The closure history information has been entered into an ORACLE database comprising two tables: the QSIA sourced data (138 records) in one table and the DAF sourced data (68 records) in the second table. These background data are linked to the MQCFR portal and can be accessed via the closure map as represented on the portal.

To ensure the provision of consistent, information-rich data by QSIA, a datasheet was developed and provided to the fishers to document the history and reasons for fishing closures. It contained three main sections:

- header information (including date of instigation),
- a formatted section where a range of reasons for instigation of the closure was provided for selection, and
- a section for free narrative description of the closures as the interviewee provided.

The selection of key terms and reference phrases in the format section allowed quick allocation of over-arching reasons for the closure under five headings or 'contexts' (see below). Moreover, the structured format of the document ensured basic data were collected in a standardised format that was consistent between each closure. The document was provided to QSIA and a couple of key fishers for comment and feedback before the final draft was adopted.

Closure histories for only two thirds of the CWTMPs were acquired. The 'missing' histories are from closures in Central Queensland and the Cape York regions. Eleven closures were identified in the Cape York region; all failed to have closure histories provided. Another poor region for return histories was the

Whitsunday/Pioneer River (Mackay) region where only one of seven closures histories was returned. QSIA provided reasons for the low return rate from these 'northern regions'. Trawl operators in north Queensland were approached, but QSIA could not find an operator who wanted to provide closure histories. QSIA suggested that 'remoteness and the thinning ranks of fisherman is a real issue'. There may have been a lack of familiarity between QSIA employees and the northern operators; perhaps the commercial fishers who operate in the north were less inclined to talk about the closures.

Five closure 'Contexts' were provided for selection in the document: fishery management, fishery biology, environment and biodiversity, competing infrastructure and socio-cultural (also called resource re-allocation) (see Appendix). The socio-cultural context was referred to as resource reallocation in the document provided to commercial fishers following input from them that reflected the frustration among commercial fishers about losing access to traditional fishing grounds. Portions of their grounds have been allocated or part-allocated to the recreational fishing sector, or to biodiversity conservation (e.g. marine national parks).

Each closure context contained sub-categories which provided a more precise descriptor of a closure context as follows (as well as the option of 'other' for particular circumstances):

1. Fishery management;
    a. Marketing,
    b. Triggers (e.g. catch rate)
    c. Seasonal closure- management.

2. Fishery biology;
    a. Protect habitat (nursery/ adult)
    b. Protect Juveniles
    c. Protect spawners

3. Environment and biodiversity;
    a. Marine protected areas
    b. Protect ecosystems/ habitats
    c. Protect dugongs
    d. Protect SOCI/ threatened-endangered-protected (TEP)

4. Competing infrastructure;
    a. Harbours and shipping,
    b. Undersea pipelines/ cables
    c. Petroleum mining,
    d. Tourism infrastructure
    e. Competing jurisdiction (legislated)

5. Socio-Cultural;
    a. Urban development
    b. Recreational fishing
    c. Indigenous interests
    d. Multiple user conflict

Summary data on closure context show that the majority of Fishery Regulated Waters were instigated for socio-cultural reasons; mostly multiple user conflict, indigenous interests and reallocation of grounds to recreational fishers (Table 7). Many of the FRWs were in remote areas of the Gulf of Carpentaria near small coastal towns and closures near the town region allowed unhindered assess to customary fishing opportunities. Some FRWs were near locations of high tourism activity on the Sunshine Coast or Gold Coast. Some FRWs were created to allocate estuaries to recreational fishers alone.

FRWs were instigated to sustain environment and biodiversity. Some were instigated to protect dugong, some to protect grey nurse sharks and some as part of Marine Park zoning plans. Some were instigated to protect estuarine habitats, particularly estuaries near urban areas. Both fishery management and fishery biology each accounted for about 13% of closure contexts for FRWs. Several FRWs were volunteered by the commercial

industry in recognition of effort reduction on target stocks (Fishery Management). The locations often were the upper reaches of a river or creek that continued to be fished in its lower reaches. Some FRWs were created to protect life stages of the fish or key estuarine fish habitats (Fishery Biology). Only three FRWs were created to facilitate tourism infrastructure.

Table 7 Closure context (over-arching reason for the closure) as interpreted from historical data gathered by the Queensland Seafood Industry Association (QSIA) and Department of Agriculture and Fisheries (DAF). Two thirds of the CWTMP (41 of 64) closure histories were completed by QSIA surveys. The upper three summary rows were compiled from data surveyed by QSIA, while the lower summary row of data was compiled during a 2010 Trawl Spatial Review by DAF (Anon 2011) A few trawl closures were supported by dual contexts at implementation.

