



Final Report

**What data how? Empowering  
and engaging industry to  
ensure the needs of  
contemporary fisheries data  
are achieved**

**What data how.**

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**What data how? Empowering and engaging industry to ensure the needs of contemporary fisheries data are achieved.  
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# Abbreviations

ACMA	Australia Communication and Media Authority
AIMS	Australian Institute of Marine Science
BRS	Boat Ramp Survey
CBA	Cost Benefit Analysis
CDR	Catch Document Report
CFISH	Commercial Fishers Daily Catch and Effort Data
CT	Coral Trout
CPUE	Catch Per Unit Effort
ECSMF	East Coast Spanish Mackerel Fishery
CRFFF	Coral Reef Finfish Fishery
CTO	Commercial Tour Operators
DPI	Department of Primary Industries
DAF	Department of Agriculture and Fisheries
GBR	Great Barrier Reef
GBRMPA	Great Barrier Reef Marine Park Authority
ITQ	Individual Transferable Quota
JCU	James Cook University
LTMP	Long Term Monitoring Program
LF	Line Fishery
MBSIA	Moreton bay Seafood Industry Association
MLS	Minimum Legal Size
NC	Net Crab
QBFP	Queensland Boating and Fisheries Patrol
QFB	Queensland Fish Board
QSIA	Queensland Seafood Industry Association
RAP	Representative Areas Program
RIS	Regulatory Impact Statement
RFISH	Recreational Fisheries Data Collection Program
SOCI	Species of Conservation Interest
SWRFS	State Wide Recreational Fishing Survey
SM	Spanish Mackerel
TAC	Total Allowable Catch
UVS	Underwater Visual Survey
VMS	Vessel Monitoring System

# Executive Summary

## What the report is about

Collaboration between James Cook University's Centre for Sustainable Tropical Fisheries and Aquaculture (CSTFA) and the Queensland Government's Department of Agriculture and Fisheries (DAF) worked closely with fisheries stakeholders to explore contemporary fisheries data needs. The project used an expertise synopsis, stakeholder survey and desktop qualitative cost-benefit analysis to assess data needs in two case study fisheries: the Queensland east coast line fishery (targeting coral reef fin fish and Spanish Mackerel), and the Queensland crab pot fishery (targeting Blue Swimmer and Mud Crab). The project responded to a need identified by the Queensland Fisheries Research Advisory Board (QFRAB) to assess contemporary data collection while reviewing historical methods and data quality. The project team utilised existing relationships and partnerships to engage with end users and stakeholders with an interest in fisheries data throughout 2015.

## Background

The problems of managing data-poor fisheries have been the subject of much research in recent years. However, there is also the issue of collecting the best available information to meet the wide range of fishery management and other needs. In some cases, too few data are collected while, in others, some fishers and other stakeholders are unclear about why some data are collected. Fisheries are increasingly investigating new technologies (such as electronic reporting and camera monitoring) to streamline data collection and administrative processes. Unsurprisingly, diverse stakeholders have diverse needs and wants from fisheries data. Fisheries data are no longer used solely for fisheries management, but for a whole range of contemporary requirements such as marine spatial planning and impact assessments.

Recent research, reviews and stock assessments of Queensland's crab and line fisheries have highlighted deficiencies in the current data collection methods. The quality and accuracy of data underlying some of the assessments used to track the status and performance (both ecological and economic) of some fisheries has also been questioned. Many stakeholders are of the view that historical data collection methods and processes are no longer amenable to contemporary needs of the diverse stakeholder group. There has also been some debate around the use of fishery-independent and fishery-dependent methods and more innovative use of fisher skills in providing information. Scoping future data needs is important if fisheries are to remain viable in changing social and ecological environments and markets.

## Aims/objectives

The project aimed to critique historical data collection methods by evaluating data robustness, identifying data gaps and exploring areas for improvement in two of Queensland's fisheries (1) reef line fishery for coral reef species and Spanish Mackerel and (2) Mud Crab and Blue Swimmer Crab fishery. It also sought to explore novel data collection methods and provide an analysis of the costs and benefits of those methods and changes to existing processes and protocols. The final objective was to identify generic principles that may be applicable to other fisheries.

## Methodology

A synopsis of historic and current data collection practises and the types of data collected was collated. We reviewed earlier reports that have commented on or made recommendations about data in the two case study fisheries. We also reviewed the extensive literature documenting general principles for gathering data and strategies to effectively monitor and manage fisheries. Processes used in other jurisdictions were also assessed. Individual fisheries stakeholders were contacted and solicited for their ideas using face to face and telephone questionnaires. Recreational and

commercial fishers, fisheries managers, assessment scientists and NGO staff were all surveyed. We also examined the costs and benefits of various changes in data protocols. The cost-benefit analysis was subjective and qualitative: however it importantly identified data fields, opportunities and weaknesses from both data collection (fishers) and data use (managers/scientists) perspectives.

## **Results/key findings**

Effective fisheries management needs informative fisheries data. The synopsis clearly highlighted the power of long-term data sets for historically important fishery sustainability goals. Typically, some limitations in the rigor and types of data are present. Data recording systems (paper logbooks recording daily effort and catch data) have remained largely inflexible. The contemporary needs and uses of data have changed and are increasingly dynamic. A system of collecting data that allows for this dynamism is needed. Such a system should be responsive to the needs of all stakeholders and allow for consultation across stakeholders when changes are required.

Many fishers (as well as some other stakeholders) do not understand the importance and use of fisheries data, both within their own sector as well as in other sectors. Fishers are often quite opinionated about fisheries data and negatively so. Both recreational and commercial fishers, are generally enthusiastic about data collection. Commercial fishers may be frustrated by a lack of communication amongst fishers and data users, while recreational fishers are unsure about how they could better participate in data collection and are often poorly informed about how data is used and the importance of those data.

For the pot fishery, the quality of effort data was questioned by most stakeholders. The quality of SOCI interaction data was considered poor across both the pot and line fisheries. These examples highlight a number of issues with the current data collection methods and processes. The recording of inaccurate data by fishers often has serious ramifications for later fisheries assessments (stock assessments, economic performance, bycatch, etc). Fishers are generally keen to participate in the collection of data, and were particularly enthusiastic about changing and improving the relevance of data collected. A number of methods to simplify data collection were proposed: line fishers, for example, suggested rationalising unnecessary data fields in the current logbooks and quota reporting systems. Some minor changes to crab logbooks were also identified including the inclusion of SOCI interactions on the main log sheet.

Sensitivities about some catch, effort and spatial data are likely to persist regardless of relationships developed between fishers and managers. Logbooks have been blatantly abused by some fishers for personal gain, while others have been disadvantaged because of incomplete logbooks stemming from a distrust of the data system and ultimate use(s) of data. In such cases, a more robust and complete system is needed. Electronic logbooks may improve this situation as they are adaptable, flexible and provide timely data, but on their own do not fully address misreporting issues. These can really only be addressed by some means of data validation, a point made consistently by many stakeholders.

Ignorance and misunderstandings about data is widespread across all sectors. A lack of communication and relationship building, particularly between fishers (data collectors) and managers (data custodians and users) has fishers and industry at odds with the current data collection processes. The loss of the formal consultative mechanisms that included MACs and ZACs as well as the deterioration of representative industry bodies has compromised the flow of information, and on-going consultation among fisheries stakeholders. Improving data and data collection processes can only begin with a concentrated effort to rebuild relationships and communication paths.

While social media communication channels are being more frequently used for communicating with stakeholders, for some sectors and individuals communication styles are critical. For the ageing commercial fishing community, face-to-face extension appears mandatory, although there is evidence that social media (Fisheries Qld Facebook, Twitter page) are an important means of communication to some, and this will undoubtedly increase in the future.

Recent restructuring and changes within Fisheries Queensland as well as industry stakeholder groups has significantly curtailed communication ability and options for improving data and fisheries management. To rebuild the fishery, communication paths need to be re-established as a priority. Concomitantly, industry representation groups and organisations will need to adopt a greater role and responsibility in opening communication paths and making sure they are functional and provide representative input.

### **Implications for relevant stakeholders**

Solutions may appear simplistic but the report acknowledges the difficulty in implementing many of the things that are necessary to improve data and the costs associated with these changes given the current political and budgetary environment. A better communication portal needs to be built. Better and more frequent communication between industry and management must occur to re-address the business of fisheries data. Currently, no clear representative body can communicate and negotiate a new way of doing fisheries data business, and the department is swamped by individuals' points-of-view. A strategic plan is needed to reinvent the business of fisheries data for Queensland's fisheries. First however, re-establishing trust between management and other stakeholder groups (highlighted as a key issue by many respondents across all stakeholder groups) must occur.

Better fisheries data will mean better managed fisheries. For example, commercial fishers will have greater business security and investment certainty, while empowered recreational fishers will participate more in data collection and fisheries management. The broader community and stakeholder groups will benefit from better managed fisheries that will be more sustainable. Filling data gaps, improving data uncertainties and collecting data in efficient and time effective ways will benefit all. Managing fisheries resources is difficult in data poor environments. Collecting data in the fisheries environment is notoriously expensive. A cost-effective method to better collect data may be to involve the fishers themselves. Fishers are often at sea throughout the year. Using fishers to collect data would improve our understanding of fisheries resources as well as improve fisher participation in and understanding of fisheries management. Communication must accompany such an exercise and regular feedback to fishers must occur if long-term participation is to be ensured.

Finally, data collection methods and tools need to remain flexible enough to be amended and adapted for change. While the undeniable strength of long-term datasets should never be compromised, the dynamic marine environment and political atmosphere that encompass fisheries management need to be supported by a data collection system that is dynamic and adaptable.

### **Recommendations**

1. Educate fishers about current status of data collection.
2. Introduce an independent system of data validation.
3. Undertake a cost benefit analysis of programs such as fisheries observers, community volunteers and extension officers which increase presence "in the field", improve data validation, extension, education and engagement.
4. Review SOCI reporting procedures against their objectives.
5. Increase the uptake of electronic logs in the commercial sector.
6. Introduce a no exemption recreational fishing licence to provide a better sampling frame for monitoring recreational effort and catch.
7. Improve consultative arrangements to enable stakeholder input to data protocols.

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### **Keywords**

Data quality, data validation, social surveys, Spanish Mackerel, *Scomberomorus commerson*,

Redthroat Emperor, *Lethrinus miniatus*, Coral Trout, *Plectropomus spp.*, *Variola spp.* Spanner Crab, *Ranina ranina*, Mud Crab, *Scylla spp.*, Blue Swimmer Crab, *Portunus armatus*

# Introduction

## BACKGROUND

Fisheries around Australia are increasingly investigating new technologies such as e-logs to streamline data collection and administrative processes and in Queensland trials are already underway utilizing this technology. The FRDC has also supported projects seeking to develop these technologies, which clearly have widespread benefit in many fisheries contexts (Piasente et al 2012; Phillips 2015). Despite the use of more sophisticated ways of recording and transmitting data the challenge of collecting the most appropriate types of data remains an issue for many fisheries.

How to manage data poor fisheries has also been the subject of much research in recent years (Koopman et al 2004; Zhou et al 2013). Data poor fisheries challenges may be further compounded by the need to collect the best available information to meet the wide range needs of the diverse group of fisheries stakeholders. In some cases too few data are collected while in others, fishers and other stakeholders are sometimes unclear about why some seemingly redundant data are collected. Because of the diversity of fisheries stakeholders there is often conflicting needs as data are not just used for fisheries management but for a whole range of contemporary requirements such as marine spatial planning and development impact assessments. There are also future uses of fisheries information which may not be currently fully understood.

A recent QDAF internal review of the management arrangements for the spanner crab, mud crab and Blue Swimmer Crab fisheries highlighted a number of deficiencies in the current data collection methods as well as the data underlying some of the assessments used to track the status and performance (both ecological and economic) of some fisheries. Most stakeholders were not confident that the data being collected was accurate and precise and some have already suggested alternative data fields. They also noted that current management practices may be perpetuating misreporting some of the data with fishing effort identified as a major source of bias. There has also been some debate around the use of fishery independent and fishery dependent methods and more innovative use of fisher skills in providing information.

Similar problems exist in the line fisheries targeting Coral Trout and Spanish Mackerel where logbooks have remained unchanged for in excess of 10 years. The focus of these logbooks is understandably on quota integrity to ensure these TACC fisheries are appropriately accessed. Unfortunately, effort fields are compromised to a point that a recent stock assessment of Spanish Mackerel included a model that explicitly corrected for the poor recording of effort data (Campbell et al 2010). With these shortfalls in data reporting, an unfortunate cascading effect results in poor confidence of all stakeholders in the quality of data and any outputs that rely on that data. To this end, all stakeholders are now aware that the historical data collection methods and processes are no longer amenable to contemporary needs.

Increasingly contemporary research, monitoring and assessment programs are limited by data. There is often considerable expertise amongst the people who actually generate and report the data on which fisheries management and other decisions are made. There are also lessons to be applied from the experiences of other jurisdictions around the world that have investigated novel ways of collecting and utilizing a diverse array of information. While many of the current innovations may be specific to particular fisheries there are obviously generic solutions that can be applied to a wide range of fisheries. Scoping future needs is also important if fisheries are to remain viable in changing social and ecological environments and markets.

This project addresses this wide-ranging issue by exploring two case study fisheries of very different characteristics – a pot fishery for crabs and a line fishery for finfish.

The project addresses two strategic themes within the FRDC Program 2: Industry strategic challenge – (5) governance and regulatory systems; and (7) production, growth and profitability. The project will produce outputs to improve regulatory systems that will concomitantly benefit fishing business production and profitability.

A project such as this requires ongoing consultation and engagement with a wide range of stakeholders. Consultation with these groups will be ongoing throughout this project, and indeed the project will only be possible with the commitment and innovative ideas of stakeholders.

## **NEED**

The proposed project responds to QFRAB Research Priority IV – Improve the relevance and quality of the data collected to underpin effective science based management of Queensland fisheries.

Traditionally fisheries data moved in a single direction, with fishers collecting data that were used by researchers and managers to manage fishers' activities within sustainable long-term goals. Historically this was considered a reliable system that informed the management of fisheries and enabled the development of suitable management objectives and tools (input and output controls).

A paradigm shift has occurred with contemporary fisheries data being utilised for multiple purposes other than QDAFF core business management. Other purposes now include conservation objectives (EPBC Act), marine spatial planning, third party accreditations, impact assessments and resource allocation. Not surprisingly, concerns from stakeholders regarding the quality and relevance of data collected are increasing. Given this notable shift in the interest and demands on fisheries data, it is timely that new and novel data and data collection methods are investigated. There is also a need to review existing systems and potential improvements that can be made to better meet contemporary needs. Further, increasing distrust of fisheries data by stakeholders is a significant hurdle in monitoring, assessing and managing fisheries. Concerns about the accuracy of commercial logbook data and catch estimates derived from recreational diary and phone surveys persist. Options for empowering all fishery stakeholders in the design of collection methods, data ownership and utility of data beyond core business requirements need to be explored to improve data quality and stewardship, and confidence in assessments/analyses that utilise these data.

## **Objectives**

- 1 Complete an expertise-based critique of historical fisheries data collection methods evaluating data robustness, identifying data gaps and improvement areas.
- 2 Identify contemporary and future data needs and develop novel candidate collection methods using the Queensland line and crab fisheries as case studies.
- 3 From Objective 2 highlight generic data improvements transferable to other fisheries.
- 4 Complete a cost-benefit review of data collection options.

## **Methods**

The project focused on a subset of Queensland fisheries to ensure meaningful results and outcomes were possible within the limits of project resources. The two fisheries included within the project

scope were the Queensland East Coast Line Fisheries and Queensland East Coast Crab Fisheries. More explicitly, the Queensland Line Fisheries included the Coral Reef Fin Fish Fishery as well as the East Coast Spanish Mackerel Fishery while the Queensland Crab Fisheries included both the sand crab and mud crab pot fisheries. The choice of fisheries for this study, was deliberate as the chosen fisheries represent contrasting types of management and subsequent data and information reporting. For instance the CRFFF includes a harvest strategy, a commercial fishery TAC, individual transferable units, a comprehensive logbook and a quota reporting system; while the QCF includes licencing and effort limits and minimal logbook recording. The Queensland east coast Spanner Crab Fishery was purposely excluded as this single sector fishery is widely considered to have “top-tier” management structure that is supported by a robust data collection strategy.

The timing of the project overlapped two significant events. Firstly, in response to ongoing concerns about the state of fisheries management, on 6<sup>th</sup> March 2014 the (then) Queensland Minister for Agriculture, Fisheries and Forestry, Hon John McVeigh, announced a wide-ranging review of fisheries management in Queensland to deliver a better system for the states commercial and recreational fishers. Consultation occurred throughout the state and with all fisheries stakeholders. This event was fortuitous as many of the fishers contacted and with involvement in this project were already thinking about and considering issues such as fisheries data and information systems, including limitations and areas for improvement. Simply, fishers were already critically appraising the management of their fisheries including data due to exposure to the consultation process completed by MRAG Asia Pacific (see MRAG 2015).

The second event was a mix of fortuitous and unfortunate, and included the political motivated declaration of 3 commercial net free areas around Rockhampton, Mackay and Cairns along the Queensland east coast. Many commercial net fishers affected also have significant investments in the QCF. Not surprisingly, many commercial fishers were reluctant to participate and when participation did occur, fishers’ responses were tarnished/biased by this political interference in fisheries management. A positive outcome of the net free areas was the proactive organisation and meeting of some recreational fishing groups to discuss the need for better data. The project was able to tap into this group of fishers and survey many fishers who were thinking proactively and positively about fisheries data.

The project incorporated four objectives.

### **Objective 1:**

A synopsis of historic and current data collection practises and the types of data collected was completed. We reviewed earlier reports that have commented or made recommendations about data used in the reef line and crab fisheries. We also reviewed the extensive literature that documents general principles for gathering data and data strategies to effectively monitor and manage fisheries.

Fisheries managers, researchers and commercial fishers from other Australian states were also interviewed about fisheries data and methods of data collection relevant to both crab and line fisheries. This was done to highlight areas of common concern and to explore innovative solutions to particular data issues that may not have been captured in the readily accessible contemporary published literature or by our consultations with Queensland stakeholders.

We also summarised changes in management, reporting and logbook requirements as these are widely acknowledged not only to effect the accuracy and precision of the data collected from stakeholders but also data collected independent of the fishery.

For both our candidate fisheries we did not conduct a forensic analysis of records of individual fishers to highlight misreported data as this has been previously discussed in earlier analyses of crab logbook data (Brown, 2010, Wang et al., 2011 and Sumpton et al. 2003) and is widely acknowledged as a problem by industry themselves (Leigh et al, 2014; Sumpton et al. 2015; MRAG 2015). These



reports highlighted broad areas where data may have been misreported but also acknowledged that without independent data it was difficult to conclusively establish specific data misreporting in anything but the most extreme cases. Instead we highlight more general logbook issues based on results of our surveys (see Objectives 2 and 3). Stakeholders were also interviewed to aid in the identification of data gaps and areas of improvement (See following paragraphs for Objectives 2 and 3 methods).

### **Objectives 2 and 3**

There are many ways of addressing the objectives of defining data needs and methods of collection. Across other jurisdictions both Australian and globally, this has often been achieved through workshops with stakeholders represented by key members. Often these representatives have been chosen from “Peak Representative Bodies” of Associations that attempt to represent the interest of their members. These workshops are more successful when there are small numbers of fishers and common business structures so that views presented are truly representative of the industry position. Other methods have included structured surveys conducted either in person, over the phone, online or by return mail. In the case of the crab and line fisheries in Queensland there are hundreds of commercial participants and many fishers who acknowledge that their positions were not being adequately represented by any of the associations currently representing these stakeholders in Queensland.

We therefore took the approach of contacting individual stakeholders directly rather than using mail-out or on-line surveys as we were interested in maximising the response. We also wanted to give as many people as possible the opportunity to contribute their ideas in a forum in which many are more comfortable and which is more amenable to gathering constructive feedback. While this was more time consuming it enabled us to educate and inform stakeholders about the sorts of data and data products currently available and how those data could be used to benefit both them personally, as well as the overall fishery. We consulted with Fisheries Queensland for already have a range of data and data summaries available to stakeholders and provided fishers with details of these various data products during our interview sessions and were able to educate and inform individual stakeholders as well as clarifying some misconceptions of data and their use. We were also interested in gathering innovative ideas and wanted the views of as many fishers and stakeholders as possible, recognising the diversity of the stakeholders and the often unrepresentative nature of those chosen to represent the diverse groups of stakeholders.

We conducted a preliminary email questionnaire of key stakeholder representatives and used the responses to refine a more comprehensive Questionnaire to gather more detailed information of relevance to particular stakeholder groups from the broader fishing population.

In the case of commercial crab fishers the initial aim was to contact all authority holders in the Blue Swimmer Crab and Mud Crab fisheries, however management changes in 2015 which established three commercial net free areas in central and north Queensland resulted in considerable disquiet amongst many commercial fishers (see later discussion). No further interviews were conducted after September 2015 as it was often difficult for those interviewed to separate events in the crab fisheries with net fisheries and data collected was often not constructive. This meant that limited data were collected from north Queensland commercial mud crab fishers. However, attempts were made to individually contact all Blue Swimmer Crab fishers throughout Queensland and 42 constructive interviews were completed with these fishers (42% of participants), while 56 commercial fishers who reported Mud Crab catch completed interviews (15% of participants).

Recreational fishers were approached at South east Queensland boat ramps during the period April 1 2015 to June 30 2015. During this time, project staff conducted surveys during the Easter school holidays and on weekends when recreational fishing activity was elevated. Surveys were conducted at several boat ramps in the Moreton Bay area including: Spinnaker Sound (Bribie Island), Air-Sea

rescue (Bribie Island), Bongaree (Bribie Island), Toorbul, Donnybrook, Beachmere, Scarborough, Clontarf, Manly and Raby Bay. Generally, fishers with crab pots visible in their vessels were asked to participate in surveys at the end of fishing activities, although those without crab pots were also approached on occasion. Project staff surveyed recreational fishers informally, in a conversational manner, while rigging their vessels for transit. Non-boaters were also asked to participate at prominent land-based fishing platforms such as the Bribie Island and Woody Point jetties, along with the Ted Smout Bridge fishing platforms. Survey participants were also sort from an online fishing forum <http://www.nuggetoutdoors.com.au/smf/index.php?topic=26360.msg184058#msg184058> although the number of forum members willing to participate in the survey was relatively poor. Overall, 124 recreational crab fishers were interviewed.

To interview commercial and recreational line fishers we used the extensive networks and relationships developed over time via a number of different research projects (eg Tobin et al 2010; Tobin et al 2014) to contact potential participants. The management changes of 2015 that impacted the surveys of (mostly commercial) crab fishers, did not have a similar negative impact on line fishers. In fact, the politicking of recreational fishers around the net free area issue and subsequent declaration meant a number of wide-reaching networks of active recreational fishers existed. The surveying of recreational fishers largely focused on these groups (eg: Queensland Recreational Fishing Network) as snowball sampling meant interviewers were referred through the network and membership. In order to canvass some recreational fishers not associated with such groups/networks, recreational line fishers were also sampled at a number of Townsville boat ramps.

Queensland fisheries managers, NGO stakeholders, researchers and stock assessment scientists were also individually contacted and interviewed (n=22 for crab) and (n = 19 for reef line).

We also contacted fisheries managers, researchers and some commercial fishers from other Australian states and internationally to gather data on their experiences with alternative collection and use of fisheries data. For logistic reasons, we did not attempt to collect information from recreational stakeholders or organisations from outside Queensland.

See Appendix 1 for copies of questionnaires used to gather data from both reef line and crab fishers.

#### **Objective 4 Cost Benefit**

The current state of fisheries management and the key data structures that underpin the management of these fisheries are currently in review with the potential for considerable change in the next 12 months.

Out of necessity we have taken the approach of not being too prescriptive and dogmatic about the cost benefit analysis, reflecting the current dynamic and unpredictable nature of the structures that may underpin the management and monitoring of both our case study fisheries. We have chosen instead to provide greater detail on some of the easier changes around log books and highlighting more qualitative costs and benefits of alternative data gathering processes. We acknowledge that further development and consultations will need to take place before some of the recommendations can be fully implemented. The ultimate management structure will be reliant on the implementation of key MRAG recommendations.

## **REEF LINE FISHERIES**

Initially commercial, charter and recreational reef line fishers were contacted through existing research networks as well as industry associations (such as Queensland Seafood Industry Association) and fishing groups (CAREFISH, the Queensland Recreational Fishers Network). Snow ball sampling also occurred. Some interviews were possible during the workshop meetings with

fishers who participated in FRDC Project 2013/230 “Defining a resource sharing option in a multi-sectoral fishery: using the Queensland Coral Reef Fin Fish Fishery as a test case.”

## **CRAB FISHERIES**

In the case of commercial crab fishers the initial aim was to contact all authority holders in the Blue Swimmer Crab and Mud Crab fisheries however events earlier in 2015 leading up to the establishment of commercial net free areas in three areas in central and north Queensland resulted in (see later discussion). No further interviews were conducted after September 2015. This meant that limited data were collected from north Queensland commercial mud crab fishers. However, attempts were made to individually contact all Blue Swimmer Crab fishers throughout Queensland.

We also contacted fisheries managers and researchers from other Australian states and internationally to gather data on their experiences with alternative collection and use of fisheries data. We had some discussions with commercial fishers from other jurisdictions as well but made no attempt to collect information from recreational stakeholders or organisations from outside Queensland

# Results and Discussion

## REVIEW OF HISTORIC AND CURRENT REEF LINE FISHERY DATA

In discussing the data needs for the Coral Reef Fin Fish Fishery (CRFFF) we also consider the data needs of the East Coast Spanish Mackerel Fishery (ECSMF) as these fisheries often co-occur and commercial and recreational data are collected by the same logbooks and/or survey methods. Not surprisingly, the issues that surround some of the data types and fields are common to both fisheries.

### Commercial Fishery Data

Similarly to the crab data, mapping historic catch is difficult due to the absence of a consistent long-term data collection method. However, historic catch has been reconstructed for both Coral Trout (the dominant species of the CRFFF) and Spanish Mackerel as required by recent stock assessments. Leigh et al (2014) reconstructed catches for Coral Trout for the period 1953-2013 and Campbell et al (2010) reconstructed catches for Spanish Mackerel for the period 1937-2009. In both time series, there are periods where no data was available and these data gaps were filled by inference and linear modelling. The historical catch prior to 1982 was reconstructed from Fish Board data, while contemporary catch (since 1989) has been reported in the CFISH compulsory logbook system. No effort information accompanied the catch data collected by the Fish Board, while the contemporary logbooks do collect effort information.

Contemporary data reporting (or logbook completion) has however been poor in some instances. Most importantly, some fishers do not record dory (small fishing vessels) numbers and this is a critical effort metric in both the CRFFF (Tobin et al 2010) and ECSMF (Tobin et al 2014). Similarly to the pot-lift data for the crab fishery, in the absence of effort (dory number) information some assumptions about how fishers fish is required to estimate catch-per-unit-effort. While these assumptions seem to be robust in the CRFFF (see Tobin et al 2010, Tobin et al 2013), they are not robust for the ECSMF (Tobin et al 2014). While most vessels engaged in targeting Coral Trout will use all available dories to fish most efficiently, so when dory number is not recorded it is reasonably safe to assume that all the dories attached to a vessel (license) will be fishing. Conversely, the drop in participation in the ECSMF means many vessels with dories do not use the dories to fish. When dory number is not recorded in the logbook there is greater uncertainty about how many dories fished meaning very imprecise catch-per-unit-effort estimates can be made for Spanish Mackerel.

A series of logbook changes have occurred throughout the contemporary history of the CRFFF and ECSMF and can be summarized as follows.

#### Logbook Version LF01 (February 1996)

This logbook was the first line fishery specific logbook. Prior to the LF01 logbook fishers catching coral fin fish or Spanish Mackerel recorded catches in a general commercial fisheries logbook (a logbook used to record data for the line, net, crab and beam trawl fisheries).

#### *Effort*

- location (grid/site or lat/long)
- number of dories
- number of crew
- fishing method (dropline or trotline)
- number of lines

*Species*

- Coral Trout
- Redthroat Emperor
- emperor

*Notes*

- Only estimated weight reported not number

Logbook Version LF02 (July 1997)

*Effort*

- no change

*Species*

- no change

Logbook Version LF03 (July 1997)

*Effort*

- fishing method - dropline and trotline changed to handline/rod, trolling, dropline, trotline

*Species added*

- Red Emperor
- barramundi cod
- maori wrasse

*Species removed*

- emperor

Investment Warning Released (February 1997)

An investment warning released for Coral Reef species saw a slight increase in combined total annual catch of key species from this fishery over the following years until the Reef Quota was introduced in 2004 (see below).