Closure context	*Fishery management*	*Fishery biology*	*Environment/ biodiversity*	*Infrastructure*	*Socio- cultural*	*Total*
FRWs	8	8	16	3	24	59
FCWs	2	15	8	0	17	40 (2 dual ratings)
CWTMP	2	13	2	1	2	41
DAF	10	31	7	4	13	62 known of 68 (3 dual ratings)

Summary data on closure context also showed that Socio-Cultural reasons were in the majority for the instigation of Fishery Closed Waters. Reallocation of fishing grounds to recreational fishers accounted for about 90% of the reasons for closure instigation under the Socio-Cultural context. Some of these closures were explicit, e.g. a weekend closure to commercial fishers, presumably to provide access to recreational fishers on weekends when they are active, and to reduce possible interactions between the two groups of fishers. Multiple user conflict in the form of interactions with swimmers provided context for closures adjacent to prime beaches in the populated south-east Queensland coastal region (Table 7).

The context of Fishery Biology accounts for the instigation of nearly as many FCWs as Socio-Cultural. Many of FCWs were relatively small, local to river mouths, estuaries or barrages on rivers and they were instigated to protect spawning barramundi in particular, or accumulations of multiple fish species in the vicinity of river barrages. These closures protected vulnerable life history stages of some fish. Fishery Management closures were instigated in two cases only, on Cape York to protect over exploitation of black jewfish and on Fraser Island to prevent over exploitation of tailor. Twenty percent of FCWs were instigated to sustain Environment and Biodiversity. Some FCWs are part of Marine Protected Areas and/or estuarine habitats often near populated regions of south-east Queensland. One is a night time net-fishing closure to protect dugong.

As compiled by QSIA, the context for the majority of trawl closures (CWTMPs) is Fishery Biology (Table 7). Seasonal trawl closures have been enacted to protect spawners and the subsequent juvenile population in a sub-set of the extent of scallop fishing grounds. Some CWTMPs are located inshore; either estuaries or nearshore areas where juvenile fish and prawns or sub-adult prawns are found and are best left unfished in these locations. In these cases, the target species likely will continue to grow and move offshore and be available to the fishery at a larger size with greater economic value. A buy-back of beam trawl licences and a ban on daytime trawling typify closures instigated for Fishery Management. One closure was enacted to protect a range of turtle species (TEP) that nest on adjacent beaches (Environment and Biodiversity) and one was enacted as a sea-ranching opportunity (Competing Infrastructure, aquaculture).

The DAF 'trawl spatial review' showed that the majority of trawl closures were instigated under a Fishery Biology context to protect juvenile of sub-adult prawns or scallops or provide for target species replenishment (this majority matched the QSIA data). About 16% of closures were implemented under a 'management' context to provide early access to some areas or to protect bycatch species that are a target species for other fisheries (e.g. trumpeter whiting). A few trawl closures were implemented to reduce trawl effort in the vicinity of the Great Barrier Reef. Four closures were implemented to create safe anchorage conditions in key locations. About 20% of trawl closures were implemented to reduce social conflict with either recreational fishers, commercial netters (e.g. pocket netters) or urban communities in nearshore zones. The conflict with the urban community centred around engine noise issues at night or overlap between trawl by-catch species and target recreational species.

Discussion

Worldwide, over recent years geographically-referenced data have been used to support decision making in coastal resource management. The data have been analysed using Geographic Information Systems (GIS) and decision-support tools to achieve optimisation. For example, in the German exclusive economic zone of the North Sea, the co-location of aquaculture sites and offshore wind farms was investigated using a GIS and multi-criteria evaluation techniques (Gimpel *et al*. 2015). Habitat suitability for several candidate species of fish, crustaceans and algae were modelled using physical and water quality parameters (e.g. temperature, salinity, ammonium, current velocity, depth); together with suitable wind farm sites to assess optimal co-location of both ventures. Arrays of spatially referenced data were key to these analyses.

In a Canadian example, GIS incorporated expert knowledge of 12 social-ecological values attributed to landscapes within a 25,000 km^2 area of a British Columbian coastal region (to 100 km offshore). The combined value outcome of the twelve attributes assisted managers to identify high-value hot-spots in these marine spaces. The decision criteria and outcomes were underpinned by a high degree of spatial statistical significance (Mahboubi *et al*. 2015). A similar approach was used to reduce user conflict whilst maintaining ecological values in a coastal reserve at Mombasa on the Kenyan coast (Tuda *et al*. 2014).