Logbook Version LF04 (July 2004)

*Effort*

- number of fishing lines was removed
- location - only grid/site

*Species added*

- sweetlips
- cods
- large and small mouth nannygai
- job fish

*Species removed* (now protected species)

- barramundi cod
- maori wrasse

*Notes*

Previously only weight was required now both the number and the weight are required - introduction of quota (see below)

#### Introduction of Reef Quota (July 2004)

An Individual TAC was brought in for Coral Trout, Redthroat Emperor and Other Species which saw a reduction of catch (about 30%) and number of operators (businesses that exited the fishery via the GBRMP rezoning compensation package) in the Coral Reef Fin Fish Fishery.

#### GBRMPA rezoning and RAP (July 2004)

In July of 2004 the GBRMPA was rezoned reducing the fishable area. As a consequence of this the Representative Areas Program (RAP) process was commenced which endeavoured to remove effort (catch) from the Marine Park area and compensate those impacted.

#### Logbook Version LF05 (July 2007)

##### *Effort*

- number of lines was added

##### *Species added*

- cods/groupers grouping
- flowery/camouflage rockcod grouping
- green jobfish
- spangled emperor
- stripey snapper
- other sweetlips/emperors grouping
- hussar
- tuskfish
- other snappers

##### *Species removed*

- sweetlips
- cods - grouped with groupers

## **Recreational Fishery Data**

Participation of recreational fishers in the CRFFF and ECSMF is popular. Data collections have occurred via a number of government survey methods (see previous discussion as relevant to crab fisheries). In short summary, surveys conducted by Fisheries Queensland (known as RFISH) occurred in 1997, 1999, 2002 and 2005 (Higgs 1999, Higgs 2001, Higgs et al 2007, McInnes 2008). A national survey (the National Recreational and Indigenous Fishing Survey, NRIFS) funded by the FRDC occurred in 2000 using different methodology than RFISH (Henry & Lyle, 2003), and this methodology has now been adopted by Fisheries Queensland for a 2011 State-Wide Recreational Fishing Survey known as SWRFS. The methods of SWRFS are thought to be more accurate than those of RFISH by avoiding participant drop-out and better knowledge of individual versus boat based catches.

Finer scale and more informative recreational data has been collected by some non-government groups with the most notable being CapReef by InfoFish Services. The CapReef program collected data on recreational fishing and fish resources in Central Queensland (see Sawynok et al 2009 for

further details). The motivation for collecting this data was to address the paucity of recreational fisheries data, a problem that became apparent during forums discussing the introduction of the Great Barrier Reef Marine Park Plan 2004 and the Fisheries (Coral Reef Fin Fish) Management Plan 2003/04. The data collected was of finer resolution than that of the broader RFISH surveys due to the focused nature of the data collection effort. The data are useful for describing recreational fishing effort and catch for the Rockhampton region, though as the offshore habitat in this area is unique to that region, these data may not be particularly informative of recreational fishing effort and catch in other areas of the state.

## **Economic Data**

Until recently, there has been limited economic data available for line fisheries in general. While Williams et al (2008) attempted to construct a baseline of value of commercial fisheries, very poor survey participation by fishers meant the quality and representativeness of the analysis is doubtful.

More recently Thebaud et al (2013) completed an economic (including business structure) profile of operators in the CRFFF, identifying key drivers of profitability as well as the possible impacts of external factors on fishing operations. While business structures may vary considerably across the CRFFF, Thebaud et al (2014) identified three broad business types including (i) generalist line fishers, operating small vessels and relatively focused on line fishing yet only partially focused on CRFFF species; (ii) Dedicated live CT fishers operating large vessels and focused on catching live CT; and (iii) a group of diversified fishers operating medium-sized vessels that operate in numerous fishery types.

While participation in the CRFFF has generally declined in recent years, mostly catch has decreased in CT fishing due to a combination of environmental (Tobin et al 2010) and economic drivers affecting CT catch rates and unit costs of harvesting. While generalist line fishers and diversified fishers have been able to adapt (or avoid) the downturn in profit associated live CT fishing, the dedicated live CT fishers have not fared so well with reports of a number of businesses' failing in recent years. Within the dedicated live CT fisher business type, vessels with hired skippers are more at risk than those of "owner" skippers.

In addition, the lease return and asset value of CT quota units has steadily diminished since quota was introduced in July 2004. While many fishers suggest this is due to an initial over allocation of quota units, other factors including weaknesses of the ITQ management system are likely to have had some influence.

Generally economic data is not well collected in fisheries as not only do the costs of operating vary widely among fishing business types, the prices fishers are paid for species can also vary considerably. Although not yet quantitatively documented, catches of live Coral Trout landed in the north of the state may be 20% less valuable than those landed in southern ports. This price disparity is driven by the desire of live fish trade for red Coral Trout that are more common in catches from southern GBR waters. Similarly whole Spanish Mackerel landed close to major markets like Brisbane often fetch premium prices as they can be caught and marketed to consumers within very short time periods as compared with fish caught in remote locations that are often over a week old by the time they are marketed.

Clearly a more complete understanding of the economic metrics of fishing businesses is required. One of the overarching issues is that fishers are by their very nature generally quite secretive and sharing pricing information is not common. However while fisheries in general are increasingly questioned about their social, economic and moral values a more complete understanding of economic drivers would be eminently useful.

## **Fisheries Independent Data**

Leigh et al (2014) noted that fishery catch rates, particularly of Coral Trout and Redthroat Emperor, do not correlate well with population size due to the effects of tropical cyclones (Leigh et al 2006, Tobin et al 2010). Underwater visual surveys are the most direct method for estimating population sizes, though are expensive, subject to large experimental errors (*stemming* from low sample sizes) and depth limited. Monitoring of population age structures can reveal trends in fishing mortality but are also expensive and only useful when long time series of data are collected.

Fisheries Queensland undertook some fisheries independent surveys of the CRFFF across the period 2006-2009 (inclusive), though the quality of the catch rate data (and thus age structures) has been heavily criticized by fishers and remains of questionable value. Catch rates and age structures of CT populations from a stratified sample of reefs across the GBR were sampled by fishery independent methods that employed skilled fishers. In some years, the contracted “skilled” fishers were anything but and thus catch rates and resulting population age structures are likely inaccurate. Consistency in fisher skill is needed to ensure the quality of data gathered.

In comparison, the long-term sampling (1995-2005 inclusive) of CT populations for abundance estimates and age structure by the Effects of Line Fishing Project (see Mapstone et al 2004) is considered to be a robust baseline of the population dynamics of CT (and many other byproduct species of the CRFFF). A consistent vessel, master fisherman and crew were utilized and provided robust data.

Similarly, the Australian Institute of Marine Science (AIMS) has completed regular underwater visual surveys (UVS) of CT populations spanning 1992-2011. In conjunction with these spatiotemporally structured and regular surveys are numerous similarly structured though less spatiotemporally regular surveys conducted by Tony Ayling mostly as contracted by the Great Barrier Reef Marine Park Authority (GBRMPA).

Despite concerns about the utility of commercial logbooks as a true indicator of the catch history in the CRFFF and ECSMF, some evidence suggests that the logbook data is largely accurate. Some stakeholders have expressed concern that the investment warning issued in 1997 encouraged fishers to over-report catches to ensure future security of access to the fishery, and that following quota introduction in 2004 fishers’ under-reported catches to conserve quota allocation or save on leasing costs. For the CRFFF the catch-rate data do not support this hypothesis with catch rates actually increasing post-2004 quota introduction (Leigh et al 2014) and remarkable inter-annual consistency in the seasonality of catch rates described by Tobin et al (2013) that would likely be masked by fishers’ attempts to mis-report. There does remain some uncertainty about the validity of some catch reporting in the ECSMF as some uncertainty in effort recording persists in the Spanish Mackerel fishery (see Tobin et al 2014 for further details).

## **Impact of Management on CRFFF Data Quality**

Many fisheries management and marine park management changes have impacted the fishery and concomitantly impacted the types of and methods of data collection.

1910 – the approximate start of the Spanish Mackerel fishery

1950 – the approximated start of the Coral Trout fishery

1962 – first records of Coral Trout landings are collected by the Queensland Fish Board.

1976 – *Fisheries Act 1976* implements a MLS of 35 cm for Coral Trout and Red Emperor, and 30 cm for Redthroat Emperor



1981 – zoning of some southern areas of the GBR by the GBRMPA including the first declaration on no-fishing marine parks.

1983 – the first Underwater Visual Survey conducted on 100's of reefs

1986 – zoning of reefs in the far northern section of the GBR

1987 – zoning of the central section of the GBR

1988 – compulsory commercial logbooks introduced

1990 – prohibition on the sale of catch by recreational and charter fishers.

1993 – changes to the MLS for Coral Trout (38 cm), Red Emperor (45 cm), Redthroat Emperor (35 cm), as well as bag limits for recreational fishers.

1997 – investment warning issued in May in response to increasing participation and catch driven by the expansion of the live Coral Trout market.

2003 – Coral Reef Fin Fish Management Plan introduced in September with changes to MLSs, bag limits, protected species.

2004 – a total allowable catch limit and ITQ units introduced for the commercial fishery, including an approximate 30% reduction in catch. A spawning closure schedule introduced with 3 x 9day closures occurring around the new moons in Oct, Nov and Dec.

2004 – Representative Areas Program (RAP) introduced by the GBRMPA increasing the proportion of the park closed to fishing from about 5 to 30%.

2009 – spawning closures are reviewed and reduced to 2 x 5day closures around the new moons in Oct and Nov.

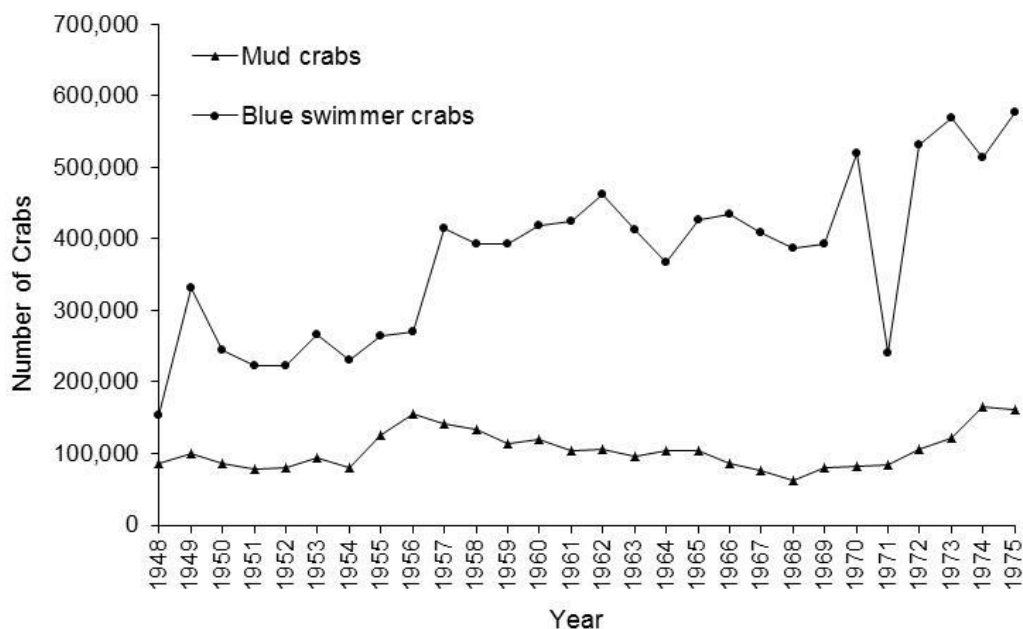
2014 – harvest strategy introduced for Coral Trout to allow the value of a quota unit to vary dependent on fishery performance (catch rates)

## REVIEW OF HISTORIC AND CURRENT CRAB DATA

In the case of data for the crab fisheries we have concentrated our attention on the Mud Crab and Blue Swimmer Crab fisheries as the other major crab fishery (spanner crabs fishery) is a TAC managed fishery, fished predominantly by commercial fishers. In this fishery the data issues are different and not as extensive as those of the mud and Blue Swimmer Crab fisheries where there are multiple sectors, multiple gears, and much larger numbers of participants and a wider array of fisheries data concerns.

### Commercial Fishery Data

There is limited historic data on either the mud or Blue Swimmer Crab fisheries prior to the introduction of commercial logbooks in 1988. There are Queensland Fish Board (QFB) records of catch extending back to the late 1930's, although total catch estimates are only available since 1948 (**Figure 1**). There are also no estimates of fishing effort and the Fish Board records are an incomplete sample of the total commercial catch as fishers often marketed their catch through outlets other than the Fish Board.



**Figure 1.** Catch of Mud Crabs and Blue Swimmer Crabs reported by the Queensland Fish Board from 1948 to 1975.

There were no data collected from 1975 until 1988 when compulsory commercial logbooks reporting of catch and effort commenced, with crabs being reported along with netting catch in a net/crab logbook (NC). These logs were daily records of commercial catch and effort with all three main species of crabs being included in the original logbook. Over the years a number of different versions of these logbooks have been progressively rolled out with the key changes affecting the crab fisheries summarized below in red.

Logbook Version NC01 (December 1991)

#### *Effort*

location - grid/site or lat/long, net mesh size, total net length

*Species added,*

Mullet, barramundi, king salmon, blue salmon, mackerel, shark

*Notes*

Only weight reported not number

Logbook Version NC02 (January 1996)

*Effort*

no change

*Species added*

“Other” crab (specify)

Logbook Version NC02A (October 1996)

Copy not found.

Logbook Version NC03 (May 1997)

*Effort*

fishing method added- drift gill netting, set gill netting, ocean beach netting, tunnel netting, ring netting, target species (for net) added

*Species*

no change

*Notes*

Fisher can select number or weight when reporting crabs

Logbook Version NC04 (June 2003)

*Effort*

no change

*Species*

no change

*Notes*

SOCI interactions added - species, number and release condition

Logbook Version NC05 (January 2004)

*Effort*

soak time added to the net effort details

*Species added*

bream, tailor, spotted mackerel grey mackerel, school mackerel, whaler shark, hammerhead shark, mullet, whiting, flathead, garfish,

*Species removed*

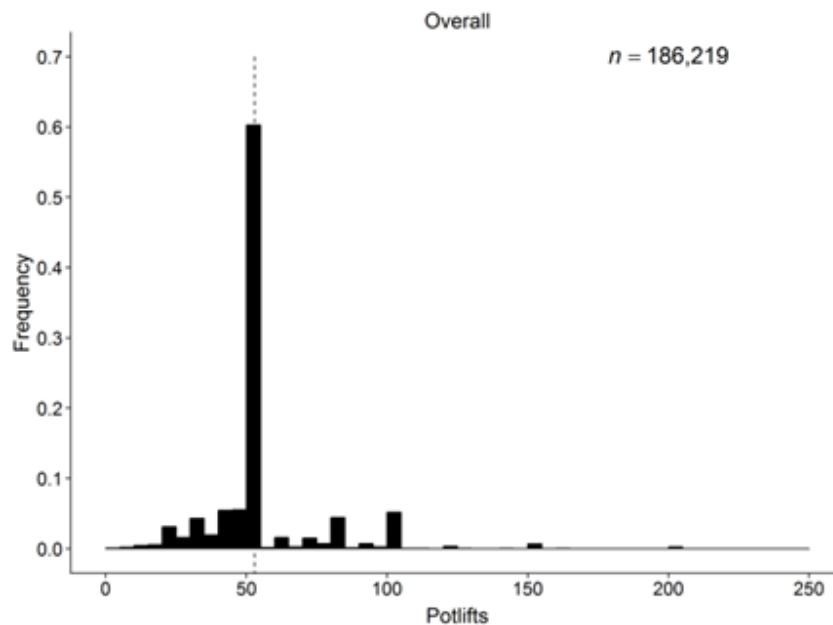
shark – unspecified, mackerel

*Notes*

Only estimated weight reported for crab (no option to report catch by number)

Sumpton et al. (2003) have previously described earlier issues related to the reporting of commercial crab catch in Queensland. When dealing with the commercial pot fishery data decision rules often need to be formulated in order to “clean” the data and exclude erroneous or suspicious records. In addition, the misreporting of pot lifts is one of the key issues in crab data management.

This is because the number of potlifts is compromised by legislation requiring the use of a maximum of 50 pots. Most fishers are likely to report the use of 50 pots/potlifts (Figure 2) regardless of the quantity that they are actually using. In recent years, fishers have reported the use of more pots after the introduction of policy provisions allowing fishers to use two licences (i.e. 100 pots) on a single vessel. Data collected during observer-based field work in the Blue Swimmer Crabpot fishery in southern Queensland reveal that fishers often use more pots than is reported in the logbooks. Offshore Blue Swimmer Crab fishers, for example, were reporting 50-60 potlifts during the period 1999 to 2001 in logbooks while the observer data suggests that at least some fishers were using closer to 100 pots. The most recent observer data shows that the number of potlifts per day in some parts of the fishery has increased to around 150 (and even more).



**Figure 2.** Frequency histograms of the number of potlifts recorded by commercial Blue Swimmer Crab fishers during the period July 1988 to June 2014. Potlifts were calculated using methods described by Sumpton et al. (2003). The dashed lines represent the mean number of potlifts reported.

Observations on commercial vessels have shown that commercial fishers working individually floated pots in Moreton Bay are able to service approximately 20 pots per hour of fishing, so servicing in excess of 150 pots per day is clearly possible, although available evidence suggests that

this is not a widespread practise in Moreton Bay. In offshore areas where gear can be run on trot lines (10 pots on a single line) it is possible to work an even greater number of pots. In the case of the Mud Crab fishery, commercial operators are often further limited by tidal effects than are Blue Swimmer Crab fishers. Mud crab fishers working in some estuarine areas are limited to

The misreporting of the number of potlifts represents a significant impediment to deriving accurate measures of catch rates and the resultant index of abundance for use in assessment models. For example, it is spurious to equate a boat-day from 1988 to a boat-day from 2014 given that some fishers are potentially using three times as many pots as they did historically. The situation for Mud Crabs is similar, although there is limited observer coverage in that fishery to gauge the extent of any misreporting.

In order to address effort misreporting, it is currently necessary to “adjust” for changes in effort over time by developing “offsets” for the number of pots used by fishers. For example, during fishery-dependent biological sampling of Blue Swimmer Crabs undertaken during the periods 1984-1986, 1999-2001 and 2011-2014, (Sumpton et al 2003, Sumpton et al 2015) observers recorded information on a pot-by-pot basis during normal commercial fishing operations. During this monitoring the number of pot-lifts was recorded accurately and was found to vary considerably both inter-regionally and intra-regionally. For example, in 2014 the number of pot-lifts recorded in the Blue Swimmer Crab fishery in Moreton Bay varied between 9 and 128 per day, with a mean of 70. In the case of the Mud Crab fishery even simpler offset rules are applied which usually involve incrementing effort by a fixed percentage each year based on a “best guess”

To develop an appropriate offset for pot numbers, the observed pot numbers from the fishery-dependent sampling are adjusted using generalised linear modelling (GLM) which allows for catch rates to be corrected for increasing levels of pot effort per boat-day between fishing years. However, this process is not possible for the Mud Crab fishery where changes in effort cannot be easily quantified due to lack of observer coverage. As mentioned earlier the way to address this in the past has been to apply an annual proportional offset, effectively increasing the effort over time. Such a practise is clearly very subjective and there is limited data to objectively adjust mud crab fishing effort.

## **Recreational Fishery Data**

Recreational fishers take significant quantities of Blue Swimmer Crabs and Mud Crabs as confirmed by several earlier state wide surveys (Higgs 1999, Higgs 2001, McInnes 2006, McInnes 2008).

Recent recreational catch data (collected since 1990) comes from basically two sources; firstly from research surveys conducted as part of more localised research work, and secondly from larger scale state-wide phone and fishing diary surveys of recreational anglers. The objectives of the former surveys have often been to allow the estimation of catch, effort or catch rates for particular species or areas while the latter are designed more for obtaining demographic information as well as state-wide estimates of catch. There have been a number of different methods applied to the research surveys including bus route methods, roving creel surveys, access point catch surveys and aerial surveillance estimates of effort (see Pollock *et al.* 1994). Each of these methods has its own particular issues with respect to accuracy and precision and each can potentially provide biased estimates if underlying assumptions of the surveys are not fully understood.

Recreational catch information prior to the 1990's is very limited and indices of catch are often inferred from boat registration data or other population demographic data

Catch and effort information was collected from the charter boat fishery by way of a voluntary logbook established in 1993/4 which later became compulsory in 1996. But there is limited data

reported for all crab species although in some areas Mud Cabs do make a contribution to the charter catch.

The following sections describe the main recreational surveys that have gathered information on crabs since 1994

*RFISH program surveys (Diary and phone Surveys:- 1996/7, 1998/9, 2001/2 and 2004/5)*

State-wide surveys of recreational anglers using a telephone survey to estimate participation followed by a yearlong diary program to estimate recreational catches have been conducted at regular intervals in Queensland. Telephone surveys have been conducted in 1996, 1998, 2001 and 2004, with diary programs conducted the following year with the co-operation of a sample of anglers identified from the phone surveys. Generally, more than 4500 angler volunteers have contributed to each of these surveys but many discontinued their diaries throughout the survey year.

The issue of whether catch rates determined from the early RFISH surveys represent an accurate index of abundance is hotly debated and the determination of an appropriate sampling frame is difficult to determine for some species. It is obviously no use including the “zero” catch of fishers who have no chance of catching a particular species. The utility of these surveys is very much species dependent but the fact that the majority of the survey respondents lived and fished in southern Queensland means that blue swimmer crabs in particular are more likely to be representatively sampled. Although the notion of a representative sample is difficult to determine as it requires a thorough understanding of the sampling frame, as well as detailed knowledge of how that frame was sampled. The weighting factors used to remove bias from avid anglers are also particularly poorly defined for some of these surveys, particularly the 2005 survey where

*RFISH program surveys (Diary and phone surveys, National methods:- 2000, 2010 and 2014)*

There have been three surveys conducted using nationally approved methods surveys, similar to the RFISH surveys, conducted. Results from the National Recreational and Indigenous Fishing Survey (NRIFS), undertaken in 2000, indicate that the Queensland recreational sector harvested

A more recent recreational survey (2010/11) and 2014 report. This survey utilised similar methods to the earlier NRIFS survey (Phone and diary survey) but more contact was maintained with fishers in order to minimise recall bias and reduce ‘dropout rate’ where anglers opt out of the program over time. The relative standard errors obtained for Blue Swimmer Crab fishers are relatively high suggesting poor precision and accuracy. The estimates for mud crab are better reflecting a much lower standard error.

*RFISH program (Bus route survey of Moreton region:- 2007/08)*

Readers are referred to Webley et al. (2009) for a complete discussion of this survey and its methodology although it is based on standard and well established techniques that are applied widely throughout the world to assess recreational fisheries. It is important to note that this survey was designed to collect information from vessels that left from, and returned to, boat ramps in southern Queensland during daylight hours only. In addition, it did not collect any catch or effort information from vessels that were moored at private jetties or marina berths. Catch rates obtained from surveys conducted at different times over the life of a fishery can provide valuable information on the relative abundance of a particular species providing all features of the fishery (including effort, impact of technology and fishery management changes) can be factored into the analysis.

*General Recreational Data Discussion*

The stratification of the earlier RFISH surveys, which results in sampling being distributed according to fisher population density, effectively means that the majority of diary participants are from the

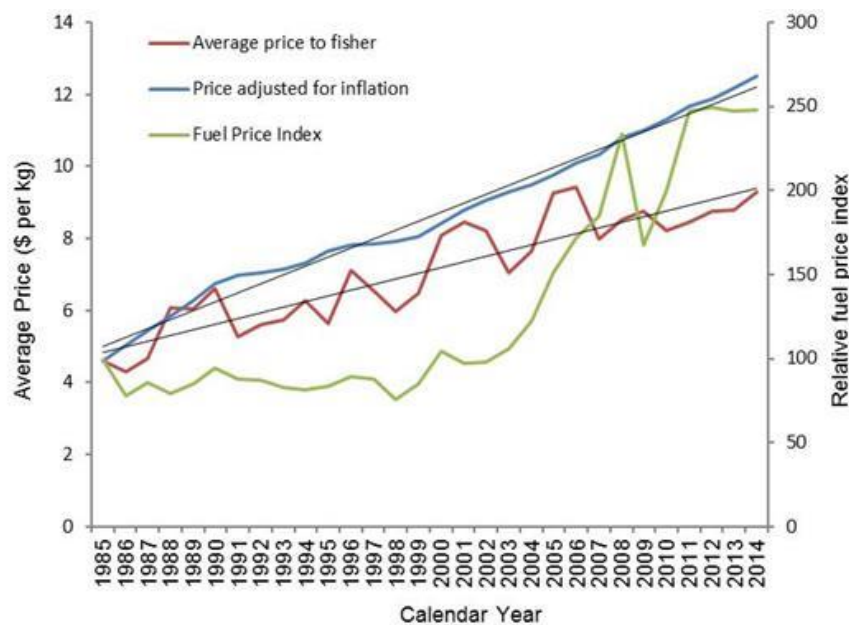
high population districts of southern Queensland. This results in even more accurate and precise catch estimates of species such as Blue Swimmer Crabs and snapper and other species where the catch is largely restricted to more southerly waters and where a high proportion of diary participants would be fishing.

The attribution of a zero catch to a trip that had no chance of catching a particular species will severely bias catch rate estimates. Including catches for trips such as these that have no possibility of catching a particular species may result in grossly deflated catch rate estimates. Likewise, only including catches when a species is actually caught has the potential of over-estimating sustainability, as unsuccessful trips that may have targeted that species are eliminated from the analysis and hyper-stability of catches and catch rates becomes more likely. When a stock is in decline it is more likely that the number of such zero catches would increase. Different fishing techniques are often very species specific and sometimes size selective as well.

### Economic Data

There is limited economic data available for Queensland crab fisheries in general. Pashen and Quinn (1984) and Moxon and Quinn (1985) conducted the only economic surveys of Blue Swimmer Crab fishers and mud crab fishers respectively in Moreton Bay. These studies generally highlighted the diversity of business structure and variable reliance on crabs as a fisher’s source of income. Many commercial operators keep detailed personal records in terms of both catch as well as a range of their different variable and fixed costs, while others keep limited records.

There is easily accessible data on fuel prices and market prices for most fisheries resources (Figure 3). A problem highlighted by a number of industry participants was that prices received by fishers varied widely depending on their marketing strategy and quality of their product. For crabs this variation was in the order of 50% and in the case of Mud Crabs was affected by the marketing of “C” grade crabs. This change in grading and marketing practices also has an effect on the overall fisheries data as many of the lower grade crabs were previously released and allowed to “harden”. Effectively the mud crab catches have been inflated in recent times in comparison to the historic data because of this practice.



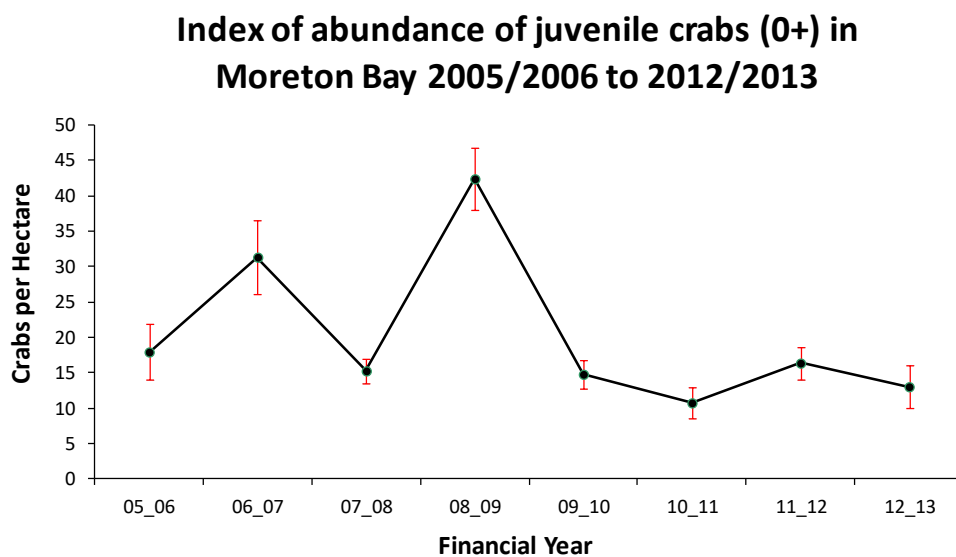
**Figure 3.** Fuel price index and average price received by commercial Blue Swimmer Crab fishers.

Some of the data that have recently been collected from commercial crab fishers in southern Queensland (Sumpton et al. 2015) highlight this diversity of business structure and the difficulty in categorizing and analysing the data needs of “typical” fishing business. Particularly in areas where fishers tend to be “mixed businesses”, relying on a range of fisheries other than crab fisheries for their income. Many fishers also identified alternate non fishing businesses to supplement their fishing income. The variable cost structures result in widely different perceptions on what is considered to be profitable and what data is required to assist in ensuring that profitability.