A further example demonstrates the integration of an existing portal (the Connecticut Aquaculture Mapping Atlas (see http://clear3.uconn.edu/aquaculture/) with the Farm Aquaculture Resource Management model (see http://www.farmscale.org) to optimise site selection for marine aquaculture in coastal Connecticut, USA (Bricker *et al*. 2016). The Aquaculture Mapping Atlas is a portal with similar aims and data to MQCFR. It maps current aquaculture sites, marinas, boat ramp facilities, State-managed reserves and navigation channels and aids. That is, it maps locations that support natural resource based economic activity, coastal access and co-located users, and locations that aim to protect biota and natural biodiversity. Bricker *et al*. (2016) demonstrate the value of spatial data portals where a range of resource distribution, legislated management and competing-use data have previously been inventoried, displayed and are available to the public. The availability of these data together with a production model that incorporates seasonal water quality parameters over the same region, allow farmers and managers to undertake spatial analysis to best predict optimal grow-out locations with minimal impact on biodiversity or conflict with other users of the coastal zone.

The key principle of these studies is to provide an informed and transparent basis for decision making and hopefully meet the needs and understanding of all coastal users while encouraging acceptance of the management initiatives. The methods use a diverse array of data types to support statistically valid outputs. Data inputs are sourced from a range of themes: biotic, economic, landform, landuse, infrastructure environment, social-value among the list. Integrated Coastal Zone Management or Ecosystem Based Management describe the underpinning paradigm for using these methods and analyses. Within the coastal zone, the integration of economic development and infrastructure with natural resources and biotic diversity allows economic benefit yet sustains biodiversity and ecosystem services.

MQCFR has achieved its objectives and they are similar objectives as these international studies. It has "researched and inventoried in a central GeoServer publically available spatial data on fishing catch and effort for major commercial and recreational fisheries species in Queensland". It has undertaken the same process for spatial data on regulation and use of the marine environment (mostly via the AMRSMA project) "in particular State and Commonwealth marine parks, aquaculture zones, ports and marinas" (Figure 12). In collaboration with QSIA and DAF, it has researched and placed in a database all publically available historical information on fishing closures in Queensland waters.

Mapping fisheries catch and effort data along the Queensland coast locates the hot-spots for fishery resources and areas of focus of fishers' attention. Closures to fishing become a major focus of users of coastal resources; with either support for their placement, or their abandonment being promoted. Whether their primary objective is to sustain the fishery or the exclusion to fishing is a secondary effect of a biodiversity no-take zone, the loss of fishing grounds is contentious. For closures to be successful, they must be accepted by a broad cross section of the public regardless of their aim (either fishery management or sustainable biodiversity). Justifying the proximity of closures to fishing hot spots or demonstrating fishing hot spots to be

distant from, and unaffected by closures can be key to encouraging understanding and acceptance by the public. Publically available electronic mapping and visualisation provides a key facility useful as part of an education process.

Over the last 30 years, legislated spatial management is increasingly being used to modify use and extraction within Australia's marine realm (Pressey and Bottrill, 2008; van de Geer *et al*. 2013; Devillers *et al*. 2014). Spatial management initiatives derive from multiple agencies and at least two levels of government. For example, the Commonwealth-legislated and managed Great Barrier Reef World Heritage Area covers 348,000 km^2 of which 115,600 km^2 is no-take (Anon 2013a). Yet State-managed trawl fishing closures also overlay waters within the Great Barrier Reef Marine Park (Anon 2015). The decentralized sources of published material describing managed areas that restrict extraction or movement in the coastal realm are a major impediment to understanding the extent and impact of closures on coastal resources and activities. Historically, fishing activity has taken place within or in close proximity to current permanent closures; or within seasonal closures that aim to enhance crucial stages in the life history of a fished species. The ability to quickly map and visualise the spatial distribution of fishing catch and effort, especially in proximity to closures, increases capacity to manage coastal resources for optimal economic return. Importantly, spatial analyses of these interrelated datasets has the capacity to greatly enhance coastal management and planning along the Queensland Coast (Rodriguez *et al*. 2009; Andrew *et al*. 2014; Bonar *et al*. 2015).

In the Queensland coastal zone, there is a significant need for a strategic approach to optimise how economic infrastructure integrates into coastal ecosystems to support the systems natural productivity and resilience. Grech *et al*. (2013) note that the Queensland Government's Draft Ports Strategy acknowledges the need for integrated planning, but they suggest that it lacks a strategy or approach to undertake the planning required. They highlight that effective management mediates the relationship between 'economic and social needs' and 'biodiversity outcomes'. This need was highlighted by the recent Great Barrier Reef Region Strategic Assessment (Anon 2013 a,b).

The Assessment considered impacts on the Great Barrier Reef from ports and marinas, together with the distribution of fisheries in adjacent coastal waters (see pages 5-27, 5-37, 5-46 of Anon 2013a). However, the coastal infrastructure and 'built-economy' features were mapped statically only. It also considered water quality and biotic stressors on reef health. Spatial analyses were undertaken on the impacts of wave exposure, crown-of-thorns, thermal stress and exposure to freshwater on coral reefs. As well, analyses were conducted on the impacts of sediment and nutrient loads, pesticides and water column chlorophyll on water quality (Anon 2013 a, pages 6-71 to 6-78). These analyses as part of the Great Barrier Reef Region Strategic Assessment highlight the value of integrating spatially-referenced data with spatial analysis tools or models.

Despite the deployment of spatial analyses for some data, neither the infrastructure geographic location data nor proximity of the 'built economy' features were used in spatial analyses. The same need exists for spatial analysis of the built-economy, and marine resources and biotic distributions geographic data (e.g. marina, port and fishing hotspot locations and extents). Understanding the spatial relationship between coastal infrastructure together with species, habitat and ecosystem data will assist natural resource managers to maintain ecosystem services as close as possible to natural function (Grech *et al*. 2013).

If available as a download from the MQCFR portal, the spatial data for fishing catch and closures, as well as features of the built economy, may assist researchers and managers such as those drafting the Great Barrier Reef Region Strategic Assessment to optimise and best predict location planning for significant coastal infrastructure or activities. Quick access to key datasets such as those housed by MQCFR would support data integration analyses as part of the strategic assessment.

While spatial data have been made readily available to the general public (project objective #4), the licence restrictions that prohibit transfer to a third party (download) restricts the "quantitative spatial analysis to facilitate resource planning around the cumulative effect of marine spatial management in Queensland" (also project objective #4). In part only, Objective 4 has been achieved. MQCFR spatial data can be mapped, but the data can't be transferred to third party researchers and managers. (Furthermore see comments about data availability and third party transfer of data that represent legislated features subject to scrutiny under Law vs spatially-represented biota biomass and distribution data in 'Further Development', below).

In the Great Barrier Reef province, Grech *et al*. (2013) developed their "Guiding principles for the improved governance of port and shipping impacts in the Great Barrier Reef". Three of their principles which would be enabled by access to spatial data as housed by MQCFR were:

1. Active monitoring and adaptive management ensures the health of the ports and shipping governance system, with a particular emphasis on enhancing principled leadership;
2. A strategic and integrated approach to port planning maximizes biodiversity outcomes whilst maintaining efficient transport networks for industry;
3. Port developments that maximize biodiversity outcomes consider ecological implications early in the design process.

These researchers suggest that only by good planning that recognises the need to maximise biodiversity outcomes early in the planning and design process can port development minimise exposure of species and ecosystems, and ecosystem services, to impacts (Grech *et al*. 2013). The same could be said for maintaining the productivity of coastal fisheries while protecting habitats and biodiversity, including all the life history stages of the stocks that sustains the fisheries. Portal access to comprehensive spatial data on fishery assets, coastal infrastructure and spatial closures would enhance manager's ability to meet the three principles outlined above.