### Fisheries Independent Data

Fisheries Queensland have been undertaking fisheries independent trawl surveys of Eastern King Prawns, Blue Swimmer Crabs and Snapper since 2006. Although the objectives and logistics of the sampling has changed over time there has been a relatively consistent sampling in November and December each year using beam trawl apparatus (For a detailed description of methods see DPI&F (2006), DPI&F (2007 a-d) and DPI&F (2008))

Given some of the problems already highlighted with the CFISH data these fishery independent trawl surveys may provide managers and regulators with indicators of stock health, and scientists in particular have highlighted that their worth will continue to increase over time as more data are added to the time series (Figure 4). Many highlighted that it is vital that some form of index of relative abundance is available for the Blue Swimmer Crab fishery given the quality of the logbook records. No such independent surveys are currently conducted on Mud Crabs despite the similarity in commercial data issues. Fisheries Queensland did conduct independent surveys of Mud Crabs for several years but these were discontinued in 2010. These surveys involved using crab pots to sample crabs from a range of areas throughout the Queensland Coast including the Gulf of Carpentaria.



**Figure 4.** Index of abundance of juvenile crabs (0+) in Moreton Bay between 2005/2006 and 2012/2013 as predicted from the two-part conditional generalized linear modelling.

### Impact of Management on Crab Data Quality

Some questionnaire respondents noted that there have been many fisheries management changes that have directly and indirectly affected the data used to monitor and manage the Mud Crab and Blue Swimmer Crab fisheries. The most notable changes in the last 30 years are highlighted below in a



timeline with the likely impacts of these changes (and on the data used to assess the fishery) are italicised and shown in brackets for some of the key changes. These management changes are sometimes critical to the quality of the data that are used to assess the fisheries and collected for a range of other purposes.

1983 Issue of new crab licences ceased.

1984 Primary/tender boat licence system was introduced which: (i) Allocated primary/tender status to all boats licensed at the time. (ii) Allocated fishery symbols to all primary licences as nominated by licence holders. (iii) Restricted the issue of any new primary & tender boat licences, and fishery symbols (iv) Established a fishing operation around a primary boat, any associated tenders boats, and fishery symbols endorsed on the primary boat licence. Fishery symbols were allocated to all licence holders in 1984 with the C1 symbol allowing the take of crabs including blue swimmer, mud, spanner and other crabs species. At that time the vast majority of fishers nominated to have CI endorsements associated with their licences thus increasing the latent effort that could be associated with the crab fishery. With increasing management change in other fisheries this enabled many fishers to expend effort in a range of fisheries on an irregular (or regular) basis.

1988 Compulsory commercial logbook reporting commenced (*At the time fishers were advised that the data would not be used against them*).

1996 First total allowable catch (TAC) - Spanner Crab fishery (C1 endorsed fishers were excluded from the spanner crab fishery based on logbook catch history. *(This resulted in an incentive for fishers to establish history in fisheries in which they were endorsed but which they had not previously fished)*).

1997 1st December 1997: A Regulatory Impact Statement (RIS) proposed reduced trawl “in-possession” limits of blue swimmer crabs of 100 for Moreton Bay and 1000 elsewhere.

1999 First Individual Transferable Quota (ITQ) Allocation – Spanner Crab fishery (*further incentive to establish catch history by falsifying records*).

1999 1st May 1999: Cabinet approved changes to the Regulation (which was subsequently absorbed into the Plan) that enabled limited numbers of blue swimmer crabs to be retained by trawlers until 31 October 2000. The Queensland Fisheries Service had undertaken a review of the arrangement for trawl caught blue swimmer crabs. Provisional in-possession limit of 100 for Moreton Bay and 600 elsewhere. It was recommended that the provision to allow trawl operators to retain blue swimmer crabs be continued until 1 January 2002. The recreational sector and commercial crab pot fishers were opposed to any retention of blue swimmer crabs by trawl operators. On the other hand, the trawl sector continued to support a proposal to allow increased catches of blue swimmer crabs in the northern Hervey Bay area.

2002 1 January 2002: Trawl in possession limits for blue swimmer crabs reduced to 30 in Moreton Bay and 500 elsewhere.

2003 12 September 2002: East Coast mud crab and Blue Swimmer Crab investment warning – (*There were “rumours” of this years before it actually happened further increasing the incentive to establish catch history in these fisheries*).

2003 13 December 2003: Blue Swimmer Crab measurement changed from 15cm across the spines to 11.5cm notch to notch (base of spine measurement). Effectively a 13mm lowering of MLS. (*An anomaly in the fisheries regulations meant that the size effectively did not change significantly in some areas as fishers were previously able to retain smaller “tipped” crabs prior to this regulatory change due to an alternative body measurement which effectively allowed smaller crabs to be retained. This change improved the accuracy of data from that point going forward as the catch was*

*less ambiguously defined. Prior to this time some fishers recorded all their catch while others only included that proportion above the previous MLS of 15cm.).*

2008 Removal of latent effort in the line, crab, eel and beam trawl fisheries.

2010 2 April 2004: Dillies prohibited in crab fisheries. *(This had a significant imp act on recreational fishers in particular as these were the preferred apparatus used by that sector. There is debate about the effect of this change in this regulation with some arguing that it has caused a reduction in recreational effort).*

2011 “Crab Review” began *(This review was designed to update management of Queensland’s crab fisheries but as of the date of publication of this report the review has not been finalised).*

2012 Entitlement to use an additional 50 to 100 crab pots in blue swimmer under permit *(probably improved data accuracy as incentive to falsify effort was removed).*

2014 Entitlement to use an additional 50 to 100 crab pots under permit extended to mud crab fishery *(probably improved data accuracy as incentive to falsify effort was removed).*

## **PUBLISHED COMMENTARY ON REEF LINE FISHERY AND CRAB FISHERY DATA**

The following references contain summaries of crab and line fishing data and have made comments on data quality or have included recommendations for improving data or data collection protocols. A short mention to the data issues identified in the reports is shown after some of the key references and the full reference citation is provided in the reference section.

### **Brown (1993).**

Quote: “The greatest information need in the area of mangrove crab fishery management generally is for time-series of reliable catch and effort data, including locality information and a realistic measure of fishing effort which can be used to calculate a CPUE or index of population density”.

### **Brown (2009).**

Identified problems with log book data quality in regard to over stating daily catch due to investment warnings and under reporting number of pots being used.

### **Campbell et al (2012).**

Identified a number of data improvements and issues for recording of catch and effort data in the ECSMF, though most notable was the lack of daily effort reporting in commercial logbooks. The consequences of this are quite serious as hyperstability is an obvious concern for a transient aggregating pelagic like Spanish Mackerel (Tobin et al 2013).

### **Fernback, M. (2008).**

Identifies the current data gaps and knowledge with respect to recreational use of the Great Barrier Reef Marine Park (GBRMP) and highlights that while “tourism visits are generally well documented by commercial companies and businesses as a condition of permit, a large volume of independent visitors also use the GBRMP yet there numbers and activities are mostly unknown.”

**Greiner et al (2013).** Identified improved monitoring and law enforcement efforts, as well as targeted education and information was required to address the widespread concern of visiting tourist anglers. “Colloquially known as “grey nomads” these anglers are commonly motivated by thrifty

living and subsistence fishing though the subsistence fishing is often motivated by the desire to harvest enough fish”

**Hay et al (2005).** Independent fishery surveys methods used in this study are a valuable adjunct where “high levels of unreported effort hamper the effective evaluation of fishing effort”

**Higgs, J. (1999).** RFISH Technical Report No. 2: Results from the 1997 Diary Round. Brisbane: Queensland Department of Primary Industries. No recommendations made regarding data collection protocols.

**Higgs, J., McInnes, K. (2003).** 2001 Biennial recreational fishing survey of Queensland residents. Department of Primary Industries, Queensland. No recommendations made regarding data collection protocols.

**Higgs et al (2002)** Identified data issues in self-completed diary programs including species misidentification and lack of species categories. Improvement in these areas would allow comparison with commercial catch information.

**Leigh et al (2014).** Identified that logbook entries by coral reef line fishers often did not include fine scale spatial information and as a result, a substantial proportion of logbook records were not included in the inaugural stock assessment.

**McInnes, K. (2008).** No recommendations made regarding data collection protocols.

**Potter et al (2009).** CapReef: Recreational fishing and fish resources in Central Queensland 2005-09.

**Sumpton et al (2003).** Provided several recommendations on related to data quality in the Blue Swimmer Crab fishery related to different weight conversion ratios and the need to improve effort reporting.

**Taylor et al (2012).** Reported that statewide recreational catch estimates for many species were improving though for some species catch estimates were still imprecise. In addition, for many species regional estimates of catch are not possible. The strength of the recreational fishing surveys is in the time series of comparable information that reveals trends in patterns of fishing activity and catches through time rather than one off “snap shots”.

**Thebaud et al (2014).** Completed the first economic survey of commercial operators in the Queensland CRFFF analyzing the activity patterns of the fleet as well as patterns of quota ownership. Key drivers of profitability are catch rates, harvesting costs and business structure. Business structure in particular has not been considered previously.

**Tobin et al (2010).** Described the impacts of tropical cyclones on the Great Barrier Reef line fishery identifying significant downward trends in CPUE of Coral Trout and thus severe impacts on the profitability of line fishing businesses. Most notably the project identified that the present commercial logbook recording arrangements are inadequate for measuring in a timely manner the impacts of severe weather events on the productivity of the fishery. In addition, the project identified that no charter or recreational fisheries data of suitable quality was available to explore the impacts of weather events on those sectors.

**Tobin et al (2013).** Quote: “Where and when it is available, fisheries logbook data can be a powerful tool for exploring the vulnerability of fishes that form FSAs to fishing.”

**Tobin et al (2014).** No recommendations made regarding data collection protocols.

**Webley et al (2009).** Note a number of important limitations with collecting recreational fishing data most notably that some species such as mackerel are infrequent in catches and that estimating annual harvest is very imprecise. The importance of understanding effort creep is also mentioned by the authors as recreational fishers use different technology and gear as compared with 10 years ago. Accompanying technological change is a changing demographic and social changes that may affect targeting and harvesting behaviors.

**Welch et al (2008).** Described discarding practices in the reef line fishery (RLF) of the Great Barrier Reef (GBR), and suggested improvements in data reporting were required for the discarded catch. The authors also cautioned that the introduction of a TACC in 2004, which was set at a level well below recent fishery harvests, may encourage a higher rate of discarding motivated by high-grading and that discarding rates should be monitored.

**Zischke et al (2012).** Estimated catch rates and catch (harvest) for a specialized sports fishery in southeast Queensland and noted disparity between their estimates of catch and those of Webley et al (2009). The authors further noted that the catch of some species by the specialized fishery is higher than that of a co-occurring commercial fishery, and therefore the significance of the recreational fishery should be represented in resource allocation decisions.

## PRELIMINARY SURVEY RESPONSES – KEY STAKEHOLDERS

We forwarded a preliminary set of questions to a subset of stakeholders of both the reef-line and crab fisheries via email as well as contacting stakeholders directly and eliciting responses over the phone. This activity was undertaken to introduce stakeholders to the project and motivate some thought about fisheries data, and how fisheries data directly and indirectly influences not only themselves but also other stakeholders and the resource at large.

The replies presented in the following section are not exhaustive but are presented to highlight some of the common concerns, thoughts and ideas raised. These responses were used in finalising the more comprehensive project questionnaires to improve the quality and relevance of the data collected.

Please note that the following are a summary of responses from stakeholders and may contain factual errors.

### ***FISHER RESPONSES***

The responses of recreational, commercial, charter and indigenous fishers are reported here cumulatively. Generally, responses from fishers from all sectors trended towards the commercial sector. This pattern is likely due to greater familiarity of respondents with commercial logbook and data processes and uses, as compared with other sectors where data is less frequently collected and thus less well known or understood.

**Charter fishery.** A comparison between the data collection of Queensland charter fishing businesses and those of the NT were highlighted by one respondent. It was suggested that the Queensland charter fishing should be referred to as commercial tour operators (CTOs), to better reflect the primary purpose (tourism) of these businesses and to clearly demarcate CTOs from commercial harvest businesses. Data collection from CTOs should then reflect the tourism aspect of these businesses. Data collection should not be limited to just catch and effort but should also include client numbers and origin information to allow for better marketing and management.

Charter tourism was not as great an issue for crab fishers with mud crabs being the only crab species that report significant charter catches.

**Recreational fishery.** A few respondents noted the paucity of recreational fishing data. While recent RFISH programs and the current SWRFS provide some information about participation, effort and catch, regional catch estimates and catch estimates of less popular target fishes are still unavailable or have poor precision.

Recreational crab fishers commented on the reduced targeting of both mud crabs and blue swimmer crabs following the banning of suicide dillies in 2010. They also highlighted the importance of recreational fishing economic and social data without offering many solutions or ideas for the collection of those data.

**Phone survey.** There were a number of respondents who had concerns about the validity of recreational fishing surveys based on phone calls to landlines when there is an increasing trend for households to move towards a mobile only telephone communication. The Australian Communication and Media Authority (ACMA) say 20% of Australians now rely solely on mobile phones. Thirty nine percent of Australian residents aged 25-39 do not have a home phone.

**Validation.** The importance of validating the entries made by commercial fishers in the compulsory logbooks was a common concern of recreational fisher respondents. While these concerns appeared based on hearsay and focused around the belief that fishers commonly exaggerate catches to ensure

their licenses are worth more some commercial fishers themselves have acknowledged this as a significant issue.

**Catch and effort – what does it mean?** There were a number of commercial fisher respondents who were concerned about the recording a day of effort for a day of fishing that produced no catch. Respondents suggested these days were an inaccurate representation of local fish abundance, and that despite not catching any fish believed fish were present though just not biting that day. Therefore they viewed the reporting of zero catch as not sensible. This belief was not uncommon and reflects a common problem that fishers are not always aware of the importance of some data fields.

Effort recording was also a significant problem in the Mud Crab and Blue Swimmer Crab fisheries with respondents noting that effort had increased due to more pots being used but this was often not reflected in the data provided by fishers.

**Distrust of responsible use.** The underlying negative sentiment from all sectors was a feeling that fisheries data were used to impose restrictions on fishers. Naturally fishers are somewhat cautious about data discussion at the individual business of fisher level as they wish to protect their intellectual property.

**Grey nomads.** Numerous responses included reference to the seasonal influx of grey nomad fishers whose fishing effort and catch is not measured by current logbook or monitoring systems. Seasonal interstate tourists present problems in many small local communities where the attitudes of some grey nomads (subsistence fishing opportunities to catch and store fish fillet needs for the next year) cause significant problems.

**Line Working Group.** Met and discussed options 3 December 2014. In spite of rosy outlook from Leigh et al 2014, many concerns were raised. Economic viability was the main under-current of a number of issues raised yet the economic costs and trends of those costs are not regularly monitored. There is a strong belief by some fishers that economic trends should be tracked so that when times are tough, stakeholders are well informed and have a basis for discussing management of change.

## ***MANAGEMENT, ASSESSMENT AND MONITORING, RESEARCH RESPONSES***

**Commercial sector.** Detailed commercial daily logbook data are compulsorily collected. They are useful for time series of catch sizes, catch rates and various other pieces of information depending on the fishery and targeted species. Commercial logbook data are not validated by, e.g., catch disposal receipts. It is open to manipulation by the data providers (fishers) for their own purposes. This problem is exacerbated by the use of the data for many purposes other than scientific analysis. Also, the logbook data do not record zero catches that resulted from nonzero fishing effort, and do not include catches of animals that were not retained (discards).

**Tourist anglers** who charter fish - although there is some recording of visitation numbers of tourists to the Great Barrier Reef (GBRMPA collect this), there is no information collected specifically about the origin of the tourist anglers, motivation for visiting, satisfaction of experience and likelihood of return visit. This information is seen by some respondents as important information to help manage the impacts of these fishery users.

**Tourist anglers** who fish themselves – there is currently no data collection methods that encompass this users group. Some recent access point surveys by QDAFF (boat ramps, tackle shops) in southeast Queensland have collected some preliminary information about angler origin.

**Shifting baselines.** Often times fisheries resources are exploited by fisheries for considerable periods of time without any monitoring or data collection. During such periods populations may be heavily

impacted meaning monitoring and data collection that starts at a later time is working from a “shifted baseline”. Significant changes in the east coast Spanish Mackerel and Moreton Bay Blue Swimmer Crab populations occurred well before data recording or monitoring were introduced, yet we know that some other forms of historical records may allow for the reconstruction of historical trends in the fishery. The reconstruction of some of these catch histories from alternate data sources may improve some stock assessments.

**Spatial units of data.** Some respondents noted that the current 30 nmile grid and 6 nmile site systems may not be the best representation of an ecological system. Further fishers themselves prefer to refer to sites such as rivers, bays or reefs. The current spatial system may not reflect sensible spatial stratification, especially where there are large bays like Broadsound and Shoalwater, Moreton and Hervey Bays (also the GBR). This is because a grid system of squares doesn't fit our complex coastline and offshore waters very well.

The current spatial detail of the CFISH data is very useful for identifying hotspots of both effort and catch. The QDAFF monitoring team and other non-government research groups use the CFISH data as a guide to informing areas of interest for fishery sectors and targeted species. This will be an important area for future discussion as we move forward with more extensive consultations.

**Gear type** used by commercial fishers is sometimes poorly recorded and has not yet been validated. The records of gear (net) type used by commercial net fishery sector could be improved. Gear type is also an issue in the crab fisheries and this relates mainly to the size of pots as well as the mesh size of the netting used to make the pots. The larger traps used in offshore waters provide greater catch rates because they have a less of a “saturation effect” but this information is not recorded currently.

**Effort records** can also be misleading in some fisheries. For example a day of Spanish Mackerel fishing effort may vary markedly between fishers and among regions leading to inaccurate estimates of effort and catch per unit effort. Likewise, the number of pots used in a day is a better reflection of fishing effort than a standard fishing day and in some areas pot fishers have noted an almost doubling of the number of pots used in the last 20 years.

**Methods of Data Collection** have not developed in line with general technology advances. Spatial tracking and mapping of users of some terrestrial parks has been common place for some time. Tracking individuals through parks allows for the mapping of major areas of use, which can better inform management of impacts. Similarly to spatial mapping, technological advances in mobile data streaming could be incorporated into commercial fisher data recording. Fisheries Queensland are currently testing the use of electronic logs in selected fisheries.

## **CONSERVATION RESPONSES**

Some conservation stakeholders have expressed concern about the extremely low interaction rates with Species of Conservation Interest (SOCI) as gauged by entries in the compulsory SOCI logbooks. There is a strong belief by some stakeholders that there is either a reluctance of fishers to complete SOCI interactions; or that many fishers may be unaware of their legal requirements; or that fishers are unaware that some species are actually considered SOCI (Maori wrasse and barramundi cod for instance).

The SOCI logbook (introduced 2002) was intended as a mechanism to reduce the costs associated with implementing an observer program with suitable sample size to provide accurate estimates of the Qld's fisheries interactions with SOCI by enabling the observer program to focus on validating the "census" information provided by fishers (a form of "contestability" using the current Government's terminology). Unfortunately, the message outlining the requirements for accurate SOCI reporting has been lost over the past 10 years, and we are in the situation where the accuracy of SOCI data is questioned and used to criticise the fishing industry.

SOCI reporting is almost universally recognized as grossly inaccurate, and is a common issue across many Queensland fisheries. Some suggestions on how to improve this area of little information include:

Remove the obligation of reporting from fishers as fear is a significant impediment

Empower reporting by including records other than negative interactions

Use camera and video technologies.

The reporting of SOCI is a common issue throughout global fisheries, particularly when social media is empowering the general community to have an interest and role in fishing impacts.



## **SURVEY RESPONSES – REEF LINE FISHERY (CRFFF AND ECSMF)**

### **Commercial Responses**

A total of 37 fishers were contacted and 31 surveys were completed. All surveys were completed via a telephone call or a face-to-face meeting. Fishers surveyed were asked to consider their personal experience in completing logbook entries for catch taken in the CRFFF and/or ECSMF. Fishers' responses reflected their experience and thoughts as they applied to both the daily catch and effort logbooks as well as the quota monitoring catch disposal records.

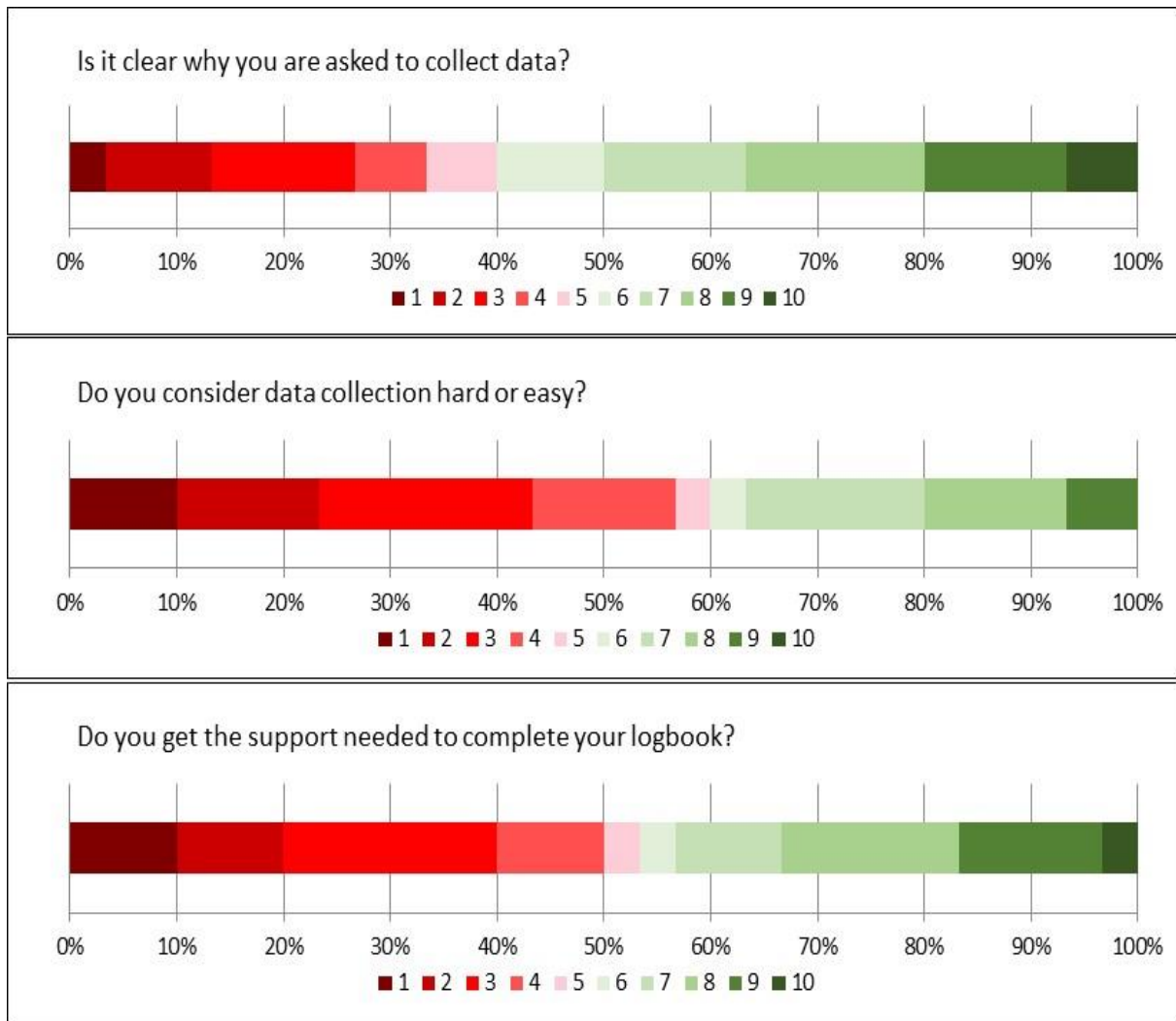
#### *Data purpose, and ease of recording*

The initial survey questions explored fishers understanding of compulsory logbooks and the purpose of the logbook data fields (Figure 5). For 40% of respondents there were varying levels of uncertainty about why logbooks and some data fields are necessary. Most commonly, fishers did not understand the need for daily recording, high level species recording, and/or high level spatial recording. Further, more than half of the respondents (60%) considered the completion of logbooks an arduous activity. These respondents were generally fishers operating out of small wet vessels where large paper logbooks are exposed to the elements. The problem of accurately tracking the number of quota monitored fish onboard was also commonly raised. About half of the respondents were not satisfied with the level of support given by the department for completing logbooks. Most of these fishers were dis-satisfied in the inflexibility of the system.

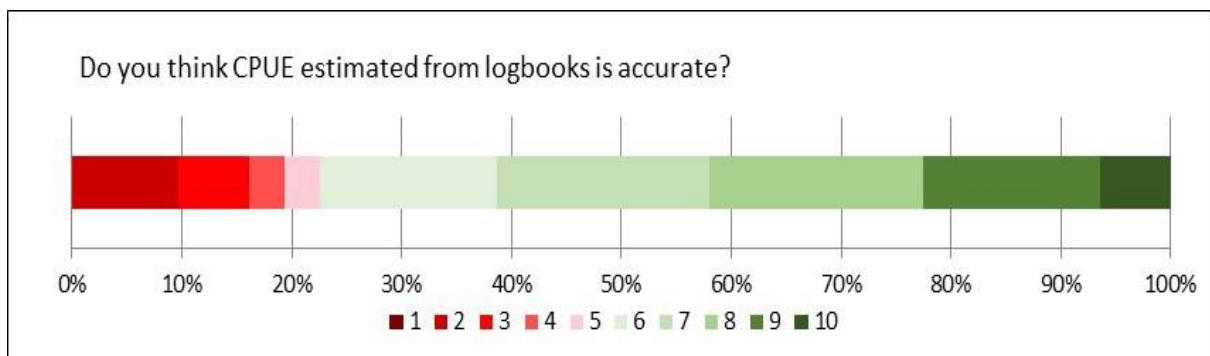
#### *Data accuracy and transparency*

Fishers generally considered the quality of CPUE estimates derived from logbook data to be an accurate reflection of actual catch rates and thus the status of the fishery (Figure 6). Some concern was voiced around the pooling of data from the two unobvious sub-sectors that are the multi-dory dedicated "live-targeting" Coral Trout vessels and the smaller "dead-targeting" vessels. These two types of fishing activity use quite different fishing techniques and methods and also target different types of habitat that likely mean catch rates from one sub-sector are not reflective of the other.

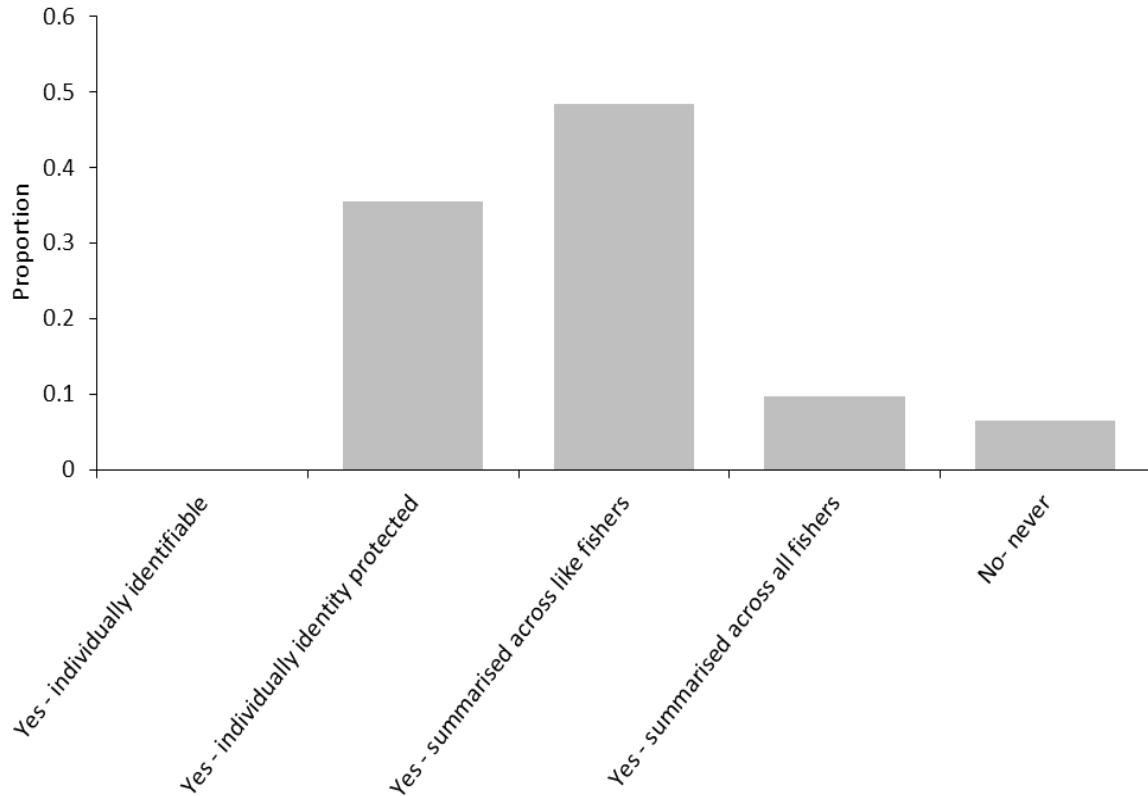
Fishers were generally happy for their logbook data to be used, available and transparent to the broader community though with the clear caveat that their personal vessel (business) data is protected (Figure 7).