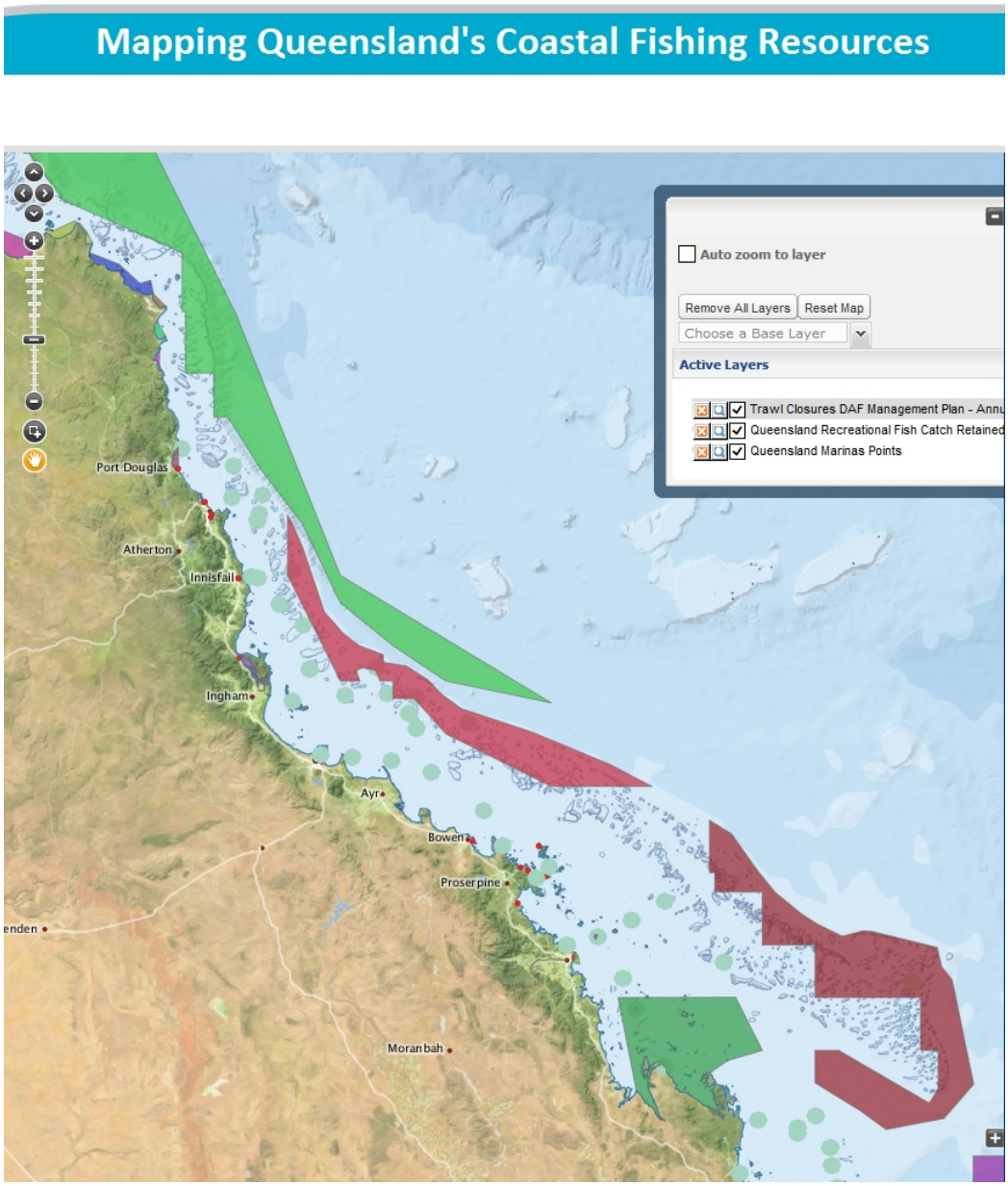

Figure 12 Snapshot of the sympatric location of recreational red emperor catch, Queensland trawl closures and marina locations demonstrating the simultaneous display of themed data via the MQCFR portal.

A considerable task that slows the display of data acquisition to support portals such as the MQCFR portal is the licencing of the data. Licencing requirements are not necessarily onerous, but they can be very time consuming. Protocols describing that appropriate display of the data are easily complied with. However, the licence agreement has to be vetted by experienced contracts managers in both the organisation providing the data and the organisation developing the portal. The exchange of small changes to the agreement can take weeks. An example is the licencing of Torres Strait prawn and lobster data by the Australian Fisheries Management Authority. The data-gap was identified in October 2015, AFMA was approached about acquiring the data in early October; AFMA required a "Deed of Confidentiality'" to be signed before the data could be exchanged. Minor changes to the Deed were exchanged. However, in November AFMA asked for a "Contract for the Provision of Services" to be signed as well. In December 2015 the CSIRO Contracts Manager questioned the need to two legal documents given the working relationship between CSIRO and AFMA. The to-and-fro of legal documents and opinion continued for months. By June 2016, the data

licencing was finalised and the exchange of data occurred. Other datasets have had similar delays including the prolonged exchange of annotated versions of legal documents that dominate the sensible exchange of data.

Conclusion

Increasingly worldwide, the framework of integrated spatial decision support is being used via geographic information systems, multicriteria evaluation and integrated datasets to identify priority locations and management scenarios to sustain ecosystem services that support biological and economic production. Spatial analysis of the multiple layers of information that are readily available will facilitate planner's and manager's abilities to optimize planning decisions

The MQCFR portal provides an inventory and electronic display of fishing catch and effort for major commercial and recreational fisheries species in Queensland; as well as spatial data on regulation and multiple use of the coastal marine environment (e.g. State and Commonwealth marine parks and fishing closures, aquaculture zones, ports and marinas). These data are housed in a central GeoServer/GeoNetwork and are publically available as electronic maps.

Major restrictions on the use of these spatial data are the non-availability of WMS and WFS features via the MQCFR portal. Currently, the MQCFR portal does not fulfil its potential to support a framework of integrated spatial decision making due to the limited availability of the data it houses. However, MQCFR allows a portal user to add other datasets to the ones provided if the user clicks the "Add WMS Servers" tab and enters a valid source (for example; "http://www.ga.gov.au/gisimg/services/topography/NATMAP_Digital_Maps_250K_2008Edition_WM/MapServer/WMSServer?").

The investigation of the history of Queensland fishing closures has provided descriptive data linked to the electronic map display. The data were acquired via interview with commercial fishers with an intimate knowledge of particular fisheries over multiple years if not decades. Previously, these data were unavailable to the general public.

Implications

The MQCFR portal has the capacity to support multicriteria evaluation of integrated datasets using a currently-developing suite of computer applications. In the short term MQCFR provides public access to mapped spatial data displaying coastal fishing resource features and their spatial relationships to legislated and built infrastructure. Recent literature and conversations with colleagues involved in developing the ACEF portals demonstrate the capacity and potential for geographic portals to provide single-source access to spatial data that can be used in models and spatial analysis tools that enhance research capacity and knowledge to support better management. Portals have the capacity for real-time mapping of data that may be acquired from satellite, fishing vessels or static sensors. Both historical maps and real-time maps enhance public access and knowledge

In overview, in recent years, researchers and technologists in this field have overseen a massive expansion in the capacity of data storage, data serving to display portals and GIS tools to assess impacts and to model outcomes to support end users such as management and industry. Moreover, the discipline–wide expansion of capacity is continuing. The MQCFR portal provides keystone capacity in this discipline that supports research and management of Queensland's coastal resources. It provides a baseline data inventory and easy access for building further capacity.

Recommendations

1. The development of the MQCFR portal should be seen as the first step on a pathway that facilitates the use of the acquired data in higher-level analyses, likely incorporating other data sets. Worldwide, portals with similar data themes to MQCFR are providing a data source to support spatial analyses to better understand and manage the use of coastal resources. These analyses facilitate optimal placement of economic infrastructure or economic exploitation of natural resources, all the while sustaining biodiversity and ecological services (Bricker *et al*. 2016).

   A more comprehensive approach would be to integrate the MQCFR portal with ecosystem models of the coastal realm or coastal production models to support an Ecosystem Based Management approach to coastal resource use. This approach would investigate a predictive capacity for impacts of, say, built infrastructure on ecological resources, or the location optimisation of protected areas, locations of productive fisheries, good water quality and the built economy.

2. Data download from the MQCFR portal would greatly enhance the capacity of the MQCFR portal. The pubic availability of electronic maps meets the first portion of Objective 4 of this project: "provide up to date spatial data that is readily available to the general public". However, Web Map Services, Web Feature Services (map delivery to an external GIS) and raw data download are needed to achieve the second portion of Objective 4 (see below), that "spatial analyses around the cumulative effect of spatial management" be undertaken on Queensland's coastal resources. Currently, only CSIRO researchers and collaborators have that capacity.

Objective #4: Provide up to date spatial data that is readily available to the general public, and allows quantitative spatial analysis and facilitates resource planning, around the cumulative effect of spatial management on access to high-profile fishing areas along the Queensland coast.

3. Consider rationalisation and consolidation of portal infrastructure to support the long term stability and currency for the MQCFR portal and the data it displays. CSIRO has committed to the maintenance of the portal in the long term. However, the method by which that is achieved has many alternatives. The portal display is underpinned by GeoServer and GeoNetwork infrastructure. The maintenance of this infrastructure is a considerable task. MQCFR data could be stored and served from other data infrastructure whilst the MQCFR portal remains intact.

   Integrate the portal with other GeoServer and GeoNetwork infrastructure such as the ACEF infrastructure, O&A's Marine Biodiversity Hub or integrate MQCFR with GeoServer and GeoNetwork infrastructure developed by Geosciences Australia. .