**Figure 5.** Commercial line fisheries perceptions of logbook data relevance, the logistics of completing logbooks and support received.

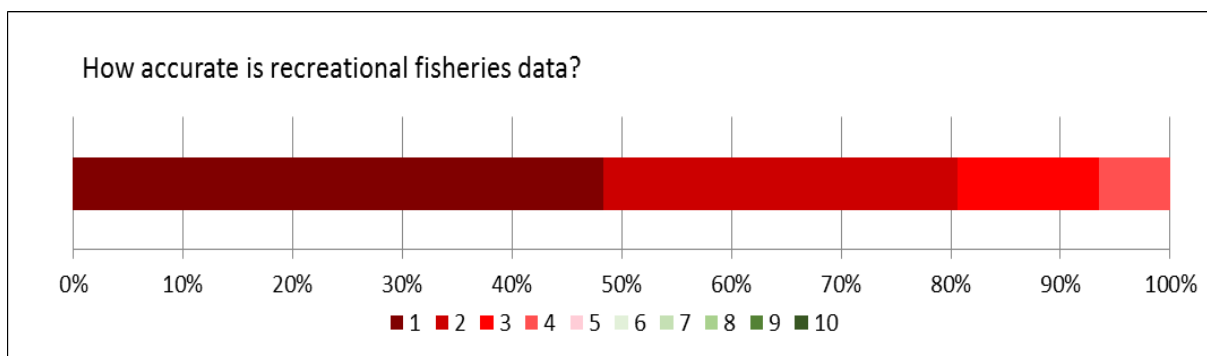


**Figure 6.** Commercial line fishers perceptions of logbook data accuracy.



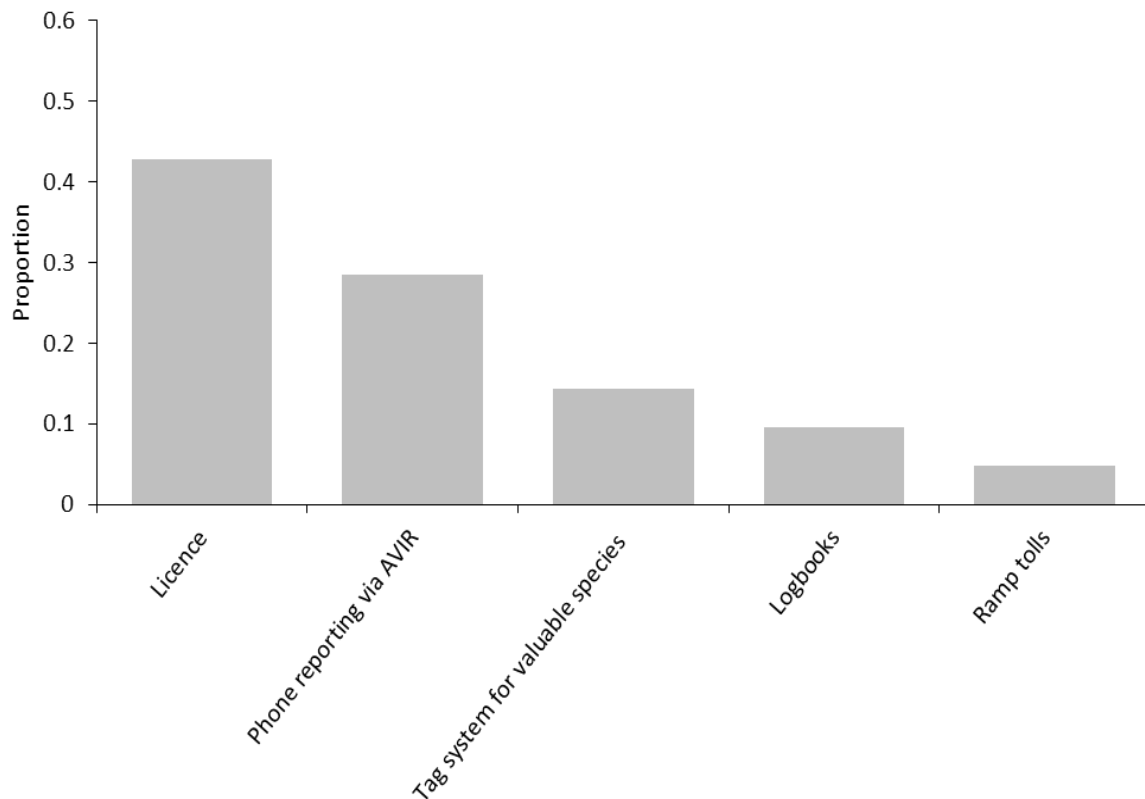
**Figure 7.** Commercial line fishers views on the transparency and use of their logbook data.

Conversely, respondents considered data collected from recreational fishers to be a very poor reflection of recreational fishing effort and/or catch (Figure 8). Most respondents considered the data too infrequent and haphazard in nature to be considered informative or useful. Most fishers believed their personal experiences and observations suggest an increasing level of effort and catch from recreational fishers is not reflective of the data held by the department.



**Figure 8.** Commercial line fishers views of the accuracy of recreational fishing data.

Respondents were most aggrieved that the recreational fishing sector is not subject to the rigors of catch reporting required for quota species caught by the commercial sector. When asked what methods should be used to collect data from the recreational sectors respondents suggested licensing and/or a telephone system similar to that used for the commercial sector (Figure 9).

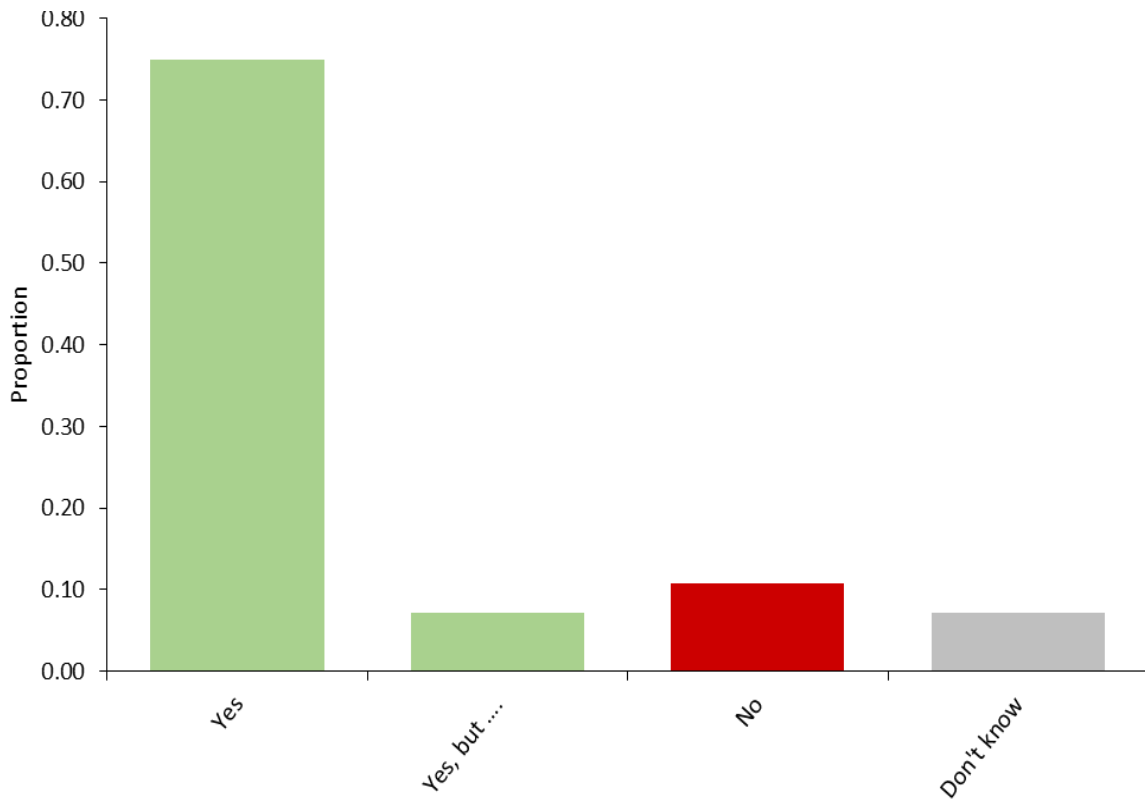


**Figure 9.** Commercial line fishers suggested methods for improving recreational fishing data.

#### Additional data

Most respondents were happy to collect additional data, with many stating they already did through programs including the LTMP (long term monitoring program) and now defunct FOP (fisheries observer program)(Figure 10). Fishers suggested some additional data needs included better recording of days fishing effort when no catch is made; recording interactions with sharks that result in loss of fish and/or gear (depredation events); and recording observed recreational fishing effort (boats at sea, or trailers in the carpark).

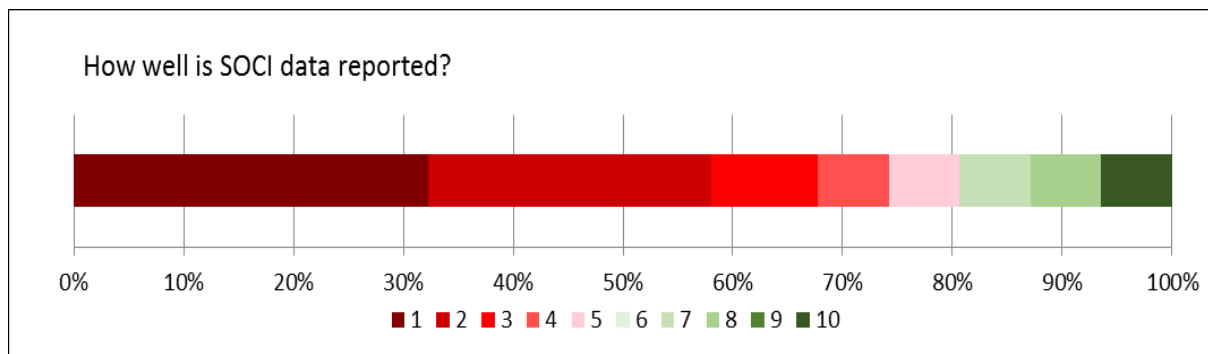
Few respondents answered negatively, adding that they didn't feel they were getting the appropriate rewards for collecting the data they did (a sustainable and robust fishery), or that the data collected now is used inappropriately or irresponsibly by some sectors.



**Figure 10.** Commercial line fishers response to requests to collect data additional to the everyday logbook data.

SOCI data reporting

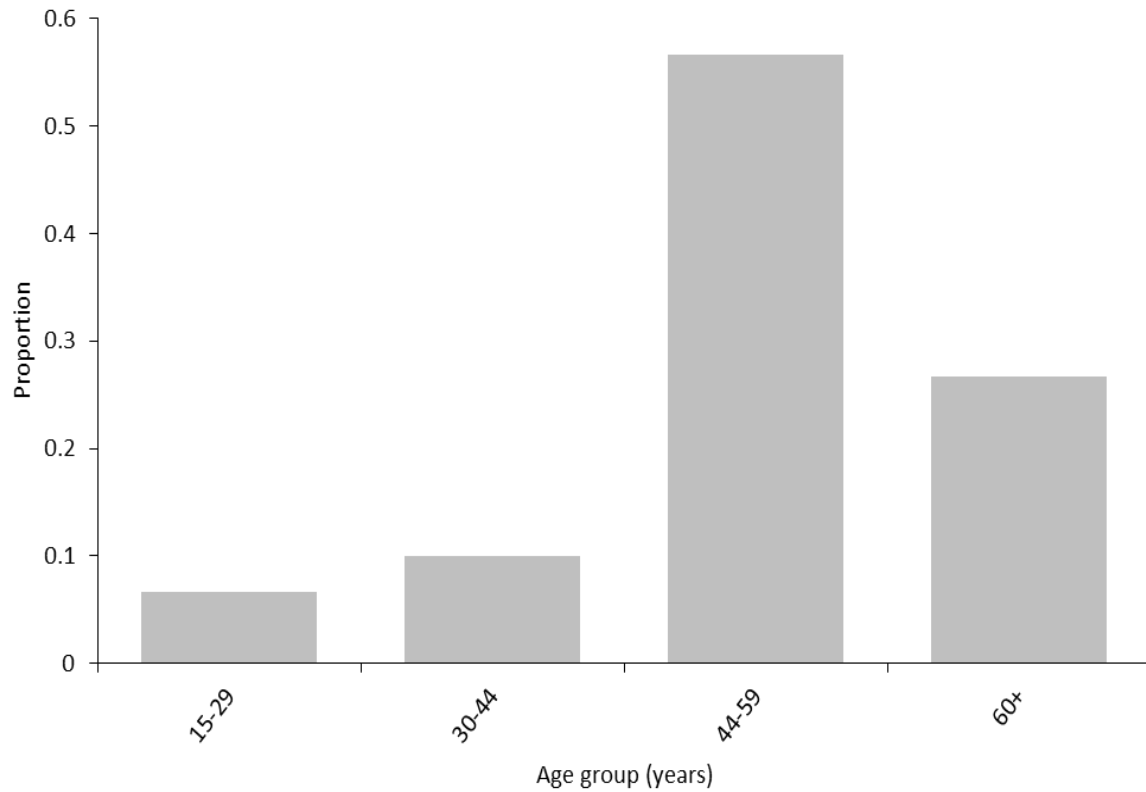
Interestingly, most respondents did not realise that occasionally captured species like Maori wrasse and barramundi cod were SOCI and captures should be recorded. Accordingly, most respondents thought SOCI was poorly reported by fishers (Figure 11). Some suggestions on improving SOCI reporting included better education by QDAF as well as the inclusion of a SOCI data field in the main logbook rather than having a separate logbook. While fishers acknowledged that an option exists in the main log to circle YES / NO to indicate a SOCI interaction, if recording YES the need to then fill out a second logbook was a disincentive to recording and reporting SOCI.



**Figure 11.** Commercial line fishers perceptions around the validity and accuracy of SOCI logbook use and data.

Demographics and fishing interests

Of the 37 fishers interviewed, most were solely or primarily line fishers targeting coral reef finfish and/or Spanish Mackerel. The surveyed group of commercial fishers were dominated by older generational fishers with a model peak at the 44-59 age group (Figure 12).

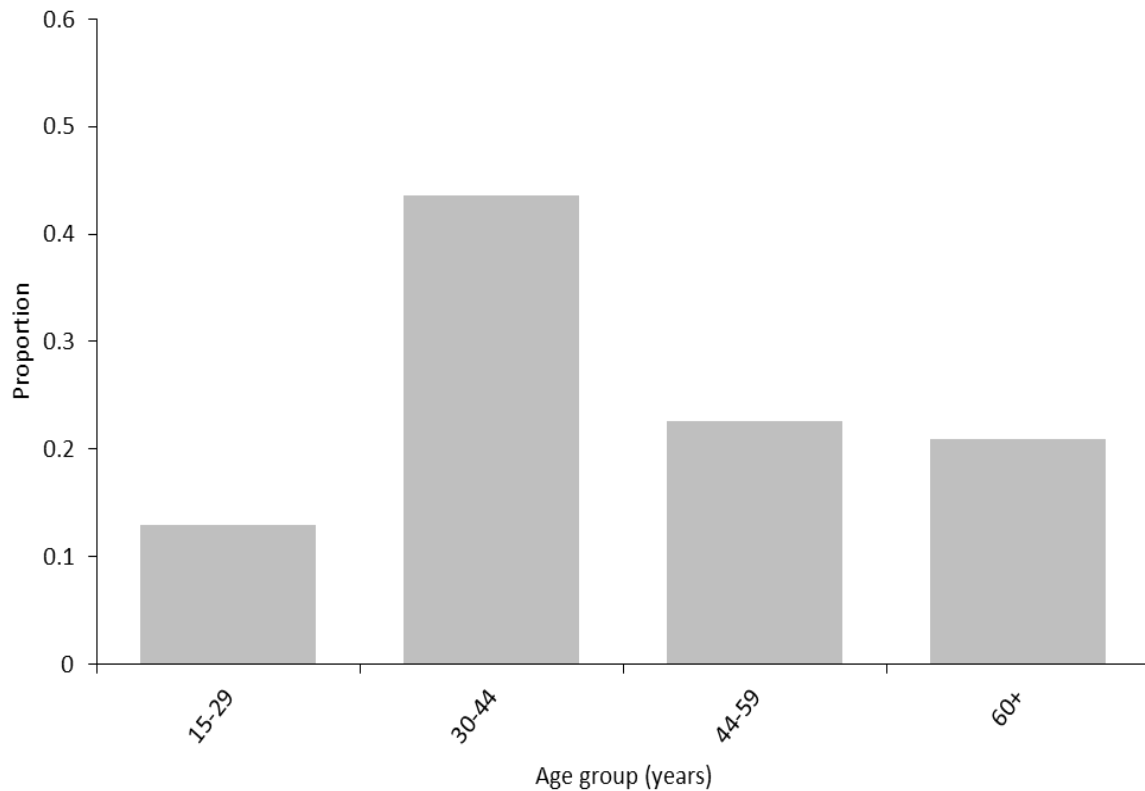


**Figure 12.** The sample of surveyed commercial fishers was dominated by older generational fishers.

## Recreational Responses

### Demographics

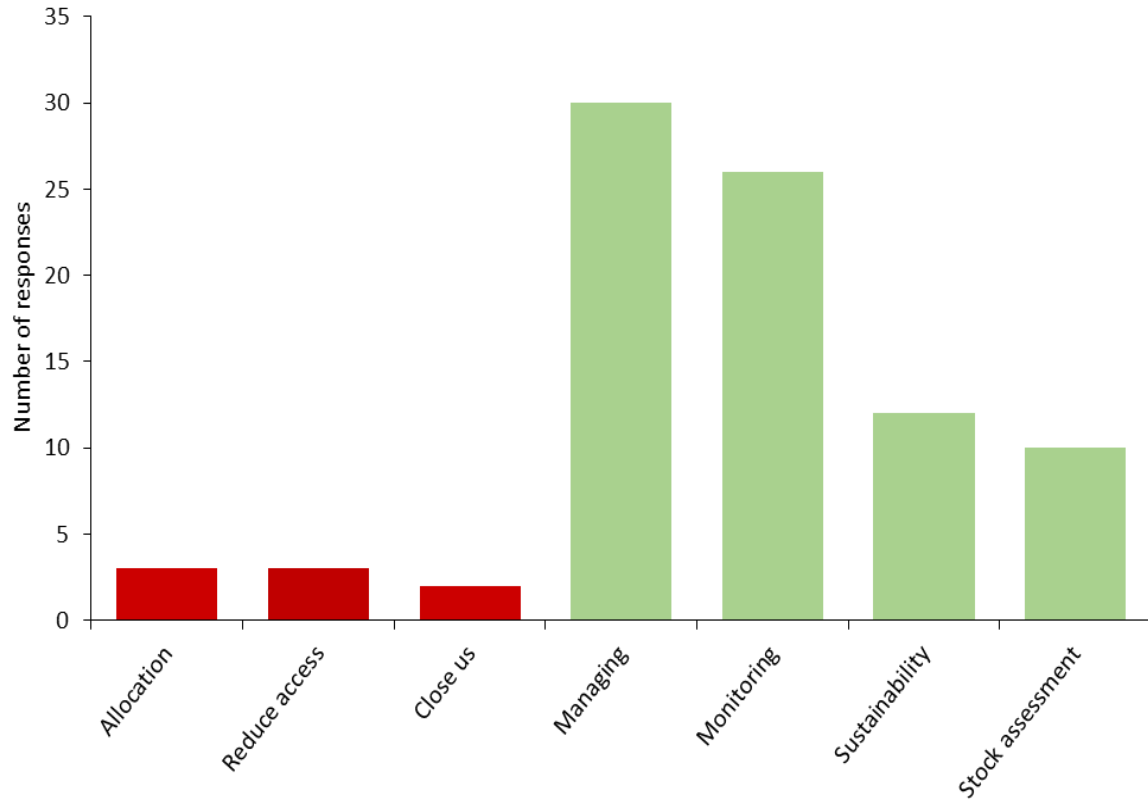
A total of 72 recreational fishers were surveyed mostly by phone and snowballing, though a number of fishers were also surveyed at boat ramps in the Townsville region. In contrast to the sample of commercial fishers surveyed, the recreational fisher sample were younger with a modal age group of 30-44 years and a more even spread of fishers among the age groups (Figure 13).



**Figure 13.** The demographic spread of surveyed recreational line fishers.

### Data purpose and use

All surveyed fishers thought the collection of some type of data about recreational fishing was necessary. The reasons why data is needed revolved mostly around positive intent such as monitoring, sustainable use and informed management (Figure 14). Some negative intent was recorded and encompassed perceived access reduction.

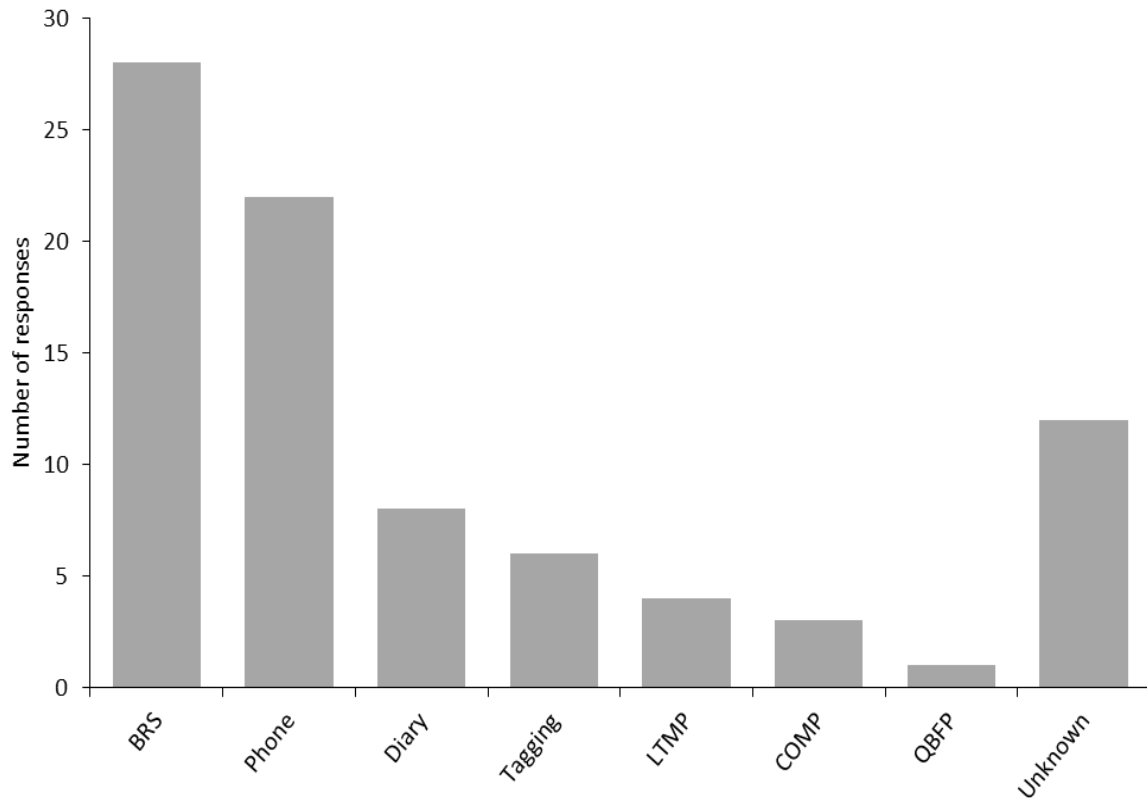


**Figure 14.** Recreational line fishers perceptions on the use of recreational fishing data. Negatively perceived uses red; positively perceived uses green.



Data collection methods

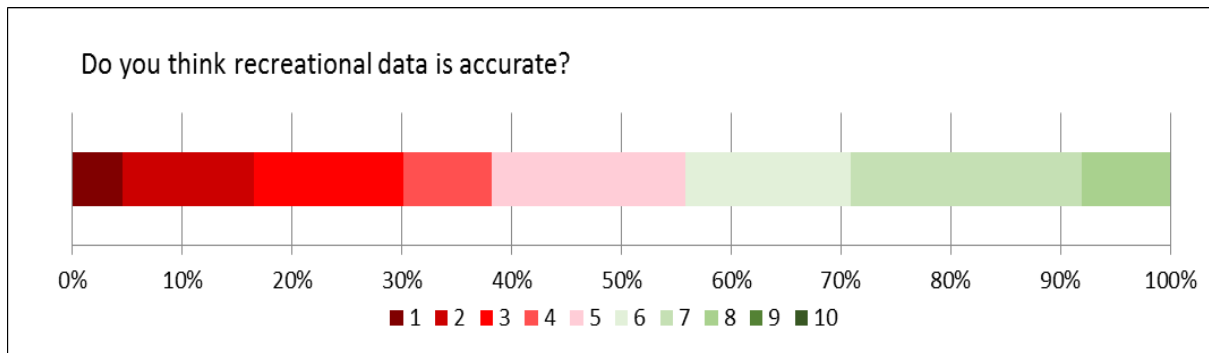
Fewer than 20% of respondents were unaware of methods used to collect recreational fishing data and information, and a range of different methods were given (Figure 15). Most fishers were unaware that recreational fishing data is principally collected by phone survey, with fishers nominating other methods such as boat ramp surveys (BRS), keen-angler diaries, voluntary tagging, long-term monitoring, fishing competitions and the Queensland Boating and Fisheries Patrol (QBFP) patrols as data collection tools.



**Figure 15.** Recreational line fishers' knowledge of methods used to collect recreational fishing data.

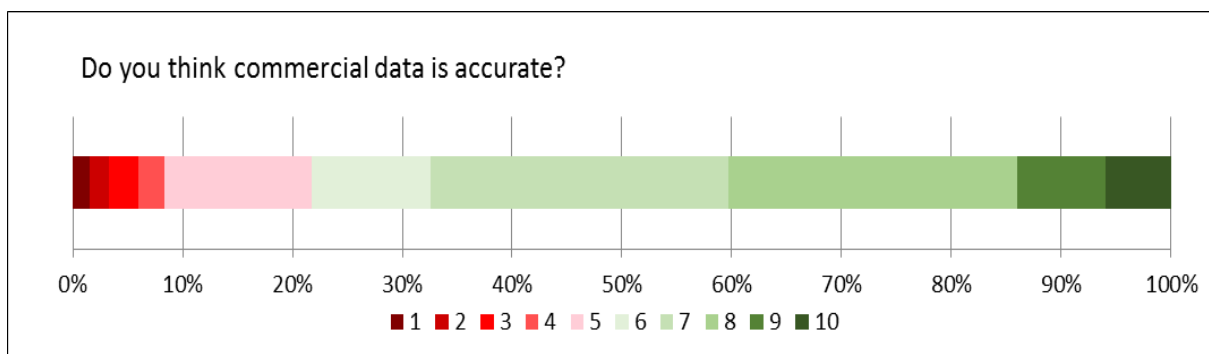
### Data accuracy

However, generally recreational line fishers were not overly confident that recreational fishing data accurately reflects the effort and catch characteristics of the sector. While 56% of respondents believed the data was too varying degrees inaccurate, none of the 44% who believed the data was accurate believed that the data was highly accurate (neither of the two highest accuracy categories available were chosen)(Figure 16).