4. Consider the benefits of two collaborators to document 'social' history perspectives. For MQCFR, a single collaborator meant that only a fishing industry perspective on fishing closure history was obtained. The involvement of the Queensland Seafood Industry Association as a collaborator and major data investigator in the project was productive. Commercial fishing operators and their representatives have a long-term and intimate involvement in decision-making, instigation and 'operation/interaction with' fishing closures. However, the closure histories that were gathered represented commercial fishers' perceptions of the closures and the reasons that they were implemented. While some data were gathered from meeting minutes, most was from individual's memory. A more sound approach may have been to allocate half the funds available to document closure histories to Fisheries Managers to gain a second perspective. The provision of a datasheet template with set format and a fixed set of criteria to document was critical to obtaining useful content.

Further development

Extending the scope of the portal to other States would be beneficial. Adding more information to the data that are currently displayed would also enhance the outputs form the portal. For example, Sean Pascoe (O&A

fisheries economist) suggested adding estimates of value of the fishery catch to the mapped catches to provide a spatial density estimate of economic value relative to the ecosystem services that produced them. That is, map value of the catch relative to the location of estuaries or nursery habitats that supported a key phase in the life history of the fished species to demonstrate the value of coastal habitats.

Currently, the MQCFR portal does not support the provision of GIS maps to a third party. There are two possibilities to supply maps to a third party via the portal. The first is Web Map Service (WMS) allowing geographic information as a simple electronic map representation to be downloaded from the portal. The second is Web Feature Service (WFS) allowing the download of map data for further use in GIS applications. The Open Geospatial Consortium (OGC) standards support the availability of maps and data via WMS and WFS in a systematic format that is interoperable among GIS facilities. Map-data availability would be very beneficial to researchers and managers. The compilation of data via the MQCFR portal provides a single source of these very useful data; yet currently they are unavailable other than as an electronic map display.

Data availability restrictions on MQCFR contrast with the ACEF Coastal Data Portal and the Marine Biodiversity Hub which allow download of datasets (i.e. allows both WMS and WFS, and the actual data). ACEF has similar aims to MQCFR: to inventory and display key coastal datasets for public use and to support management and policy decisions. The ACEF portal supports a multidisciplinary approach to coastal management and data sharing. Oceans and Atmosphere's Marine Biodiversity Hub (http://www.nespmarine.edu.au/) maps similar data and supports the download of all data displayed on its portal.

The key difference between much of the data acquired by MQCFR and ACEF is that much data acquired by MQCFR represents legislated features subject to scrutiny under Law; or fishery catch subject to anonymity provisions for individual fishers, and individual licence agreements. Fisherfolk do not want their hotspots for catch to be made available to competitors or the general public, so catch summaries can be published only when ≥ five (5) fishers are displayed per visualisation (6 nm grid square for MQCFR). As well, licencing of the acquisition and display of some fisheries data has considerable strictures. In contrast, the majority of ACEF data are spatially represented biota biomass and distribution data. Often, the biomass and distribution data are collected by researchers who are eager to share data sets with other researchers as part of a multidisciplinary approach to coastal management. Much of the data acquired by ACEF used a CC3.0 licence agreement; whereas agencies supplying data to MQCFR (and AMRSMA) insisted on custom licencing vetted by the source agency and CSIRO's Oceans & Atmosphere. These licences prohibit transfer to a third party. More so for the AMRSMA portal, some data are purchased and the source agencies see these data as a commodity of value, not to be freely distributed.

While not universal, some agencies that supply spatial data that reflect legislative instruments limit the use of the data they make available by licence agreement. They prohibit: transfer of the data to a third party; display of data apart from the licenced portal; and insist on attribution upon display. Licencing the MQCFR portal to support Web Map Services (WMS) feed to provide electronic map image download would be a major initiative for the portal.

Negotiating licence agreements to allow transfer to a third party would be a major future task and very time consuming.

Currently, O&A internal discussions are occurring about consolidation and integration of the infrastructure that support portals. While the MQCFR portal will remain a distinct entity, the long-term maintenance of the infrastructure that supports the portal and the temporal updates of the data will benefit from an integrated approach.

Until the remaining batch of Queensland fisheries closures is delivered to MQCFR (the FCWs), the linking of closure histories to the closure data is problematic. Currently, the linking of closure history data to the map portal is in development as closure shapefiles are delivered and not all links may be available.

Extension and Adoption

MQCFR published a descriptive article introducing the project "Mapping Queensland's fishing hot spots and fishery closures" in the QSIA magazine 'Queensland Seafood in 2015 (reported in Milestone Report 1). A similar 'results and discussion' article is planned for Queensland Seafood in 2016.