**Figure 16.** Recreational line fishers perceptions of the accuracy of recreational fishing data.

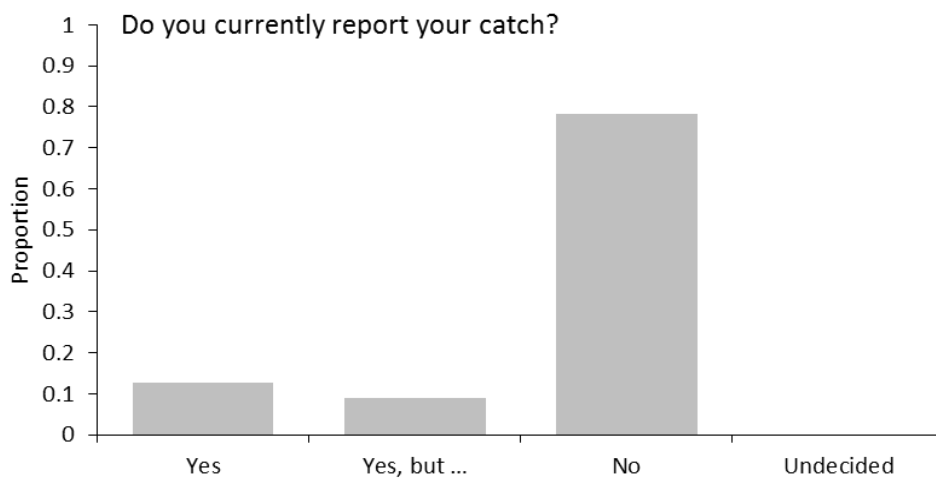
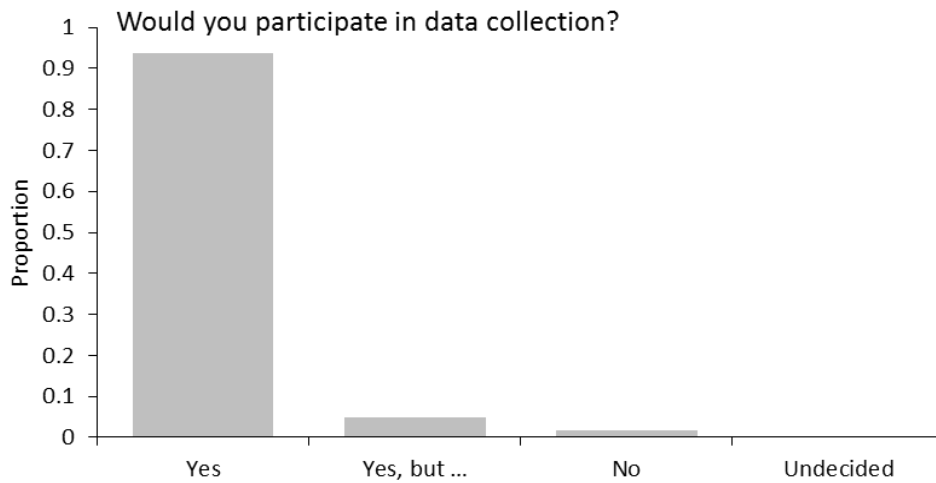
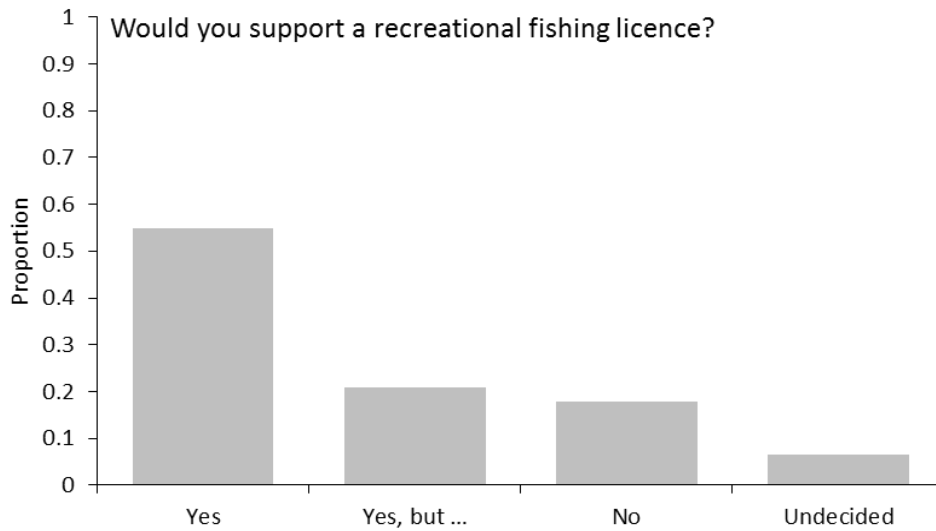
Interestingly, the converse was true for recreational fishers reflecting on the quality of commercial sector data with 78% of respondents believing the commercial data was accurate though again to varying degrees (Figure 17). Most of the negative responses about commercial logbook data were associated with the lack of a validation program and hearsay about both over- and under-reporting by commercial fishers' for a perceived personal gain.



**Figure 17.** Recreational line fishers' perceptions of the accuracy of commercial line fishing data.

### Licensing and data reporting

Most (75%) surveyed recreational fishers supported the concept of a fishing license (Figure 18), and the large majority (98%) would be happy to provide some level of information and data to a formal data collection strategy. Currently some fishers (22%) report about some aspect and/or level of their fishing experiences on web forums and social media channels.



**Figure 18.** Recreational line fishers attitudes towards a recreational fishing license, participation in a formal data collection process(es) and current informal reporting (web pages and social media channels).

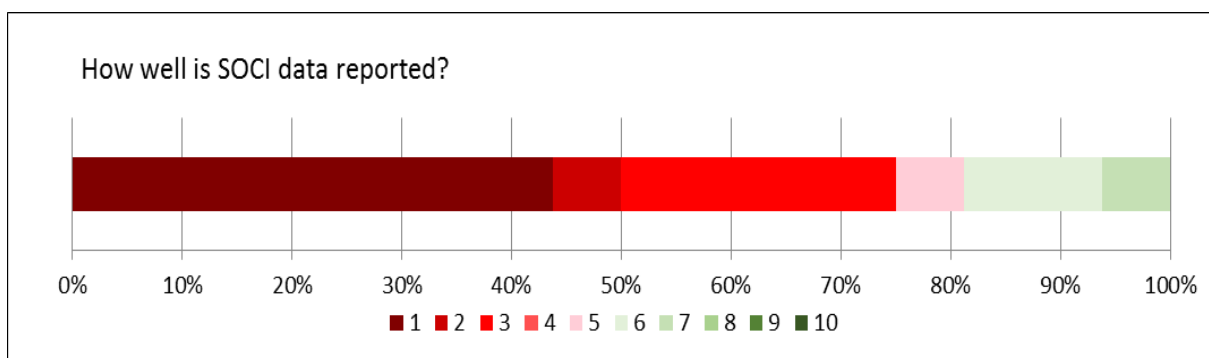
## Management, Research and NGO Responses

### Data use

All managers and researchers confirmed that the data collected was predominantly for sustainability, stock assessment or other management related reason.

### SOCI data accuracy

Overwhelmingly, managers and researchers responded that the Species of Conservation Interest data for the CRFF fishery was of very poor quality with no one scoring higher than seven (Figure 19). The two most frequent responses for improving the SOCI data quality were concerted efforts at education (40%) so fishers are not fearful of how the data will be used and consequently report accurately. Notably, however some suggested that education programs had previously been tried and failed. Secondly, the use of an observer program, either electronic or human featured in 40% of responses.



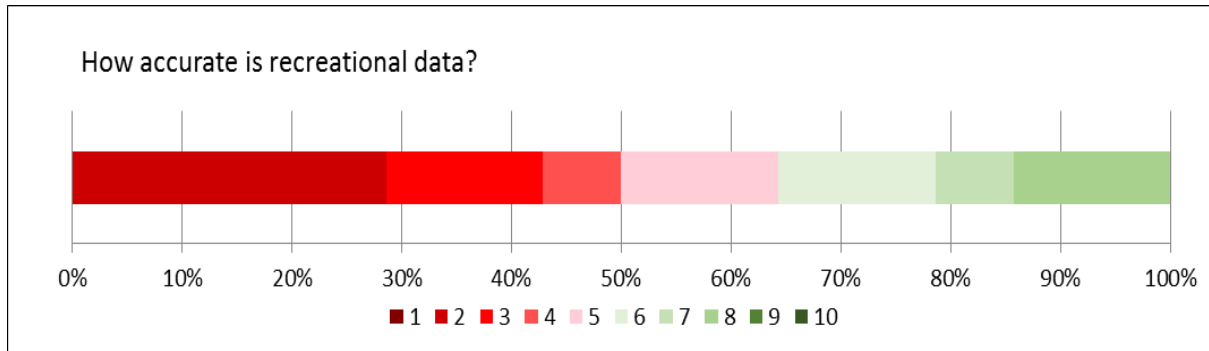
**Figure 19.** Non-fisher stakeholders perception about the validity and accuracy of SOCI data as reported by commercial line fishers.

### Additional data needs and improvements

This group of stakeholders suggested a wide variety of additional information that should be collected. Notably these focused on improving spatial effort data and refining effort measures.

### Data accuracy

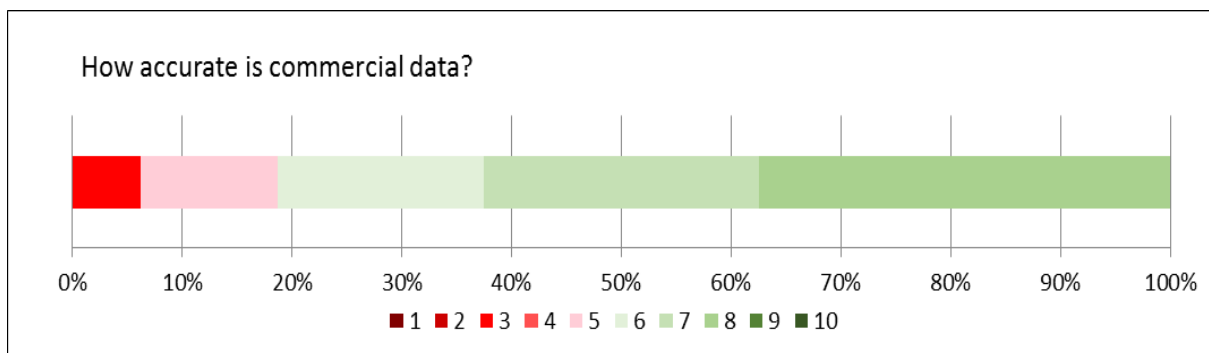
This group was concerned about the accuracy of recreational data currently being collected with about one-third of respondents suggesting the data was accurate (Figure 20). Most concern was about how the collected data is used to extrapolate state-wide recreational catches. More specifically about two-thirds of respondents were particularly concerned about the small “data frame” used.



**Figure 20.** Non-fisher stakeholders’ perception about the validity and accuracy of recreational fishing data.

Constructive suggestions for improving the quality of recreational data were offered by this group and mostly centred on improving the “data frame” (67%) with most suggesting a licence as the most effective way of achieving this goal. A greater use of on-site methods (40%) or use of technology such as video infrastructure and electronic reporting also featured regularly in responses.

Commercial data was generally rated much more favourable (Figure 21). However, all respondents identified areas requiring improvement, in particular spatial information and effort data were nominated as needing further refinement. Primarily catch validation (60%) (eg through sales receipts) as well as Vessel Monitoring Systems and electronic logs featured regularly as suggested methods to improve the quality of commercial data.



**Figure 21.** Non-fisher stakeholders perception about the validity and accuracy of commercial fishing data.

## **Survey synopsis**

There was, in general, greater negativity in the recreational responses.

Commercial fishers sometimes tended to be resigned to the process and methods they feel have been forced on them.

Commercial fishers would like greater opportunity to be more active in the data collection space, and mostly support the need for data collection to be adaptive to changes through time.

Some commercial fishers and non-fisher stakeholders identified the need for improved economic data, as well as the need for more streamlined data collection systems.

Most animosity appeared around commercial fishers' consideration of recreational fishery data. Some fishers were particularly aggrieved by the rigors of quota reporting and the existence of a harvest strategy that does not apply to nor include recreational fishers.

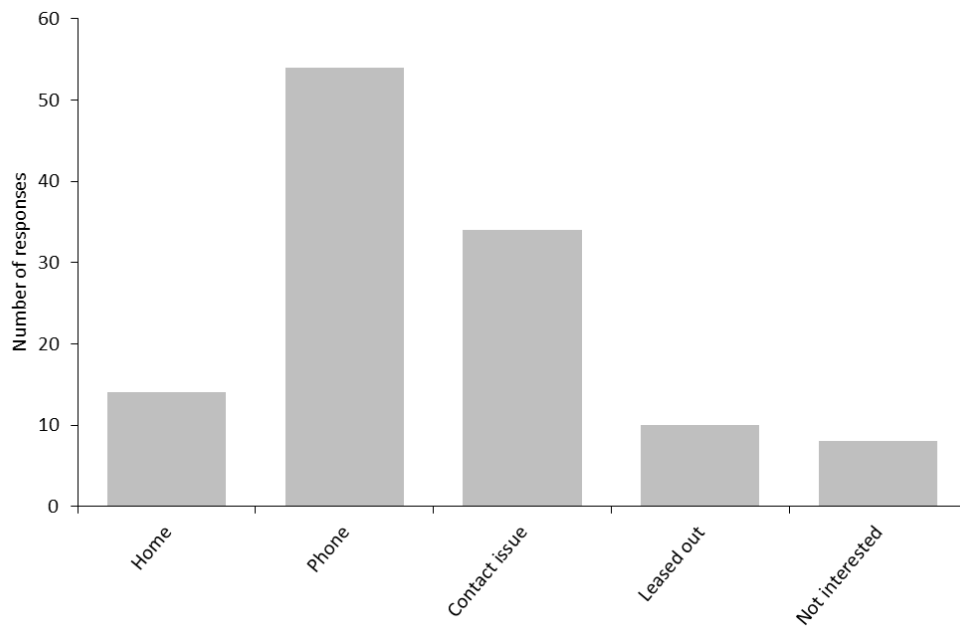
Recreational fishers appeared aware of the shortcomings of recreational fishing data, and most had not actively participated in the RFISH or SWRFS.

Most recreational fishers were supportive of more and improved data collection and considered a recreational fishing licence as a tool to help that occur.

## SURVEY RESPONSES – CRAB FISHERIES

### Commercial Responses

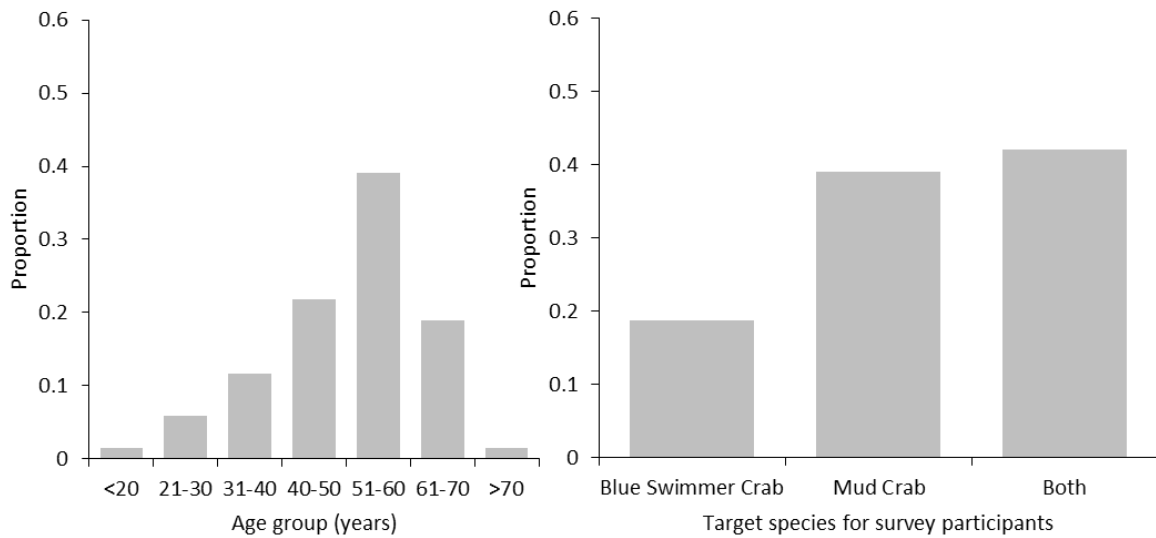
There was a high proportion of commercial crabbers that could not be contacted or had leased-out their entitlement, but once contacted only a relatively small proportion of fishers (12%) refused to be surveyed (**Figure 22**). Overall, 69 commercial crab fishers completed surveys either on the phone or in person.



**Figure 22.** Method of contact and success of contact of commercial crab fishers who were surveyed.

### Demographics and fishing interests

The age distribution of the fishery clearly reflects an ageing industry with the modal age group of 51 to 60 years with the majority targeting both species of crabs (blue swimmer crabs and mud crabs (Figure 23).

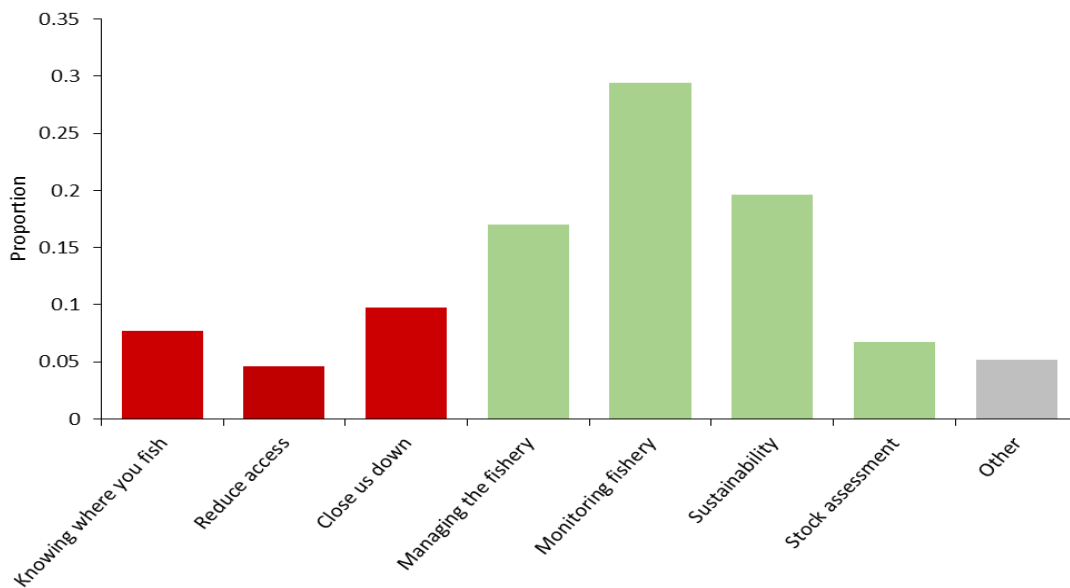


**Figure 23.** Age distribution of commercial crab interviewees and species of crab targeted by those fishers interviewed.

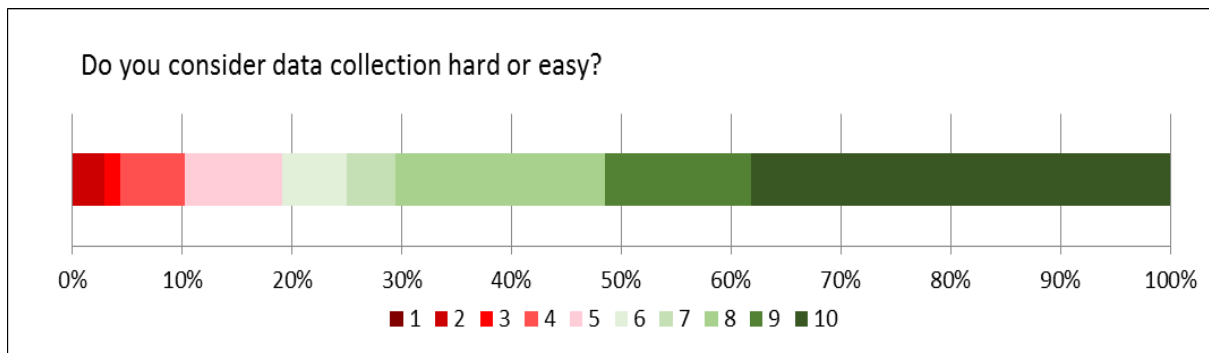
Data purpose, and ease of recording

Fishers were generally positive about the reasons that data were collected (Figure ) reflecting a relatively high level of understanding of the process of data collection and analysis, although 23% of respondents were mistrustful of how their data are used. Fishers responded favourably regarding the ease of reporting, predominantly through existing logbooks and over 50% of respondents believed that they received good support from Fisheries Queensland (Figure ).



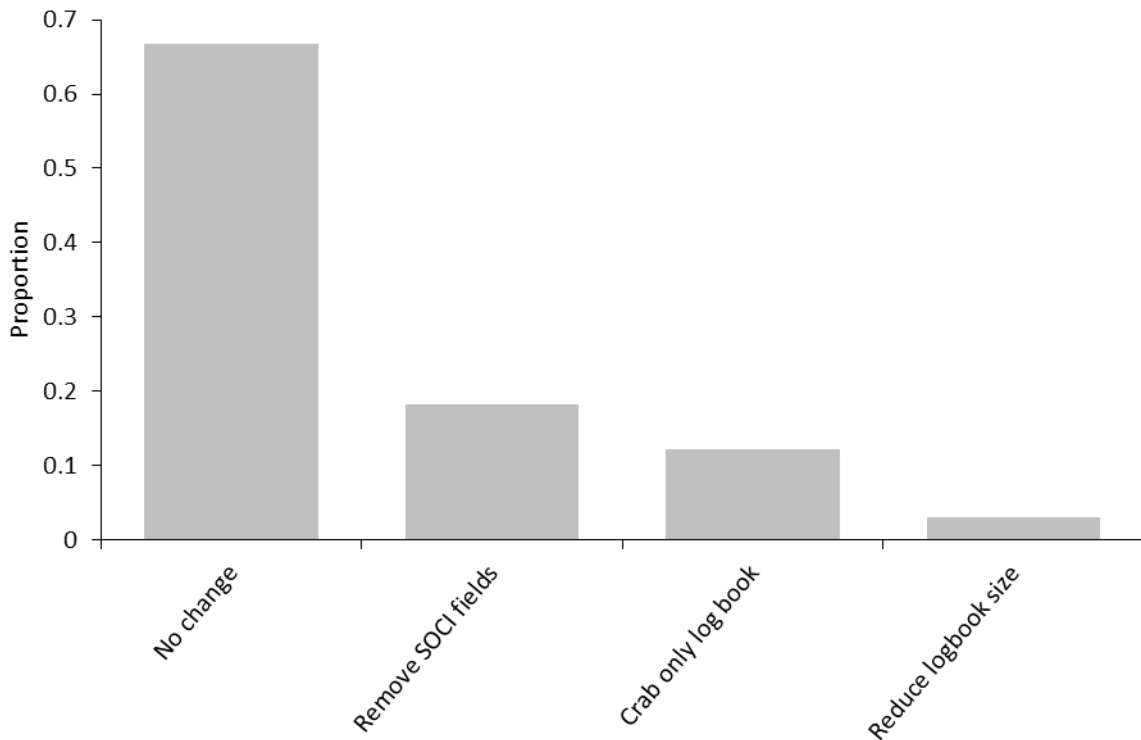


**Figure 24.** Fishers views on the purpose of data collection from commercial fishers.



**Figure 25.** Fishers responses regarding the ease of filling in logbooks and support provided by fisheries Queensland.

Sixty-one percent of participants felt there was no need for changes to the log books (**Figure 26**). Four percent thought that recording catch of females would be useful. Nine percent wanted pot theft/loss recorded so that managers had an idea of the economic impact upon the fishery and compliance resources could be directed towards areas where this was a major issue. Whilst 17% suggested that the grade of the crab should be recorded as well as the number of crabs with receipts to prove what was caught. Grading of crabs was only an issue with mud crabbers. Other suggestions included: pot size as an indicator of efficiency; making the catch grids more precise; recording bycatch; recording soak time.



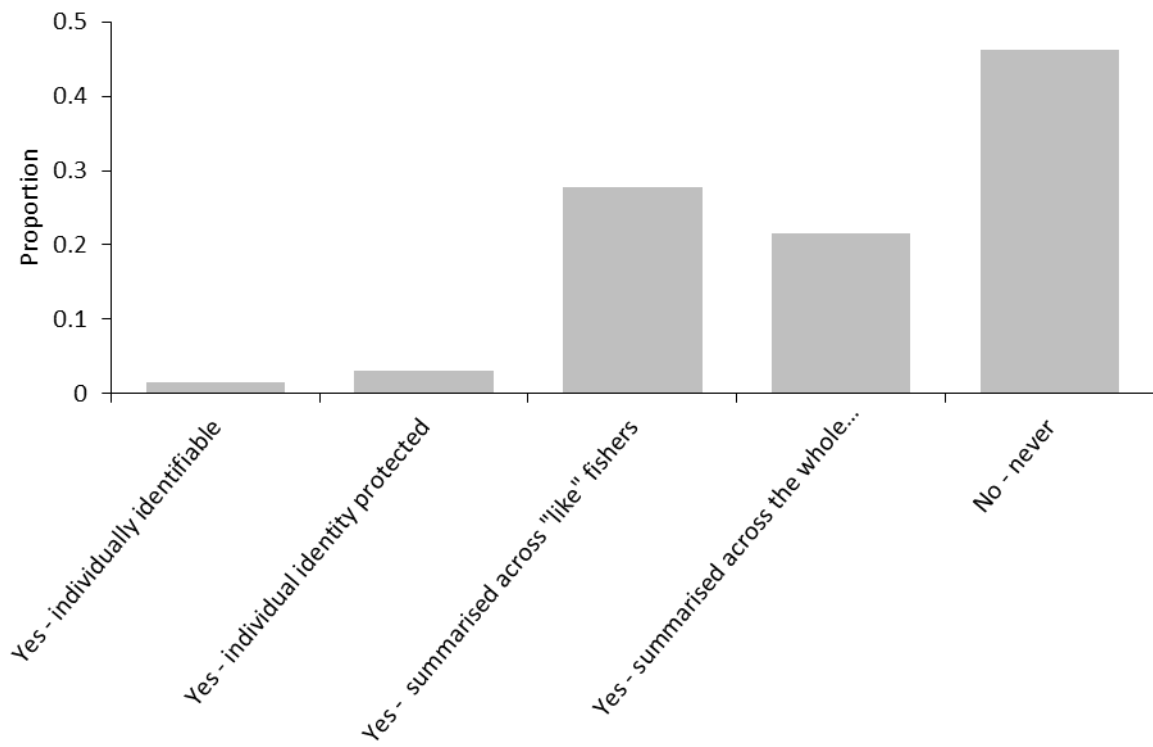
**Figure 26.** Changes to commercial logbooks suggested by commercial crab fishers.

Data access

Only three (4%) of respondents had actually used the online resources provided by Fisheries Queensland; A further fourteen (20%) were aware of the webpages but weren't interested in using them; 10 (14%) had either no computer and/or no interest in computers but only a very small proportion of fishers (5%) had no idea of what was available.

Of the 37 respondents who offered a comment 38% (n = 14) emphasised that they wanted to have input into the type/method of data collected; 32% (12) didn't see a need and the remaining 30% (11) wanted to make sure logbook data was more accurate and not used against them. Further, of those respondents who made a comment, 59% (n=22) expressed a desire to see information from Fisheries Queensland such as catch statistics or stock status reports either as hard copy reports or as online resources. A further 14% (n=5) wanted only information relating to their own catches or areas. 16% (n=6) commented that there was no need for any information and a further 8% (n=3) commented that the logbook data was so poor that any report based on logbook data is inconsequential.