A PowerPoint presentation outlining the objectives and achievements of the MQCFR project was delivered internally to CSIRO colleagues (Oceans and Atmosphere Research Review) in June 2015 (reported in Milestone Report 3).

A PowerPoint presentation outlining the objectives and achievements of the MQCFR project was delivered to the QFRAB Board on 6th October 2015 (reported in Milestone Report 4).

A PowerPoint presentation outlining the objectives and achievements of the MQCFR project was delivered to the Fisheries Statistical Working Group (chaired by Nadia Engstrom, DAF Queensland and covering State and Commonwealth jurisdictions) in February 2016.

Liaison with Geosciences Australia re geographic portals and capacity overlap between their Australian Marine Spatial Information System" (AMSIS) (http://www.ga.gov.au/imf-amsis2/) and MQCFR. Contacts were Matthew McGregor and Anna Potter (ongoing). David Makin from NSW Fisheries attended the meeting and expressed interest in extending the spatial scope of the portal to include the NSW jurisdiction.

A MQCFR Poster is in development. It will promote awareness of the MQCFR portal as available to the general public and detail its scope.

An abstract for a conference presentation describing the MQCFR portal and its uses has been submitted to the Seafood Directions 2017 Conference in Sydney in September 2017. The abstract summarises objectives, methods and achievements.

The use of the GIS-based portals already has been adopted internally in CSIRO. A January 2016 request as set out below was received. CSIRO staff were asked to calculate the areas of various closures by marine bioregion or State jurisdiction. As well a map of the Great Australian Bight was requested showing the range of closures that exist. In this case, staff will use the AMRSMA portal due to the Australia-wide to undertake the investigation. But the MQCFR portal provides the same spatial management data (for Queensland only), plus fishing catch and effort.

> CSIRO colleagues requested:-
> "A table or spreadsheet showing the area under spatial management by marine bioregion (or perhaps by State and Commonwealth) for:
>
> a. State and Commonwealth MPAs
> b. IPAs
> c. Native Title (assume this is the same as sea country)
> d. Fishery closure areas (e.g. for Australian Sea Lions)
> e. Aquaculture leases
> f. Offshore petroleum – acreage release areas (separating active and non-active or perhaps ones that have been taken up from those that have not)
> g. Any Oil and gas pipeline reserve areas
> h. Any marine cable reserve areas
> i. Any other major spatial restricted areas that I have not included."

To date, the portal is not available publically so the scope for uptake of the portals facilities is limited.

Similarly, a December 2016 request asked for:

1. Areas in Commonwealth waters that are closed to demersal trawling as a result of fisheries closures
2. Areas of Commonwealth waters closed to demersal trawling due to existing MPAs
3. Areas of Commonwealth waters closed for other reasons
4. Map of areas that remain open to demersal trawling
5. Map showing what area has been trawled.

MQCFR shapefile layers were used together with other data to achieve this task.

Project materials developed

The project created the Mapping Queensland's Coastal Fishing Resources (MQCFR) Portal (http://mqcfr.csiro.au/). It houses an inventory of data for Queensland's coastal resources.

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Appendices

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Mapping Queensland Coastal Fishery Resources – History summary of fishing closures

Fishery Regulated Waters #:		
Closure Name:		**DATE of Implementation**
Coastal region:		**Changed over time**
Reviewer:		**Recent validation**
Date of Review:		**Confidence level (high, med, low)**
Fishery Impacted		**Compliance issues ?**

CLOSURE CONTEXT	**Seasonal closure**	
Fishery management	**Closure triggers (catch rate)**	
	Marketing	
	Other	

CLOSURE CONTEXT	**Protect nursery/adult habitat**	
Fishery biology	**Protect juveniles**	
	Protect spawners	
	Other	

CLOSURE CONTEXT	**Marine Protected Areas**	
Environment and biodiversity	**Protect ecosystems/habitats**	
	Protect dugong	
	Protect SOCI/ TEP	**Other**

CLOSURE CONTEXT	**Harbours/ shipping**	Competing jurisdiction
Competing Infrastructure	**Undersea pipelines/ cables**	
	Petroleum/ mining	
	Tourism infrastructure	**Other**

CLOSURE CONTEXT	Urban development	
Socio-Cultural	**Multiple user conflict**	
	Indigenous interests	
	Recreational fishers	**Other**

Under-pinning DATA	**Input from fishermen**	
	Industry data (logbook)	
	Science fishery-dependent data	
	Science fishery-independent data	

Narrative: (some suggested headings)

History

Scientific research or surveys

Relevant Publications

Compliance issues