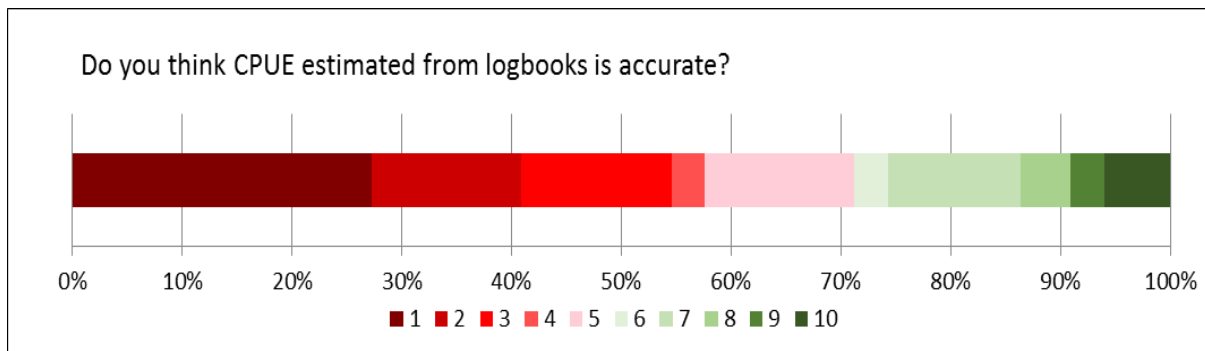
Of the 65 respondents who commented on whether data should be made widely available, 46% (n=30) felt that the information should not be made available at all (**Figure** ). These respondents commented that their information had previously been used against them (and was still being used against them). Of the remaining respondents, 22% (n=14) wanted to see the resolution of available data reduced to the sector level while 28% (n=18) were happy with the status quo (that is the five boat rule where data had to be aggregated to a minimum of 5 boats). Of note is that the fishermen who wanted access to individual catch records were leasing their licenses



**Figure 27.** Level of transparency and availability of fisheries data to other stakeholders and managers.

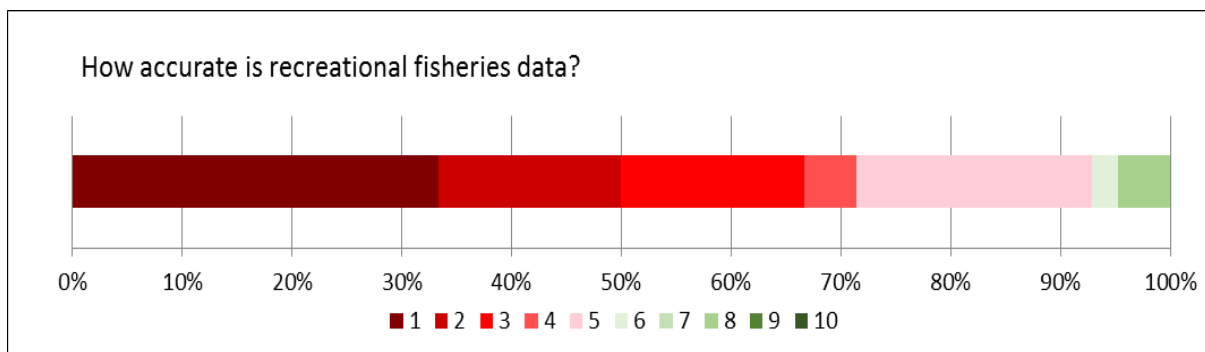
### Data accuracy

When commenting on the quality of logbook data, over 70% of respondents commented that catch and effort data were not of a good quality rating (**Figure 28**). Generally fishers commented that the catch records were possibly over-reported and effort was likely to be under-reported.



**Figure 28.** Respondents views on the accuracy of catch and effort data reported in commercial logbooks.

Fishers views on the data collected from the recreational sector also reflected perceptions of inaccuracy with 90% responding with a 5 or less (**Figure 9**). Comments regarding the difficulty of sampling the recreational fishery in a meaningful way were recorded whilst other comments highlighted issues with the honesty of reporting, pot robbing, pot theft and black marketing.



**Figure 29.** Respondents views on the accuracy of data currently being collected from recreational fishers.

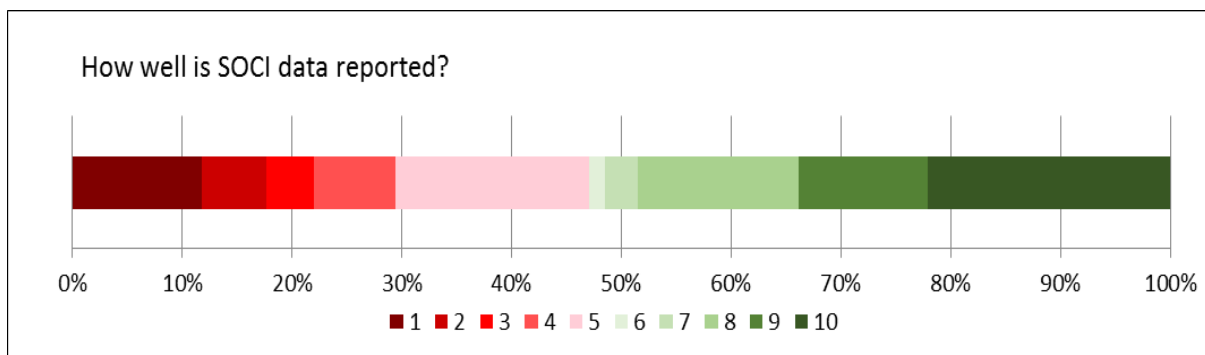
Twenty percent of respondents (n=12) thought a fishing licence and /or logbook system would improve the recreational data that was currently being collected. Forty-three percent (n=26) recognised that more effort was needed in the form of more enforcement or surveys, with some suggestions to use student volunteers. The remaining 37% offered no suggestions for improving recreational data collection with comments reflecting the scope of the task and the likelihood of making an improvement.

Thirty-seven percent of respondents were interested in electronic logbooks but most of these commented that they would only try electronic logs if they were easy to use and at no or minimal cost. The main reasons electronic logbooks were not supported included cost, electronics and salt water, and the fact that the current paper logbook was simple to use. Some (8%) also described

themselves as computer illiterate or reported having no interest in computers or personal electronic communication devices.

Eleven percent of respondents (n=6) would be happy to collect additional information. The main concern, however, was the amount of extra time it would take, particularly for mud crab fishermen in the north where access to crabbing areas was limited by tidal flows. Fifty-two percent cited time as the reason for their unwillingness to collect additional information. Trust issues were again cited, with 8% of fishers preferring to take out observers to collect additional data rather than collect it themselves.

There was a wide range of responses of questions regarding the accuracy of reporting interactions with species of conservation interest (**Figure 300**). Ninety-five percent of fishers interviewed felt there was no way to improve SOCI reporting. The main reason given was that it was a rare event (48%), with a further 18% listing that it was not in a fishermen’s best interest to report any interactions.



**Figure 30.** Perceptions of the accuracy of reporting interactions with species of conservation interest.

Additional data

Sixty-one percent of fishers did not collect any data additional to what they recorded in their logs reported to Fisheries Queensland. Of those that did not currently collect additional data some (26%) used to keep extra data but no longer did.

Of those that collected additional data, 23 collected information on catch, area, time, tide and season. A minority of mud crab fishers recorded information on the grade of the crab and a couple of fishers declined to detail the additional information they collected.

A slight majority of fishers (57%) would be prepared to be involved in collecting new types of data (photos of catch, set additional pots in specific locations) should they be requested. Participation was contingent on the amount of time required and possible incentives (

**Table 1).**

When asked to provide suggestions for improving the data that was collected by commercial fishers thirty-one percent recommended some type of validation of records either through sales dockets, taxation records or other means. A further 34% linked data quality to quality of management decisions and use of data in providing detrimental outcomes. Twenty-five percent were of the opinion that it was impossible to feasibly improve the data quality.

All the general comments offered by commercial crab fishers related to fisheries management issues with the top three issues being, (1) problems with logbook data being used for buybacks and other management decisions, (2) the number of pots allowed per licence and (3) the need for enforcement to combat pot and/or product loss and theft.

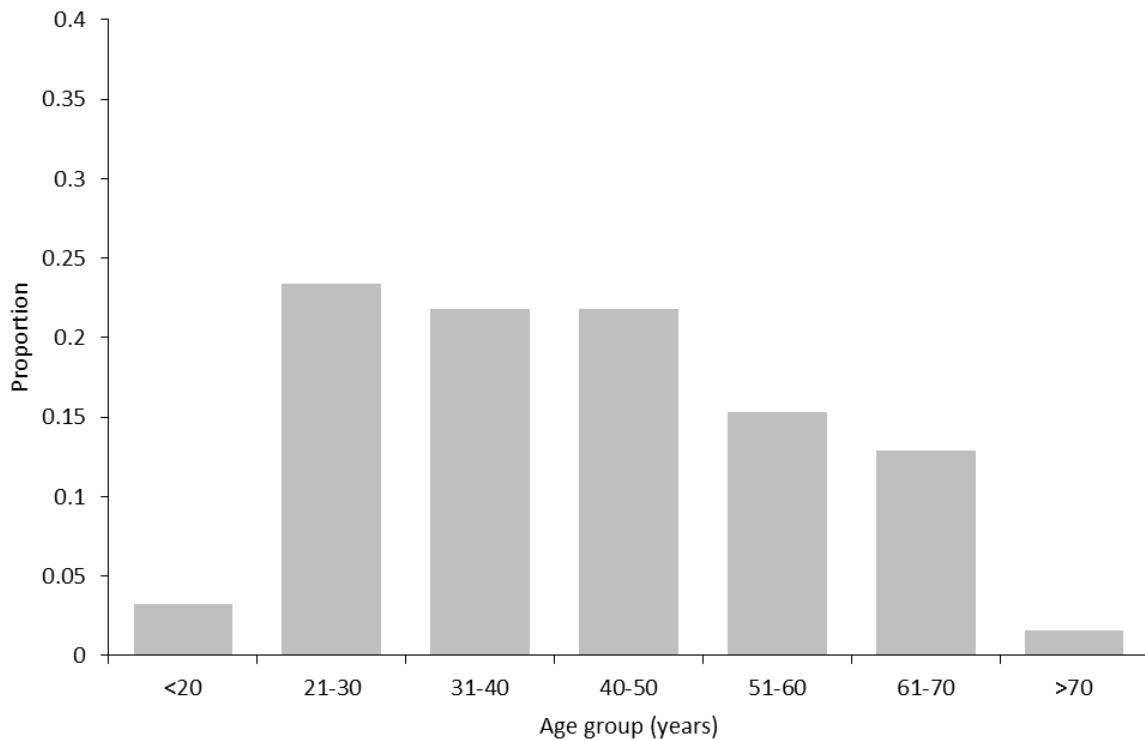
**Table 1.** Responses provided by commercial crab fishers to providing additional data and incentives for providing data.

Response category	Number	Percentage
None – Not interested in providing additional data	10	16%
None – Not interested in providing additional data - too time consuming	15	23%
Would help with some form of financial incentive	16	25%
Would help if it lead to better management of the fishery	16	25%
Happy to help (unqualified)	7	11%

## Recreational Responses

### *Demographics*

Responses from recreational fishers were largely sourced from boat ramp interviews with this summary including the responses of 126 recreational respondents. In contrast to the commercial fishery the majority of recreational fishers surveyed were less than 50 years old and more indicative of the distribution of the broader population (Figure 31).

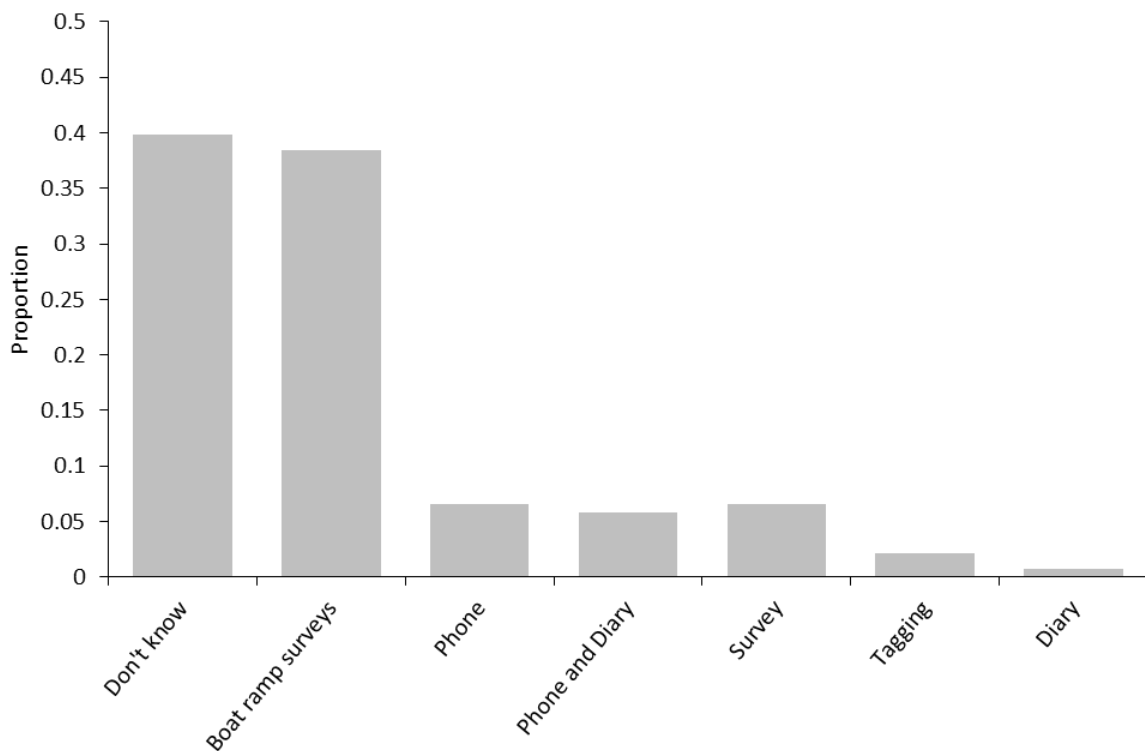


**Figure 31.** Age distribution of recreational crabbers surveyed.

Sixty one percent of recreational respondents did not think it was necessary to collect recreational crab data with the most common reason being that their catch was insignificant compared to that of the commercial sector (58%). Less than 5% of recreational crabbers responded with a positive reason, or indicated any positive benefit from collecting data from their sector.

Data collection methods

Most recreational crabbers were not aware of any of the methods used to collect data from their sector (**Figure 32**) and when asked to elaborate over 80% of those surveyed said words to the effect that there could not be enough sampling and that any data collected would be grossly inaccurate. Given this response, it was surprising that 14.5% of participants had been asked to provide data with all these people being asked to provide finfish information at either boat ramps or as part of keen angler programs conducted by DAF. None had participated in the diary or phone surveys conducted by Fisheries Queensland, although this is not necessarily surprising given the relatively small sample size.

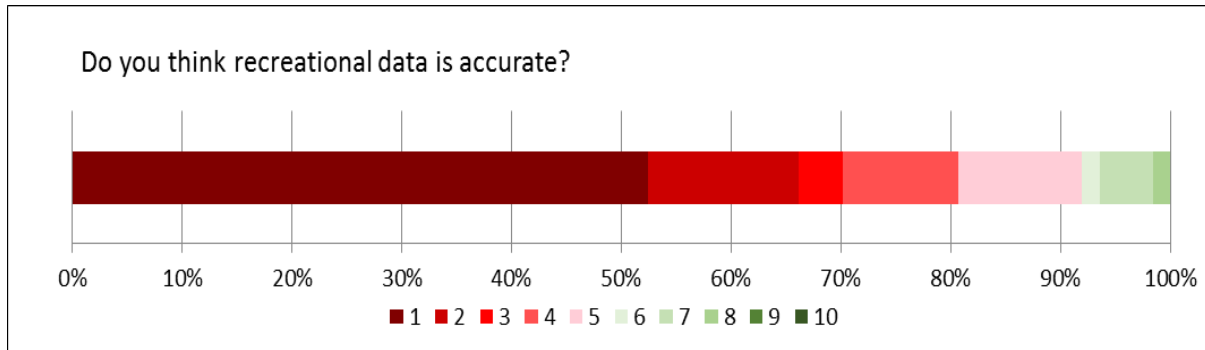


**Figure 32.** Number of times keywords were mentioned in recreational surveys regarding methods used to collect recreational data.



Data accuracy

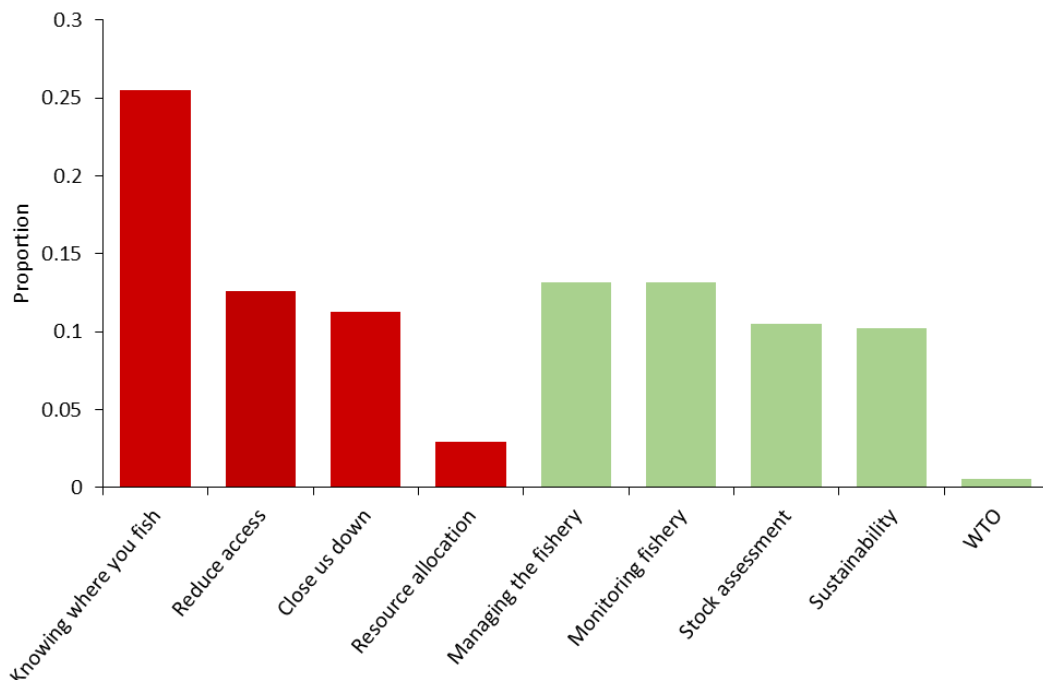
Similar to the commercial sector, recreational crabbers were concerned about the lack of accuracy of data collected from recreational fishers with over 50% of those surveyed responding with the strongest negative categorisation of data accuracy (**Figure** ).



**Figure 33.** Recreational perceptions of the accuracy of data collected from recreational fishers.

Data purpose and use

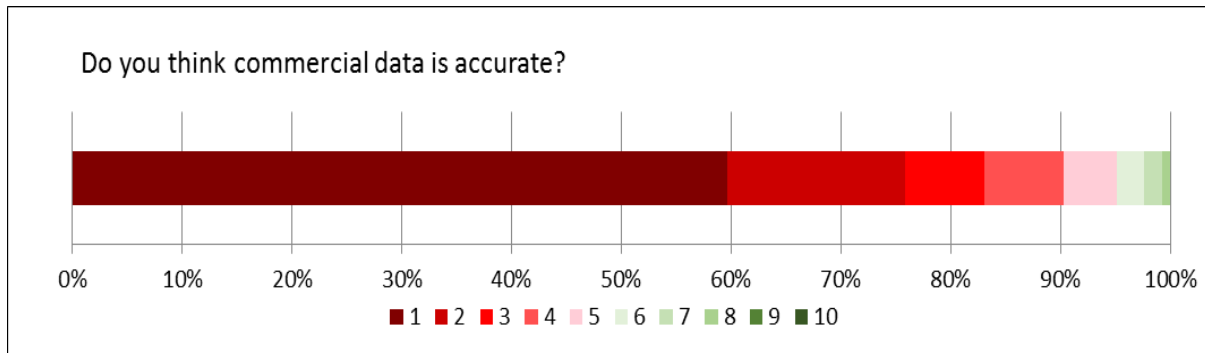
When asked about the purpose of collecting recreational data, the majority of responses were suspicious (red) in nature, but there were still over 30% of responses that recognised the importance of the data for fisheries management purposes (green)(Figure 34). Only twenty- three percent of surveyed recreational fishers were aware that data were collected from commercial fishers via logbooks or any other form of data collection methods.



**Figure 5.** Recreational fishers perceptions of the reason data is collected from recreational crabbers.

When asked about the commercial data that is used to manage crab fisheries most recreational fishers responses reflected the mistrust that the recreational sector has for commercial fishing with only 8.8% responding that the data was probably “OK” (Figure ).

There were no innovative solutions to the perceived inaccuracies in the commercial data offered by recreational anglers. Some of the more constructive suggestions included simplifying the logbook (3%), more checking by the QB&FP (8.8%) and some form of validating catches either through tax records or some form of catch disposal records (11%).



**Figure 35.** Perceptions of recreational crabbers regarding the accuracy of data provided by commercial fishers.

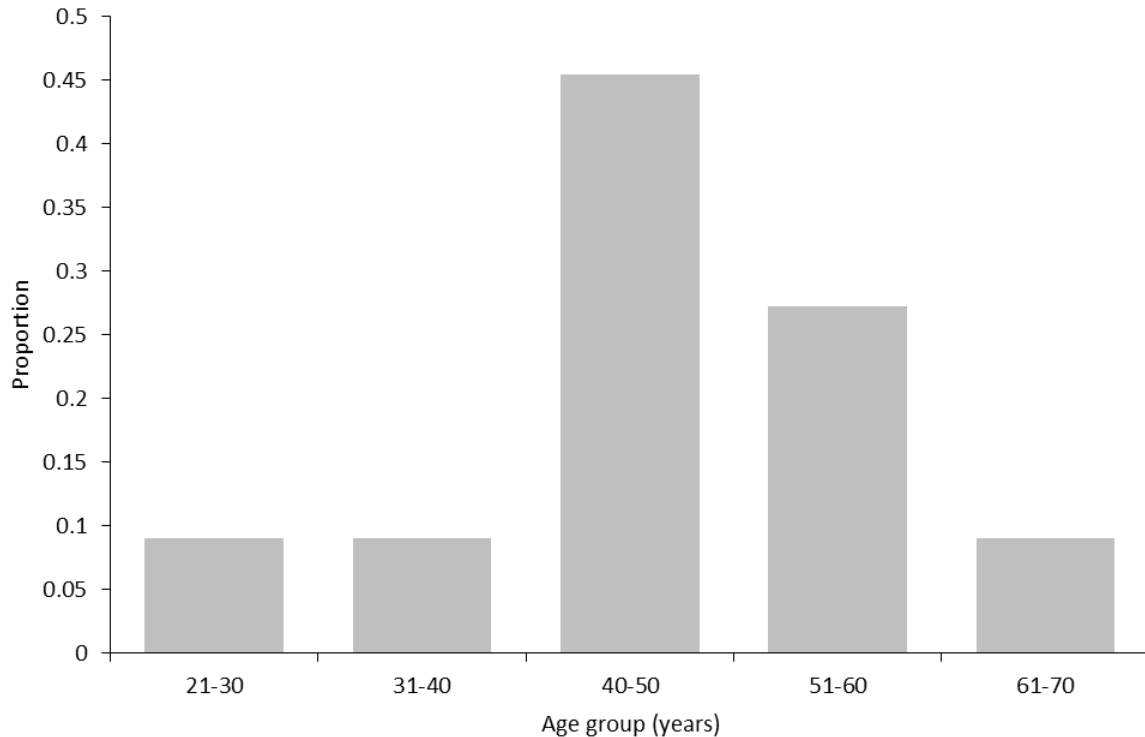
When asked if they would be willing to participate in future recreational surveys or data gathering efforts, only 34.7% of respondents answered in the affirmative. Fifteen percent (19) of respondents said that they had reported their fishing activities on web forums or through social media and, of those, all reported posting activities at least monthly. Four of the 19 reported on at least a weekly basis.

When asked if they would report via a smart-phone application or similar, more convenient methods, 41% indicated that they would be willing to provide data via these methods. Incentives increased the willingness of recreational crabbers to collect and provide data to fisheries management authorities but all incentives came at a financial cost. The main incentives suggested were gift vouchers (50%), fishing tackle (20%) and prizes (9%).

Thirty-seven percent of those surveyed had fished outside Queensland in jurisdictions that had a recreational fishing license but overall only 29% of recreational crabbers surveyed indicated support for a recreational fishing licence.

## Management, Research and NGO Responses

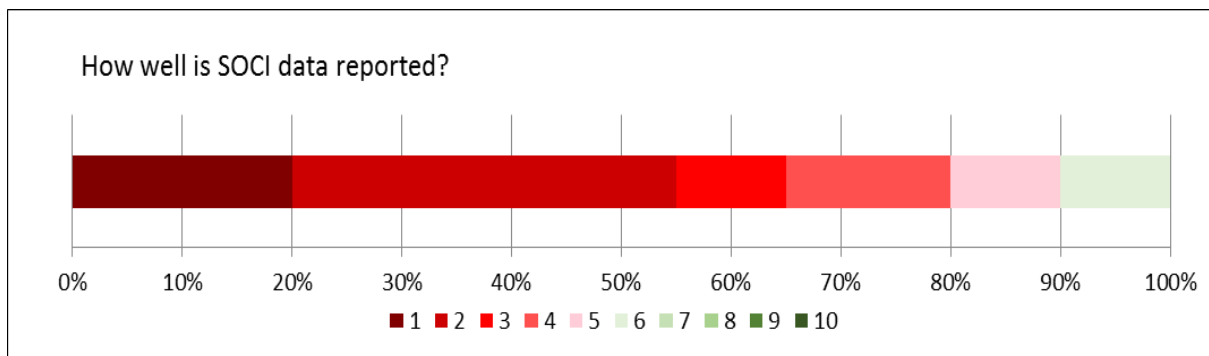
A total of 22 managers, researchers and NGO employees were surveyed as part of the project. Most of these were mid- to late-career professionals in excess of 40 years old (**Figure** ).



**Figure 36.** Age frequency of manger/researcher group surveyed.

Not surprisingly, all managers and researchers confirmed that the data collected was predominantly for sustainability, stock assessment or other management related reason.

Overwhelmingly, managers and researchers responded that the Species of Conservation Interest data for the crab fishery was of very poor quality (**Figure** ). Suggestions for improving the data quality centred around two different themes. The first related to building of trust between industry and management and the other centred around use of independent means (such as observers and video surveillance) to check reporting. There were also some respondents who believed that nothing could realistically be done to improve the data. This group generally cited cost of implementing some of the independent checking mechanisms as prohibitive to their introduction, particularly given the current large number of participants and economic conditions in the crab fisheries.



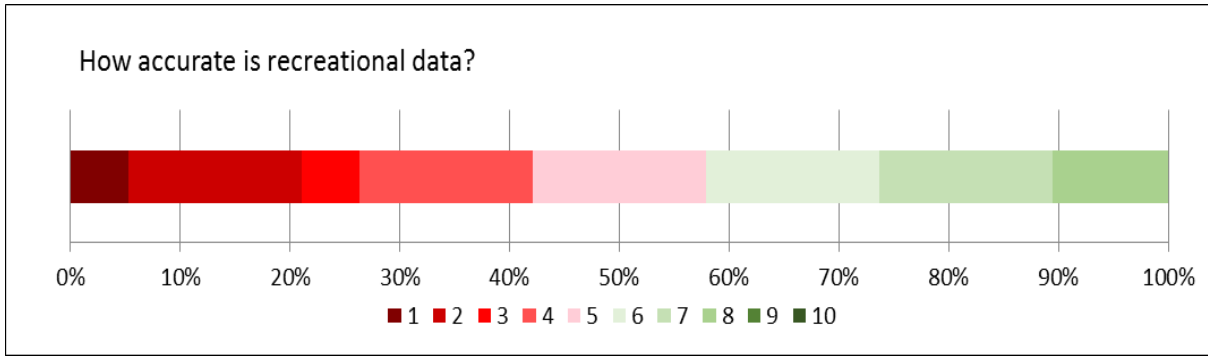
**Figure 37.** Perceptions of the accuracy of Species of Conservation Interest (SOCI) data reported by commercial fishers.

This group of stakeholders suggested a wide variety of additional information that should be collected from the fishery. There were common themes with some suggesting that there needed to be a balance between collecting too much information and recording accuracy. Some of the suggestions for additional data were economic and business information (4%), discards of target species and bycatch (6%), crab grading information and crab size data (8%) and reporting sightings, not just interactions, of protected species (2%). Some respondents also highlighted the need to improve the spatial resolution of the data and to improve ways of effort reporting although they did not offer any suggestions for achieving this.

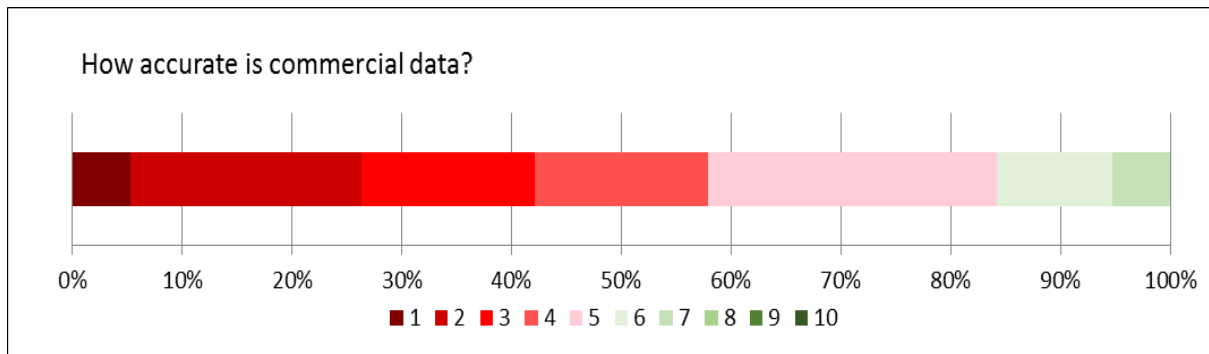
This group was also not overly enthusiastic about the quality of the recreational data currently being collected (

**Figure )** with no responses higher than 6. This was despite the fact that this group had the best understanding of the methods used than the other stakeholder groups.

Constructive suggestions for improving the quality of recreational data were offered by this group but none of these were cost-neutral including greater use of on-site methods (20%) or use of technology such as permanent video infrastructure. The most common suggestion, which was arguably cost-neutral depending on administrative procedures, was using a fishing licence to ensure a more representative sampling frame was available for the recreational fishing sector (16%).



**Figure 38.** Managers, researchers and NGO employees' perceptions of accuracy of recreational crab data.



**Figure 39.** Managers, researchers and NGO employees’ perceptions of accuracy of commercial crab data.

Commercial data were likewise believed to generally be of a poor quality by this stakeholder group (**Figure** ) and there was consensus that effort recording was far inferior to catch reporting. Investment warnings and impact of management changes were all cited as reasons for poor reporting as many commercial fishers believed that accurate reporting would be disadvantageous to their businesses. Suggested improvements centred on validating logbook data using buyer returns or other independent data verification method. Output controls (such as TAC) were also raised by some, particularly for Mud Crabs, as prior reporting would serve as a check on logbook recording.

The question of buyers’ returns was strengthened by comments from one participant suggesting that DAF already had the legislative authority to reintroduce buyer returns. Upon checking, this observation was verified.

General comments and suggestions supplied by this group were also supportive of using independent measures such as the Long Term Monitoring Program (LTMP) trawl recruitment survey to monitor the fishery. Others highlighted that if effort could not be controlled then there may be benefit in introducing output controls (as highlighted earlier). The value of observer programs were also stressed for providing multiple benefits, providing they are managed appropriately. Some of the more intangible benefits recognised by respondents included: greater communication between management and industry and earlier detection of “industry issues” given no formal consultative and/or extension programs exist in DAF.

## Survey synopsis

There was general greater negativity in the recreational responses.

Commercial fishers who were impacted negatively by the recent net-free area decisions provided more negative responses and it was more difficult to focus their attention on crab fishery issues.

There was generally a poor understanding about the data collected and how that data were used across all stakeholder groups.

On the positive note there were relatively only small changes recommended in the commercial logbook reporting structures and fields and these are further explored in the CBA section.

Re-establishing trust between management and other stakeholder groups was highlighted as a key issue by many respondents across all stakeholder groups.

## **Validation of Logbooks**

General consensus across all groups of the need to validate fisheries catch and effort data. Data validation was also a key recommendation of the recent MRAG review of fisheries management in Queensland.

Observers are used for a range of reasons in fisheries contexts and are also widely used as a means of validating logbook records. We believe that the benefits of observers extend far beyond the goal of validating logbook records. Previously, Fisheries Queensland employed staff tasked with maintaining contact with fishers and assisting them with logbook training. Further QB&FP staff, researchers and long term monitoring staff could theoretically assist in validating catches when they accompany fishers or measure catches etc. as part of their duties.

Many validation techniques only validate catch and it is recognised as being very difficult to validate effort. Only cameras, observers and to a lesser extent VMS can be used to validate effort in crab fisheries. At present technology is not yet cost efficient enough to enable camera observation to be used as a viable monitoring method in our crab fisheries given the small size of some boats used in the mud crab fishery in particular.

Catch Document Records or sales dockets provide an alternative validation process which has also been discussed in the MRAG report. The fact that this recommendation received widespread support among commercial industry members surveyed lends further weight to their introduction in some form.

Electronic logbooks do not currently have widespread support in the crab fisheries but the issues surrounding elogs are discussed in more detail in the Alternative data section of the report and have also been highlighted in the MRAG (2014) report. We note, however, that there was not a high level of support among crab fishers for elogs.

There have been many occasions where data checking for stock assessments and a more forensic analysis of the logbook data has highlight logbook records that looked suspicious. However on checking, many of these instances were subsequently found to be accurate records. While a forensic analysis of data could identify fishers to be targeted for further investigation there will be many occasions where the and there will be many cases that do not raise concerns of the analyst but which will be false records.

## **Recreational Issues**

Recognition of the difficulty in collecting accurate and precise estimates of recreational catch in crab fisheries. It is widely accepted across Australia that the methods used by Fisheries Queensland are best practise, yet this does not seem to be accepted by any stakeholder group. In many cases this is due to a lack of understanding of the goals of the surveys and the data. Stock assessment scientists want the most accurate and precise estimates to feed into the

There was a high degree of mistrust among each of the stakeholder groups towards each other and even within groups.

Greater education and extension was needed regarding the data and how data were used across both the commercial and recreational fishing sectors.

Opportunities exist to use commercial fishers in more structured ways to collect better data. This can only be achieved with the building of trust.

## ALTERNATIVE DATA COLLECTION METHODS

### Fishery Independent Surveys

Fishery independent methods were highlighted mainly by managers/researchers as beneficial in the crab fisheries largely due to the lack of confidence stakeholders had in the accuracy of the logbook commercial data and imprecision of the crab recreational estimates, in particular. While independent surveys may be useful in providing indices of relative abundance they will not be able to provide estimates of total catch. The main requirements of fisheries data in the two crab fisheries are to enable comment on stock status and to be used in stock assessment models and harvest strategy evaluation. Fisheries Queensland had previously been conducting fishery independent sampling of the mud crab fishery for a number of years from 2002, but this was discontinued in 2008, while there is still an ongoing fishery independent recruitment survey for blue swimmer crabs.

Fishery independent sampling of the CRFFF occurred from 2006 – 2009, and included age-structure sampling, catch rate analysis and UVS of relative abundance. As one of the most expensive Long Term Monitoring Projects (LTMPs), the monitoring was discontinued as a result of budgetary cuts. Fishery independent sampling of the ECSMF continues and samples length and age frequency structure of Spanish Mackerel. Both recreational and commercial fishing sectors are sampled, with a particular emphasis on sampling fishing effort and catch around the annual spawning aggregation fishery that is likely prone to hyper-stable characteristics and overfishing (Tobin et al 2013, Tobin et al 2014). The age structure data has been used in stock status reports and stock assessments of both species (see Leigh et al 2014; Campbell et al 2012).

Catch rate analysis is used in a harvest strategy for Coral Trout in the CRFFF. In the last two consecutive quota years, the value of a Coral Trout quota unit and hence the commercial TACC has been reduced. The desired outcome is a re-built stock. Recent meetings discussing the CRFFF harvest strategy for Coral Trout have expressed concerns about the absence of any data concerning recreational fishing sector catch and effort in harvest strategy discussions and deliberations.

Discussions with stakeholders confirmed the requirement for ongoing monitoring and assessment of the crab fisheries and little choice in ongoing collection of catch and effort data from the commercial sector, in particular. Managers, researchers and NGO's also stressed the need for recreational catch and effort estimates in all fisheries.

The examination of trends in catch rate is interpreted in different ways among stakeholder groups and often significant trends are “explained away”. It is important that any system of data reporting that is used for stock status reporting or stock assessment has the support of the major stakeholders as there is currently a considerable lack of understanding about fisheries data collection methods across all stakeholder groups.

Blue Swimmer Crab recruitment surveys have been conducted since 2006. There is currently insufficient data to quantifying the financial benefits and costs of these surveys as they have yet to be used in stock assessment models used to manage the BSC fishery. However, a series of standardised catches of juveniles will most likely form an important part of the next BSC stock assessment (Sumpton et al. 2015). Staff estimates for this survey are about 100 person days at TO4(4) rates this puts the staff costs at approximately \$7000 plus vessel charter and travel costs which come to an additional \$56,000 making a total cost of \$63,000. This trawl survey is conducted in conjunction with surveys of the eastern king prawn and snapper fisheries so costs can be apportioned across these three fisheries which would reduce the attributable Blue Swimmer Crab survey cost. The sites surveyed and fishing gear used means that samples of the three species collected can be used to produce indices.



There are considerable negotiations that are still yet to take place regarding the range of alternative designs that are possible. This will require extensive consultation and negotiation with industry and management but for the crab fisheries there are clearly opportunities to minimise costs by utilising industry to assist with these surveys. Indeed there is an existing model where both fishery independent and fisheries dependent methods are used to assess and manage a crab fishery in Queensland. Currently the spanner crab fishery is managed by a quota system that relies on a mixture of the results from an annual fisheries independent survey of the adult population combined with standardised catch rates derived from logbook records.

The Mud Crab fishery independent survey was discontinued in 2009 but taking into account inflation current costs would be in the vicinity of \$43,000 for a similar survey with the same spatial coverage (6 locations). However, it is possible that the number of locations could be reduced and still provide a useful index for long term monitoring of stock status.

In the case of Mud Crabs, the independent survey gives an index of adult abundance whereas the BSC survey provides an index of relative abundance of pre-recruits to the fishery, albeit in only one part of the fishery (Moreton Bay), although this is arguably the most important area of the fishery.

### **Electronic logs (E-logs).**

The Queensland Department of Agriculture and Fisheries (DAF) has trialled electronic logs in the east coast trawl fishery and CRFFF, and is working towards enabling electronic logs to be submitted in several other fisheries including the east coast line, Spanner Crab, Beche-de-mer and Trochus fisheries. It is anticipated that e-logs will be available for all fisheries sometime in the future. There is currently only one approved provider of electronic catch reporting software but there is no reason why this could not be expanded to more providers in the future. Fisheries Queensland estimates that it would cost approximately \$6000 for the Department to develop an Extensible Mark-up Language (XML) so that a private company could develop an electronic logbook arrangement for the crab fishery. The Departments' position is that any e-log would need to be developed external to Government by an accredited service provider and then industry would be required to pay for the software and ongoing support. Based on results of the current surveys, such a system would not currently receive widespread support in either the mud crab or Blue Swimmer Crab fisheries, largely due to the costs associated with both the purchase of the software and ongoing annual costs of maintaining such a system. Based on the current commercial prices for such a service annual costs would be over \$400. The trend towards non-acceptance of e-logs was not related to age, as both younger and older fishers raised objections to using e-logs, but generally support came from younger members of the commercial fishing industry. As of 2<sup>nd</sup> November 2015 only four trawl operators and one line fisher had taken up the offer to trial e-logs.

Whilst electronic logs may prove to be a more streamlined and efficient way of collecting commercial data in the future they do not address issues of data accuracy and misreporting highlighted as being the major issue in the both the Mud Crab and Blue Swimmer Crab fisheries. An external, non-governmental provider of logbook services may address some of the concerns of fishers but the use of the data is still ultimately in the hands of the end user and fishers recognise that ultimately management has access to those records and may still use the data to their detriment. The movement from paper to electronic reporting would also impose additional costs on fishers as current costs of administering the logbook and reporting system are largely borne by government although licence fees can (arguably) be said to partially offset those costs.

It is somewhat surprising that e-logs have not been better accepted by line fishers given a major outcomes of previous research on the effect of TCs on the productivity of the CRFFF called for and encouraged the uptake of real-time data reporting. Real-time data reporting needs were also strongly supported by fishers. The poor uptake may be relatable to the lack of an effective communication strategy with fishers. Limited FQ budgets mean communication with fishers about the availability of

elogs is via mail, a demonstrated ineffective communication method (Tobin 2010). Similarly, the absence of the peak representative body and effective industry communication network stifles efficient communication. Maximising the uptake of new methods and technologies requires a collaborative effort. Relationships between managers, elog developers and fishers needed to occur long ago.

## **Other methods of gathering data**

The greater acceptance of “on the ground” methods of data collection by both recreational and commercial crab fishery stakeholders suggest that fisheries observers may provide a viable monitoring alternative in the mud crab and Blue Swimmer Crab fisheries. Fishing trips in these fisheries are usually less than 12 hours duration, greatly reducing the management costs of observer programs. While observers have often been criticised in some fisheries as providing data that is unrepresentative of the total catch it is difficult for crab pot fishers to dramatically modify their behaviour when accompanied by an observer as it would necessitate moving gear. It is still possible for a fisher to only check a proportion of their gear or to modify their handling and sorting practises but pot and trap fisheries in which fishing gear is left out overnight and retrieved on a daily basis are not as prone to bias and manipulation as some other forms of fishing. In fisheries such as trawl, line and net fisheries it is easier to manipulate fishing activities by fishing in areas that would not have fished had an observer not been on board. In some of these fisheries the duration of a fishing trip can also be more than 7 days which also greatly increases observer costs and the ability to representatively sample a fishery.

One of the issues that would need to be addressed is the problem of only sampling catches of a select few fishers that were willing to have observers on their vessels. In the case of the crab fisheries many commercial fishers offered to have observers on board and this was often their preferred method of data collection.

Observers in these fisheries may not address the issues of SOCI species (other than confirming that the probability of interactions is low) as previous observer studies in the Blue Swimmer Crab fisheries have shown no SOCI interactions from over 7000 observed pots lifts (Sumpton et al 2003) representing a sample fraction of 1.6% of the total annual commercial pot effort.

The relative likelihood of fishers interacting with SOCI may be higher in the RLF as opposed to the CF, reflecting differences in the relative abundance and interaction mechanisms between the fisheries. In the RLF, relevant SOCI includes the fin fish barramundi cod and Maori wrasse, two species that are of naturally low abundance though not uncommonly caught on the baited handline gears of fishers. A review of historic data collected by the CRC Effects of Line Fishing project suggest regional effects on the likelihood of SOCI interaction, with both species more likely to be captured by fishers working in lower latitudes (Mapstone, unpub data).

Conversely, SOCI interactions in the CF are most likely with turtles that become entangled in the apparatus following passive interaction and occasionally as a result of actively feeding on bait.

Fishery dependent observer programs have also worked in some fisheries. The NPF introduced a deckhand observer program in recent years to assist that fishery in meeting the requirements of third party accreditation. A successful crew member observer program collects information about threatened, endangered and protected species.

Other alternative means of monitoring and gathering data such as on board cameras have previously been the subject of earlier FRDC sponsored research and have been assessed as non-viable in the case of small-scale fisheries involving outboard powered vessels for both logistic and economic reasons. However, advances in technology and reduced costs may still make cameras a viable future option.

## **GENERIC FISHERIES DATA PRINCIPLES**

There is considerable literature around the use of fisheries data and information systems that support sustainable fisheries management. Most of the literature around fisheries data needs and monitoring has developed around commercial fisheries whereas both of our case study fisheries have a significant recreational component. It is acknowledged that recreational fisheries offer somewhat unique problems, yet many of the overarching principles that have been developed in commercial fisheries remain the same when considering recreational fisheries and their data. It is just more difficult and costly to adhere to those principles in recreational fisheries for a multitude of reasons. The following discussion synthesises results highlighted in recent reviews and published fishery specific literature. We highlight them here to provide a comparison between established best practice and the generic learning we view relevant to Australian fisheries based on our two case study fisheries.

### ***Stakeholder Engagement and Periodic Review***

It is vital to engage stakeholders early in the data and information design process and regularly at intervals as the fishery progresses. Systems need to be adaptable and dynamic, able to change with changing circumstances and fishery development. When changes are required to data and monitoring structures it is vital that all stakeholders are consulted to avoid redundancies and appropriately utilise knowledge within the fishery about the impact of those changes.

### ***Understand the Specific Fishery Characteristics***

Each fishery is unique with different levels of complexity related to gear, spatial and temporal considerations, number of participants etc. Decisions need to be made about the scope of data structures.

### ***Establish Clear Goals and the Data Requirements for the Fishery***

The goals of the fishery will influence the types of data required to achieve management, assessment, industry and compliance objectives. Different stock assessment models and management strategies have different data and monitoring requirements. *(In the context of Queensland's fisheries this principle will be strongly influenced by tier level categorisation of these fisheries. MRAG have recommended that each of the major species being considered in this report should be Tier 1 species requiring the highest level of data and assessment. While the final outcome of the current regulatory reform of fisheries is unknown it would seem that each of these fisheries is of significant importance to warrant this level of classification).*

### ***Carefully Consider Monitoring and Enforcement Strategies***

Data requirements will have compliance and enforcement implications. It is common in the literature to establish an education program for fishers, enforcement officers and other stakeholders so that they understand both the regulations and the data that will be used to monitor the fishery. *(In the case of Queensland's crab and line fisheries it is somewhat complicated by the mixed nature of the fisheries and the large numbers of commercial operators and the need to update and re-educate as fishers enter the fishery or the fishery changes).*

### ***Cost Considerations***

Scaling the monitoring, assessment and data costs to the value of the fishery is a common practise as is the recovering of costs from industry. While comprehensive records of commercial catches are often available, apportioning costs is more complicated if the fishery has a recreational component where catches and economics are more difficult to quantify. The concept of MEY is well established

in the fisheries literature. Fishers may be able to maximise profits at a certain level of effort (or catch) but in order to manage using MEY principles additional costs need to be factored into the analysis. It is well recognised that management, research, monitoring and enforcement costs need to be factored into the overall cost considerations.

These general principles for effective data collection are also inherent in some of the recommendations of the recent Review of Fisheries Management in Queensland (MRAG 2015) and regulatory reform currently taking place in the management of Queensland's fisheries.

## **Applicable Generic Principles from Investigation of the Reef Line and Crab Fisheries in Queensland**

### *Fishery Participation and Scale Considerations*

Fishers operating in mixed fisheries (net, crab, line) find it difficult to divorce experiences in one fishery with what is happening in other fisheries. Positive experiences in one fishery are overshadowed by negative experiences in another. This was apparent in the current research where reform in other fisheries directly impacted on the perceptions and response of fishers to our engagements.

The likelihood of gathering accurate and precise information is inversely proportional to the number of participants in a fishery. While this is not universally true across all fisheries, it is easier to check and validate the data provided by a few fishers rather than a larger number, particularly if business structures are varied (as is the case in the mud crab and Blue Swimmer Crab fisheries). The situation in Queensland is that there are more than 400 current entitlements to catch approximately the same quantity of blue swimmer crabs as are landed by fewer than 20 entitlements in South Australia and Western Australia.

Fisheries stakeholders generally find it difficult to view the world from the point of view of other stakeholders and this often also applies to within stakeholder groups. Large fishing businesses, for example, sometimes cannot appreciate (or choose not to appreciate) the circumstances of smaller businesses. This has important implications for choosing representatives of stakeholder groups when there is considerable diversity in business structure and fishing entitlements (in the case of commercial fisheries) and in fishing motivation and expectations (in the case of recreational fisheries).

While diversity and flexibility of fishing businesses (due to multiple entitlements) enhances resilience and adaptability to external forces such as climate change and changing markets this same capacity hinders the ability of fisheries managers to address specific or localised fisheries issues unless flow-on effects to other fisheries can be reduced. The fact that there is an inshore logbook that contains netting and crabbing information is evidence of this dilemma, as management interventions that cause a change in crab fishing can have flow on effects to netting effort for those fishers that have multiple entitlements.

### *Importance of Education, Communication and Trust*

While observer programs will have benefits for catch composition, bycatch recording and validation of data, low observer coverage will struggle to validate catch, and validating effort is even more problematic. Observer programs and industry monitoring programs have additional education and engagement benefits that are often underestimated. They can also assist with building trust. A visible presence "on the ground" lends confidence to the data collected.

The need for better education of all stakeholder groups is a key (but not surprising) outcome of this study. This also needs tailoring to the characteristics of each of the stakeholder groups.

This is reflected in the support of recreational and commercial stakeholders for on-site survey methods to gather recreational data and observers/in field collection of commercial fisheries data. This may not be a totally valid response, as offsite methods and other data collection methods are often best practise, it is often the case that fishers (and other stakeholders) do not fully understand these methods. There are also significantly greater costs associated with “in field” methods that is sometimes a significant impediment to their application.

Trust (which is directly linked to data quality) can only be built in an environment where data provided by users is not used to disadvantage those providing the data. Some fishers will attempt to manipulate data to their advantage. Once trust is lost it is also difficult to recover. Some stakeholders highlighted specific instances from over 10 years ago that were still impacting on their current behaviour.

While trust is low, validation and independent verification of the data is critical.

## **COST BENEFIT ANALYSIS**

The Cost-Benefit Analyses for both the Queensland line fisheries (the CRFFF and the ECSMF) and crab pot fisheries were largely informed by the outputs of the survey/questionnaire as well as expertise advice from stakeholder groups. Accordingly, the CBAs for the two fisheries focused on different aspects of the data recording processes and methods for each of the fisheries.

Given the line and pot fisheries have very different characteristics, both in fishing methods and daily operations, it is not surprising that the advice from stakeholders about improving data collection (relevance and efficiencies) focus on different elements of data collection.

### **CRFFF and ECSMF**

The cost-benefit analysis (CBA) was guided by and completed using scenarios and suggestions received from respondents during the questionnaire/survey. From this information the CBA compared the current-day data and information recorded by fishers in the CRFFF and ECSMF to a proposed and hypothetical alternative. The hypothetical alternative is not a formal proposal of change, rather a synthesis of (some) identified changes and modifications noted during the project questionnaire/survey. Naturally, as fishers are physically tasked with recording data, fishers were the dominant in suggesting and proposing change to the CRFFF and ECSMF data collection processes. In most cases the suggestions and proposed changes are in direct response to a data field and/or method with which fishers do not agree is useful, or struggle to complete appropriately (user-friendliness). The CBA includes background information and/or interpretation of some data fields and/or methods which may not reflect the original intent of those data fields and/or methods. Here it is important to note, that no reference material exists that clearly explains the “Why?” or intent of contemporary data fields and/or data collection methods. That is, as an example, a fisher entering a fishery today is given a logbook that must be filled out each day though limited or no training or guidance as to why the logbook and data fields are important and how they should be completed may be offered.

The CBA steps through the data recording process in a chronological order of a hypothetical fishing trip. Costs and benefits are identified throughout and mostly discussed in a qualitative manner. Some additional items relevant to data collection not included in the hypothetical are discussed as well.

**Table 2.** The data recording activities and processes of commercial fishers in the CRFFF and ECSMF. A subjective cost-benefit analysis was guided by the responses and comments received from fishers and other stakeholders participating in the project.

	<b>Current day process and procedure for logging and reporting catch taken by commercial fishers operating in the CRFFF and ECSMF</b>	<b>Simplified reporting – a hypothesized proposal</b>
1	<p>Complete paper logbook (LF06, version 06) before/as departing port.</p> <p>Data fields to be completed include boat name, boat mark, fisher’s name, and fishers licence #, boat activity code, port &amp; time of departure.</p>	<p>Complete paper logbook (LF06, version 06) before/as departing port.</p> <p>Data fields to be completed include boat name, boat mark, fisher’s name, and fishers licence #, boat activity code, port &amp; time of departure.</p>
	<p>The completion of these initial fields could be considered evidence that the fisher has clear intent to fish and catch quota regulated fish. Maintaining this requirement removes any potential doubt about the intended fishing activities that may occur in the absence of this data.</p> <p>Costs: na</p> <p>Benefits: na</p>	
2	<p>Prior Notice 1 – phone call to report catch taken on the trip, must be received at least 3 hours before the vessel will return to port/landing point. The intent of Prior Notice 1 is to give quota enforcement officers (QBFP) time to organize to meet the fishers at the point of landing to inspect catch and maintain quota system integrity.</p> <p>Catch needs to be reported as number of fish taken for each of 4 quota groups (1 – Coral Trout; 2 – Redthroat Emperor; 3 – other reef species; 4 – Spanish Mackerel).</p> <p>The prior notice for some types of fishing businesses (dead reef fish and Spanish Mackerel fishers using small vessels for trips of short duration)</p>	<p>The prior notice could take the form of a simple SMS that identifies the fishing vessel has left port to engage in fishing for a quota monitored species. Remove the requirement to record species #s, port and time of return as all of these fields can be changed within an hour of landing.</p>

	<p>is often lodged at home in the fishers lounge room, hours before setting to sea. The catch is reported as all 0s (zeros), and the estimated landing time is cautiously predicted to be many days in advance of the likely landing time. Similarly, the landing point may also be unknown at the time of lodging the prior notice.</p> <p>Prior 1 has largely become a defunct and information limited requirement. The only useful piece of information lodged is that the vessel has (or is about to) put to sea with the intent of targeting and taking quota monitored species.</p>	
	<p>The prior notice is broadly recognized as being uninformative and ineffectual. The ability to change all of the data recorded in the initial prior notice when all of the data in that prior notice can be amended (changed) one-hour before landing, highlights the redundancy of the initial prior notice.</p>	
	<p>Costs: none obvious</p> <p>Benefits: simplified and less confusing system. Saves time for commercial fishers. Less uninformative and distracting data that may bog down catch and quota surveillance.</p>	
3	<p>24 hour logbook entries – for trips longer than 24 hours, a tally of each days catch must be recorded at the completion of each fishing day. The recognised end of a “fishing day” is midnight. For fishers fishing through the night, the logbook must be completed at midnight.</p> <p>This requirement means that a fisher must cease fishing and tally all fish onboard, enter data into the logbook before resuming fishing.</p>	<p>For fishers who can demonstrate that 24 hour round-the-clock fishing is occurring, a more amenable time period for reporting catch is required. Trip totals have been suggested by some stakeholders for fishing that occurs for greater than 24 but less than 72 hours.</p>
	<p>Daily records of catch are often not feasible for some fishers.</p>	
	<p>Costs: Daily catch rate estimates may be compromised, though the current system is unlikely to provide robust data.</p> <p>Benefits: A simplified system for fishers means greater business efficiency, and less stress. Catch records at a different time period are likely to be more robust than the currently mandated 24 hour time period records.</p>	



4	<p>When a vessel moves multiple times to fish different locations during a 24 hour period, the catch taken at each of those individual locations is expected to be lodged in separate data columns in the logbook. Spatial data reporting includes two data fields: a 30 x 30 nmile grid, within which are 25 individual (6 x 6 nmile) fishing sites. For each different site fished, the catch taken at that site should be recorded.</p>	<p>The adoption of VMS has been encouraged by some stakeholders. While fishers are generally resistant of the costs likely to be imposed on them, adopting VMS that is linked to a real time data collection method would generally alleviate the concerns surrounding the difficulties and likely inaccuracies around recording spatial data today.</p>
<p>As for 3 (above), fishers who participate in short duration trips often fish around-the-clock and often move locations (and possibly significant distances), accurately recording catch to the required grid and site level is arduous. It is likely few fishers record this information accurately and correctly. It is likely fishers' record cumulative catch from multiple sites to the single site.</p> <p>Similarly for larger CRFFF vessels with multiple dories: often the multiple dories are fishing in different sites making it impractical for the daily catch to be accurately recorded.</p>		
<p>Costs: If VMS is considered for recording the spatial distribution of fishing effort, costs may be associated with introducing that technology, ongoing maintenance (fishers) and management of the data and system (QDAF).</p> <p>Benefits: A simplified system. More robust and confident data.</p> <p>Ancillary benefit of VMS is that this tool may also help curb green zone infringement fishing.</p>		
5	<p>Prior Notice amendment – phone call to amend the earlier prior notice, and record fish numbers landed for the trip as well as estimated landing time.</p>	<p>Maintained.</p> <p>Include SOCI field.</p>
<p>The recording of SOCI interactions is acknowledged as poor, likely due to an absence of fisher knowledge and a difficult and separate reporting system. See step 6 below for further discussion, and qualitative CBA.</p>		
6	<p>Any interactions with SOCI should be recorded in the dedicated SOCI logbook.</p>	<p>Include the SOCI species of likely interaction (Maori wrasse and barramundi cod) on the main logsheet, not in a separate book.</p>
<p>The reporting of SOCI is generally regarded as poor. Recording is poor due to a combination of poor knowledge and apathy. Most fishers are not aware that they should be recording and reporting interactions with barramundi cod and Maori wrasse. Including these species of SOCI as fields within the day-to-day logbook is likely to result in better recording of SOCI.</p>		

	<p>Costs: A re-designed logbook to include SOCI is likely a reasonably expensive exercise.</p> <p>Alternatively, modifying the AVIR system to include SOCI is likely to be cheaper and more acceptable to fishers.</p> <p>Benefits: Better recording of SOCI by fishers.</p>	

Additional points raised.

1. Species specific reporting. The requirement for fishers to record each species of fish individually is questioned by numerous stakeholders. However, some non-fisher stakeholders have expressed concern about the lack of species-specific information about the “other species” component of the CRFFF quota, particularly in relation to popular species that are not well understood biologically or ecologically, stifling informed management.

A proposal is the adoption of a Tiered approach to be adopted where species of considerable importance/vulnerability have more stringent reporting requirements than species of less critical need. Less critical species may be recorded via a catch-all process. Should species specific information be required at certain times and/or places, this data could be collected by a fisher-dependent method.

Costs: Minimal costs associated with a change in the

Benefits: Streamlining data collection is paramount, as too is ensuring data collected is relevant to the needs of sustainable management.

2. Economic data needs. Numerous stakeholders have identified the need for better economic data relevant to all fishing sectors of the CRFFF. For the commercial sector, the volatility of the export market for live Coral Trout as well as the seasonal and regional differences paid to fishers’ means valuing the fishery can be difficult. Similarly the expenses of the commercial fishery as well as the expenditure of the recreational fishery are not well understood.

**Table 3.** The data recording activities and processes of recreational fishers in the CRFFF and ECSMF. A subjective cost-benefit analysis was guided by the responses and comments received from fishers and other stakeholders participating in the project.

	Current day process and procedure for logging and reporting catch taken by recreational fishers operating in the ECSMF	Fishers suggested methods for improving reporting
1	<p>None.</p> <p>There is no legal requirement for recreational fishers to log or report their catch.</p>	<p>Phone application to prior report all reef catches.</p> <p>Mandatory reporting of all reef catch.</p> <p>OR</p> <p>A reef (offshore) specific fishing licence similar to that introduced in Western Australia in 2005.</p> <p>Accompanied by a diary</p>
	<p>Costs:</p> <p>The existing AVIR system that is used by commercial fishers may be modified for use by recreational fishers. This would minimise costs by avoiding the need to design and introduce new technologies and systems.</p> <p>Benefits:</p> <p>Data describing the effort and catch characteristics of the recreational fishing sector are sparse that any improvement to data quality and breadth would be beneficial.</p>	

Analysis: In the absence of a robust data collection method for the recreational fishery, a data poor environment does not enhance the management of the fishery and the likely economic benefits and social amenity gained.

## **Crab Fisheries**

### ***Changes to current commercial logbooks***

The cost-benefit analysis (CBA) of changes to commercial logbooks in the Mud Crab and Blue Swimmer Crab fisheries was guided not only by suggestions made by commercial fishers but from questionnaire respondents (from all stakeholder groups). There were no suggestions in terms of specific changes to logbook fields offered by the recreational sector. Commercial fishers provided the most detailed and consistent responses while managers and researchers provided a range of suggestions that commonly involved the collection of additional information (sometimes very detailed and complex). From these suggestions we have compared the current information provided by stakeholders to a proposed and hypothetical alternative. As is the case for the reef line fishery, the hypothetical alternative is not a formal proposal of change, rather a synthesis of (some) identified changes and modifications noted during the discussions with surveyed stakeholders. In the case of suggested modifications to logbooks the CBA is largely a qualitative exercise as changes to the logbook have varied financial cost that is directly related to the scope of the change and benefits are both tangible and intangible. Discussions with Fisheries Queensland indicated that obtaining accurate financial costs for some of the changes would be difficult as it involved using contractors to implement some of the changes and the scope of the work was not easily quantified. There may be economy of scale savings depending on the extent of changes undertaken. The current regulatory reform also increased the uncertainty in the determining what were feasible options.

In most cases the suggestions and proposed changes are in direct response to a data field with which fishers do not agree is useful, or an alternative field that they have proposed as being a useful addition to the data. We have only included those suggestions that had a relatively high level of level of support. Other suggestions made by some stakeholders included the following:- (a) recording the numbers of discarded crabs, particularly female crab, (b) more detailed information on sightings of threatened and endangered species, (c) information of fishing gear (trap dimensions) and (d) bycatch data.

The CBA includes background information and interpretation of some data fields which may not reflect the original intent of those fields. It is important to note, that there is limited reference material that clearly explains why certain data fields are used or the intent of contemporary data fields or data collection methods. A fisher entering a fishery today is given a logbook that they are required to fill out each day without being provided training or instruction as to why the logbook and data fields are important and how they should be completed. While there are written instructions for filling out the logbooks at the front of each book, a wide range of misinterpretation and misunderstanding of what data is collected has resulted in a few erroneous practices. These can generally be remedied by better communication between fishers and agencies responsible for collection and analysis of the data.

We note that some of the suggested changes presented below have previously been discussed in relation to earlier reviews of logbooks or when changes in management altered the specific reporting requirements of a fishery. This was particularly the case for the spanner crab fishery where the move to quota management necessitated the development of a separate logbook and major changes in reporting due to the need to track quota. In contrast there have been few changes to management of both the Blue Swimmer Crab and Mud Crab fisheries. We note that there needs to be a good justification for changing a logbook field as changes made in earlier logbooks have caused significant analytical issues during stock assessments and other exercises that rely on the analysis of catch and effort (e.g. status reports). The change over from the option to report catch by numbers to exclusively catch by weight for example caused many problems in discerning the fishers who still continued to record numbers for some time, effectively reducing data accuracy.

In addition to the suggested changes to logbook fields highlighted below, the responses of some fishers emphasized the need for better explanations and reasons why some of the fields are included. While recent supplementary information has been prepared by Fisheries Queensland (see appendix) which provides some guidance to fishers in recording effort in both net and crab fisheries there was a recognised need for better education around the recording of number of pot lifts and numbers of pots as well as stressing that the catch recorded should be the retained catch. While this is mentioned in the instructions at the front of each log there were still a proportion of fishers who claimed to have been recording retained catch as well as discarded catch in the Catch field in log books. (The research team are still unclear whether this is a strategy to imply the over-reporting of catch from some fishers).

As is always the case, written instructions and supplementary material are only useful if they are read and understood by those recording the information and they also have an understanding of how that information will be used to ensure the sustainability of their shared fisheries resource.

**Table 4.** The data recording activities and processes of commercial crab fishers. A subjective cost-benefit analysis was guided by the responses and comments received from fishers and other stakeholders participating in the project.

	<b>Current process and procedure for logging and reporting catch and effort used by commercial blue swimmer and mud crab fishers</b>	<b>Simplified reporting – a hypothesized proposal</b>
1	Estimated catch is reported in three fields for Mud Crab, Blue Swimmer Crab and other crab.	Include an additional (or two) fields for Mud Crab to reflect different crab grades
	<p>Some Mud Crab fishers commented that over the years lower grade crabs were being taken in greater numbers which has artificially increased the total catch in comparison to historical records. The inclusion of an additional field would incur additional costs from a database administrative view point.</p> <p>Benefits would include a higher level of precision in the catch. It would also allow for adjustments to be made in historic catches providing some information on when practices changed could be obtained.</p>	
2	Field heading for recording catch of the three categories of crab is currently ESTIMATED CATCH (kg)	Change heading to RETAINED CATCH (Kg)
	<p>This suggestion was not recommended by stakeholders directly but the project team believed that it would improve data accuracy due to the apparent difficulty some fishers had in recognizing the distinction between catch that is sold (harvest) and catch that is returned to the water (discards). There were fishers who were recording females as well as some undersized male crabs that were subsequently returned to the water in their “estimated catch”. Discussions with fishers showed that the word “estimated” confused some people as they were more inclined to think that this meant they had to include what they had also discarded. They had quite accurate records of their retained catch because they commonly sold their product by kilograms so the word “estimated” was confusing. This distinction was clearly described in explanatory pages and instructions at the front of the log books but it was still being misinterpreted by some fishers. Some of these issues highlighted the need for greater education of fisher in filling in the logbooks.</p> <p>It is also recognized that there should be consistency between the logs used in different fisheries to avoid this confusion.</p>	
3	Interactions with SOCI are recorded in a separate dedicated SOCI	Include the SOCI species of likely interaction (mainly turtles) on the

	logbook.	main log sheet, not in a separate SOCI logbook.
	The reporting of SOCI is generally regarded as poor in a range of fisheries but not as much of an issue in the crab fishery. This change was requested by a significant proportion of the crab survey respondents but it is really only an option if there were to be a separate crab logbook in the future as there are more interactions with SOCI species in the net fisheries and therefore there will be a need for a separate log for those fishers that operate in both net and crab fisheries where the total level of interaction will be higher than the crab fishery alone.	
4	Catch from net fishing and crabbing (Mud Crab and Blue Swimmer Crab) operations are recorded in a single net and crab logbook	Produce a separate logbook for crabs (Mud Crab and BSC)
	<p>The concept of a separate crab and net logbook has previously been proposed and rejected for a range of reason, yet this recommendation still has some traction within sections of the commercial crab industry. Upon further questioning it was predominantly those fishing businesses that relied primarily of crabbing that were supportive of this suggestion.</p> <p>Costs: there are significant costs identified with this option and as mentioned above it has been dismissed as inefficient in the past. It is interesting to note that with a system of electronic logs this would not be as much of an issue as information could be reported seamlessly in one operation. Again, due to the diversity of fishing businesses such a change would have some fishers only filling out one logbook whilst others would be filling out more than 4 separate logs (eg. Spanner Crab, Net and Crab, Line, SOCI).</p> <p>There may be an option for producing a separate crab logbook for those fishers who do not undertake any netting activities.</p>	
5	Pot Loss is currently not reported in logs	Record numbers of pots lost as a new field in the net logbook
	<p>This was suggested only by the commercial sector (7% of those surveyed) and was clearly an important issue for many of those surveyed.</p> <p>Costs: New data fields would need to be formulated and there would need to be agreement across a range of stakeholder groups.</p> <p>Unclear what stakeholders would use the information for (other than compliance)</p> <p>This additional data field would still not quantify the number of pots lost and left in the environment, as the ultimate fate of the lost pots could not be verified.</p> <p>Benefits: Would highlight areas where pot loss was a significant issue and allow the targeting of compliance resources to reduce the incidence of pot loss/theft.</p>	

# Conclusions

Fisheries literature provides guidance on data that is required to manage fisheries, yet there is no recognition of the needs of diverse stakeholder groups. There is an ongoing need to communicate how data is used, validate data and educate stakeholders while having a system that is flexible to changing data requirements.

The expertise synopsis demonstrated the power and strength of long-term data sets, whilst identifying limitations in the types and rigour of data collected. Through time, the demands on data have changed as management structure has changed, and so too the types of data needed. The project clearly demonstrated that a common operational limitation is a lack of understanding of fisheries data by the fishers and stakeholders at large. The ever changing needs are a reality of dynamic fisheries environments, though inflexible systems used to collect data are incompatible and often stifle best information-based decision making and management.

The contemporary view of fisheries data by stakeholders is complex. Clear issues exist around a lack of understanding of fisheries data both within and across sectors. There was even some confusion about fisheries data among the management, researcher and NGO stakeholders. Trust of data quality and responsible use of data varied among fisheries and sectors. Generally commercial sector data was considered more robust than recreational sector data. Within the commercial sector, catch data was considered more robust than effort data. Conversely, the quality of both catch and effort data from the recreational sector was considered poor by most stakeholders. There was greater confidence in quota managed line fishery data compared to the effort-controlled blue swimmer and mud crab fisheries. Generally fishers were enthusiastic and keen to be involved in data collection. Commercial fisher's aspirations to be more involved are frustrated by inflexible systems which were not well understood. The absence of a portal for communicating and accessing help and assistance was repeatedly noted by fishers. Similarly, some recreational fishers were uncertain about how they could participate in data collection.

There was universal acknowledgement that the recording of SOCI was very poor across all fisheries. However, SOCI within the crab and line fisheries are considered less critical than trawl and net. Crab fishers perceive some infrequent interactions with turtles as a non-issue, while line fishers are unaware that they catch SOCI (Barramundi Cod and Maori Wrasse are listed SOCI species, yet most fishers are unaware they should be recorded). Most fishers perceive SOCI as large marine mega-fauna including whales, dolphins, dugong and turtles; a perception that clearly needs to be remedied by communication and education. There is clear distrust by fishers that SOCI data may compromise their future fisheries access and thus business security. While this distrust exists, SOCI data is likely to remain poorly reported and thus highly unreliable.

Validation of logbook data was viewed as essential by the majority of stakeholders although support was tempered when the increased administrative costs were included. A plethora of methods for validating fisheries data exist offering an opportunity to explore methods that best-fit fisheries specific operational circumstances and limitations. A risk assessment approach could be married with a cost-benefit analysis to direct often limited budgets to the most at need fisheries.

Solutions to many of the issues raised and identified by stakeholders centred around the clear need for better engagement and communication between the management agency and fisheries stakeholders. Most processes that nurtured this historically – such as extension officers, education officers, Fishcare volunteers, fisheries observers – no longer exist. Similarly, peak bodies and representative structures that engage with industry are fractured, disparate and no longer effective. Programs such as Fisheries Queensland's Long Term Monitoring Program can add value to the process of stakeholder engagement. Education across all stakeholder groups was a common theme highlighted in stakeholder discussions.



Some of the concerns, problems and proactive ideas about contemporary data collection are likely best addressed by the adoption of electronic logbooks (E-logs). Fisheries Queensland have recently developed an E-log option that is being trialled in the ECOTF and CRFFF. Uptake has been poor, and is likely reflective of a limited communication and roll-out strategy to clearly highlight the benefits to fishers and fishing businesses. In addition, the development of E-logs did not incorporate industry participation or involvement; a limitation that likely further eroded the interest of fishers. Similarly, the GBRMPA through the Reef Guardian Fishers Program, have been trialling VMS in the CRFFF. In this case the GBRMPA sought proactive fishers to lead by example and extend the benefits of such technology to the wider fisher community.

For the recreational fishery, the sampling strategy for data collection was roundly criticised by the majority of stakeholders, although recreational fishers were generally enthusiastic about participating in data collection processes. Almost all commentary around a recreational fishing licence was supportive of such. The licence was viewed as a clear and simple way to define a sampling frame for data collection methods. Many stakeholders were also concerned about the unknown quantity that is interstate tourism anglers (colloquially known as grey nomads) who are often implicated in fisheries offences such as disregard for bag limits. The effort and catch characteristics of the grey nomad fishers are unknown, though likely to be significant.

Fishery independent surveys (FISs) and data are useful in managing fisheries where uncertainty exists around logbook data quality. FISs can give confidence in fishery and/or stock status trends and can also value-add by predicting future catches. FISs are particularly useful in high value fisheries that are managed by output controls. Secondary benefits of FISs are fisher involvement (such as spanner crab fishery), building relationships and greater understanding of data importance by fishers.

Other alternative means of monitoring and gathering data such as on-board cameras and other remote techniques have previously been the subject of FRDC-sponsored research and have been assessed as non-viable in the case of small-scale fisheries involving outboard powered vessels for both logistic and economic reasons. However, advances in technology and reduced costs may still make cameras and other technologies viable in the future. In the meantime, an observer program addresses multiple objectives and allows access to many additional data streams.

The outputs of this research project together with the recommendations of the recent Fisheries Review presents an opportunity for an effective review, restructure and development of fisheries data in Queensland. The coincidental timing of these two events present fisheries managers and the broad stakeholder group with an information-rich environment from which productive development of a forward-looking strategic plan for fisheries data could be developed.

# Implications

To review, strategically plan and restructure the business of fisheries data would be an enormous undertaking. If committed to such a process, significant resourcing would be required.

The medium and longer-term implications include a more sustainable fishery in which the community has confidence. Robust information communicated well is what all fishery stakeholders and the broader community need. The implications of reviewing and restructuring the business of fisheries data could be significant.

Establishing a system of data validation is a costly process as it involves the establishment of another bureaucratic process. While it is easier to validate catch, effort validation is more difficult.

Resources will need to be reallocated to maximise education and engagement with industry stakeholders. This will be further complicated if the reinvigoration of representative peak bodies proves unsuccessful. Without functional and representative peak industry bodies, fishing sectors and individual fishers need to be empowered to be more involved and proactive in data collection and fisheries management.

There are significant budgetary implications as the adoption of some of the recommendations of this research is not cost neutral. Detailed costs and benefits of recommendations involving more complicated alternative data processes such as Fisheries Independent Surveys are also difficult to quantify and negotiate without functional representation.

Clearly, handing a logbook to fishers and expecting data to be recorded appropriately, is not achieving the desired outcomes. Without a clear education and continued extension effort, fishers will struggle to complete data and participate in co-management.

# Recommendations

Primary recommendation is for a strategic plan to improve data relevance and quality. Under this broad umbrella recommendation, a number of key areas for attention, improvement and/or development exist. Further, the recommendations arising from this project should be considered in tandem with the recommendations included in the Fisheries Review

1. Re-establish lines of communication and education between fisheries data collectors (fishers) and fisheries data users (managers/scientists). The absence of communication has eroded confidence in fisheries data for many stakeholders. This needs to be repaired. Too few fishers are aware of the importance of robust and accurate data, and the various uses of that data. Too few non-fisher stakeholders are aware of the interest and commitment of fishers for good data, yet those fishers are unsure of how to improve the situation. MACs, ZACs and/or other consultative mechanisms (extension officers, fisheries observers, Fishcare volunteers) should be re-established.
2. An independent data validation process is needed. The cessation of the fisheries observer program has left many stakeholders questioning the veracity of fisheries data. How data are validated should be negotiated and implemented in collaboration with industry. Industry needs to have ownership over the process. Several options are available (including buyer returns), none of which are cost neutral and all add another layer of responsibility, administration and bureaucracy requiring careful consideration.
3. The recording and reporting of SOCI needs to be revisited as a matter of urgency. Existing SOCI data is considered inaccurate by all stakeholder groups. Fisher-independent options and methods for monitoring SOCI should be explored. However, fishers accessing and harvesting from a community resource need to embrace the expectation from the community that their activities are transparent and accountable. Removing the onus of reporting from fishers might be the best solution in some instances. Better communication and education is also clearly needed with many fishers not clearly understanding what species are considered SOCI.
4. The adoption and uptake of E-logs should be fast-tracked. An electronic reporting option that is adaptable will address many of the concerns fishers and managers raised during the project. The need for timely data will also be addressed. E-logs that allow fishers to build their own sub-datasets, will likely be more attractive as fishers embrace greater ownership of fisheries data.
5. A recreational fishing licence is strongly recommended. Licencing structure must be a catch-all. That is, learning from experiences in other states and jurisdictions, licences should be mandatory for all users (no exemptions) to ensure accurate estimates of participation and effort are possible. Some fee-exempt licences may be required (for the very young and old). The extended advantages of a licence are to better inform debates about resource allocation and other management issues and contribute to the funding required to manage recreational access and use. Similarly, a monetary investment in improving data is likely required from commercial fishers.
6. Economic and social data are becoming more relevant in the values of contemporary society. While some robust methods for economic data collection and interpretation are available, there is no consistent and replicable collection of data to inform long-term trends. More uncertainty surrounds data to evaluate social values and trends in those data through time. Dedicated effort is required in this area to define social goals and aspirations that may guide what type of social data may be collected.

7. The strategic planning and mapping of data needs for a fishery must be an open and consultative process. Some fishers are enthusiastic about embracing greater ownership of the data they collect. We recommend that methods to develop “ownership” be explored as a matter of priority. Building fisher ownership of fisheries data should begin with including fishers in the strategic planning and implementation of a data strategy. The benefit will be greater levels of engagement and improved accuracy of data.
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## FURTHER DEVELOPMENT

At the broadest level, further development needs to focus on embracing technology to improve data quality, accuracy, timeliness and appropriateness for contemporary needs. To guide further development, a strategic plan should be developed in the first instance. Development of a strategic plan should involve the re-engagement of all stakeholders and provide for those groups to actively participate in the process, building important ownership values in fishers who collect data.

This project and “The Review” clearly highlighted the fact that many stakeholders have identified that better information is required to manage Queensland’s fisheries. Communication and trust between management and fishers needs to be rebuilt, before a strategic plan to review and improve fisheries data can be implemented. A functional and representative stakeholder network does not currently exist. Similarly, there is no clear structure within DAF to allow stakeholder engagement. This is a key area for further development, but we acknowledge this will be challenging given recent initiatives in this area.

Within the restricted scope of this project, we highlight a number of more specific areas needing immediate and, in some cases, urgent attention. Further development is required to develop a validation method for catch and effort data relevant to the crab fishery. Data for this fishery is universally regarded as inaccurate. Further development is required to streamline the cumbersome processes of data recording, quota monitoring and catch disposal records required for the quota managed line fisheries. The data and monitoring processes for these fisheries could be blueprints for data collection in other fisheries in Queensland: however, they need to be reviewed and made first-class systems themselves. Finally, processes for better recording fishery interactions and more appropriate processes for data recording and monitoring of the recreational sector need urgent further attention and development. In both instances, many technological advances and unique and innovative approaches could be instituted.

# Extension and Adoption

Members of the project team provided regular updates to Fisheries Queensland and have provided sections of milestone reports and other material to assist in current deliberations regarding logbooks, E-logs and other developments stemming from the recent MRAG (2014) review and ongoing regulatory reform. Some members of the project team have allocated additional time to work with Fisheries Queensland and other stakeholders over coming months to assist with the implementation of recommendations and refinements highlighted by the current research.

Members of the research team are currently developing material to be extended to industry and stakeholders via a range of media. However, due to the fact that this research will complement the process of ongoing regulatory reform already underway, extension strategies will continue to ensure a co-ordinated approach with Fisheries Queensland following the outcomes of the current reform process.

A final de-briefing meeting with Fisheries Queensland core staff was held in the closing stages of this project to ensure complete access to and awareness of the outcomes and findings of this project. This initiative ensured that the white paper being developed by Fisheries Queensland can refer to, or be informed by the projects outcomes.

## PROJECT COVERAGE

Not applicable to this project.

## Project materials developed

Not applicable to this project.

# Appendices

## PROJECT STAFF

Project staff included:

Andrew Tobin	Centre for Sustainable Tropical Fisheries & Aquaculture, James Cook University
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## INTELLECTUAL PROPERTY

There are no intellectual property issues with this report.

## REFERENCES

- Brown, I.W. (1993). Mangrove Crabs, pp 609-42 in A. Wright and L. Hill (Eds.) *Nearshore Marine Resources of the South Pacific*. Institute of Pacific Studies (Suva), Forum Fisheries Agency (Honiara) and the International Centre for Ocean Development (Canada), 710p.
- Brown, I. W. (2009). Taking female mud crabs (*Scylla serrata*): assessment of risks and benefits (D. o. E. State of Queensland, Economic Development and Innovation, 2010., Trans.): Fisheries Research and Development Corporation.
- Campbell, A.B., O'Neill, M., Stauton-Smith, J., Atfield, J. and Kirkwood, J. (2012). Stock assessment of the Australian East Coast Spanish Mackerel fishery. The Department of Agriculture, Fisheries and Forestry, Brisbane, Australia.
- Department of Primary Industries and Fisheries (2007a). Fisheries Long Term Monitoring Program Sampling Protocol—Blue Swimmer Crab: (2007 onwards) Section 1. Department of Primary Industries and Fisheries, Brisbane, Australia.
- DPI&F (2007b). Fisheries Long Term Monitoring Program Sampling Protocol – Eastern King Prawn: (2006 Pilot study). Department of Primary Industries and Fisheries, Brisbane, Australia.
- DPI&F (2007c). Fisheries Long Term Monitoring Program Sampling Protocol – Snapper Pre-Recruit: (2006 Pilot Survey) Section 1. Department of Primary Industries and Fisheries, Brisbane, Australia.
- DPI&F (2007d). Fisheries Long Term Monitoring Program Sampling Protocol – Eastern King Prawn: (2007 onwards) Section 2. Department of Primary Industries and Fisheries, Queensland, Brisbane, Australia.
- DPI&F (2008). Fisheries Long Term Monitoring Program Sampling Protocol—Blue Swimmer Crab: (2007 onwards) Section 2. Department of Primary Industries and Fisheries, Brisbane, Australia.
- Fernback, M. (2008). A review of recreational activities undertaken in the Great Barrier Reef Marine Park. Great Barrier Reef Marine Park, Research Publication No. 93
- Greiner, R., Franklin, D. and Gregg, D. (2013). Towards an improved understanding of angler tourism in northern Australia: The “grunter hunters” of Karumba (Queensland).
- Hay, T., Gribble, N., de Vries, C., Danaher, K., Dunning, M., Hearnden, M., Caley, P., Wright, C., Brown, I., Bailey, S. and Phelan, M. (2005.) *Methods for monitoring the abundance and habitat of the Northern Australian mud crab Scylla serrata*. NT Dept. of Business, Industry and Resource Development; Qld. Dept. of Primary Industries and Fisheries; Fisheries Research and Development Corporation,
- Higgs, J. (1999). *RFISH Technical Report No. 2: Results from the 1997 Diary Round*. Brisbane: Queensland Department of Primary Industries. Higgs JB, McInnes (2003). Biennial recreational fishing survey of Queensland residents. Department of Primary Industries, Queensland.
- Higgs, J. and McInnes, K. (2003). 2001 Biennial recreational fishing survey of Queensland residents. Department of Primary Industries, Queensland.
- Higgs, J., Olyot, L. and McInnes, K. (2002.) Experimental results from the third statewide Recreational Fishing Information System diary program (2002). Department of Primary Industries and Fisheries, Queensland, Brisbane, Australia.
- M. Koopman, A. K. Morison and V. Troynikov (2004). Population dynamics and assessment of sand and rock flathead in Victorian waters. Published by Primary Industries Research Victoria, Marine and Freshwater Systems, Department of Primary Industries, Queenscliff, Victoria, 3225.



- Leigh, G.M., Campbell, A.B., Lunow, C.P. and O'Neill, M.F. (2014). Stock assessment of the Queensland east coast common Coral Trout (*Plectropomus leopardus*) fishery. The Department of Agriculture, Fisheries and Forestry, Brisbane, Australia.
- McInnes, K. (2008). *Experimental results from the fourth Queensland recreational fishing diary program (2005)*. Brisbane: Department of Primary Industries and Fisheries.
- Phillips, J., South Eastern Professional Fishermen's Association Inc, 2015, Southern Rock Lobster IPA: Assessing functionality and suitability of the iPhone [iPad] application 'Deckhand' for on-board electronic data capture in Southern Australian Rock Lobster (*Jasus edwardsii*) fisheries, Adelaide, May.
- Piasente, M., Stanley, B., Timmiss, T., McElderry, H., Pria, M and Dyas, M. (2012). Electronic onboard monitoring pilot project for the Eastern Tuna and Billfish Fishery. FRDC Project 2009/048. Australian Fisheries Management Authority 105 pp.
- Potter, M.A. and Sumpton, W.D., (1986). A study of the sand crab (*Portunus pelagicus*) and its exploitation in a subtropical multisector fishery. FIRTA Project 84/23 Final Report. Department of Primary Industries, Brisbane, Queensland, p. 46.
- Sawynok, B., Platten, J. and Parsons, W. (2009). CapReef: Recreational fishing and fish resources in Central Queensland 2005-09.
- Sumpton, W., Gaddes, S., McLennan, M., Campbell, M., Tonks, M., Good, N., Hagedoorn, W. and Skilleter, G., (2003). Fisheries biology and assessment of the Blue Swimmer Crab (*Portunus pelagicus*) in Queensland. Final report to FRDC on Project No. 98/117. Department of Primary Industries and Fisheries, Brisbane, Australia, p. 156.
- Taylor, S., Webley, J. and McInnes, K. (2012). *2010 Statewide Recreational Fishing Survey*. Brisbane: Department of Agriculture, Fisheries and Forestry.
- Thebaud, O., Innes, J., Norman-Lopez, A., Slade, S., Cameron, D., Cannard, T., Tickell, S., Kung, J., Kerrigan, B., Williams, L. and Little, L. R. (2014). Micro-economic drivers of profitability in an ITQ-managed fishery: An analysis of the Queensland Coral Reef Fin-Fish Fishery.
- Tobin, A., Schlaff, A., Tobin, R. C., Penny, A., Ayling, A. M., Ayling, A. L., Krause, B., Welch, D. J., Sutton, S. G., Sawynok, B., Marshall, N., Marshall, P. and Maynard, J. (2010). *Adapting to Change: Minimising Uncertainty About the Effects of Rapidly changing Environmental Conditions on the Queensland Coral Reef Fin Fish Fishery*. Townsville: James Cook University, Fishing & Fisheries Research Centre.
- Tobin RC, Sutton SG, Penny AL (2010). *Towards Evaluating the Socio-economic Impacts of Changes to Queensland's Inshore Fishery Management*. Fishing and Fisheries Research Centre Technical Report No. 9, James Cook University, Townsville.
- Tobin, A., Currey, L. and Simpfendorfer, C. (2013). Informing the vulnerability of species to spawning aggregation fishing using commercial catch data. Fisheries Research 143, 47-56.
- Tobin, A., Heupel, M., Simpfendorfer, C., Buckley, S., Thurstan, R. and Pandolfi, J. (2014). *Utilising innovative technology to better understand Spanish Mackerel spawning aggregations and the protection offered by Marine Protected Areas*. Centre for Sustainable Tropical Fisheries and Aquaculture, James Cook University, Townsville, pp 70.
- Webley, J., Taylor, S., Mayer, D., Dew, K. and Olyott, L. (2009). Survey of marine boat-based recreational fishing in south-eastern Queensland (2007-08). Department of Agriculture, Fisheries and Forestry.
- Welch, D., Mapstone, B. and Begg, G. (2008). Spatial and temporal variation and effects of changes in management in discard rates from the commercial reef line fishery of the Great Barrier Reef Australia. Fisheries Research 90, 247-260.

Zhou, S., Pascoe, S., Dowling, N., Haddon, M., Klaer, N., Larcombe, J., Smith, A.D.M., Thebaud, O., Vieira, S., and Wayte, S. 2013. Quantitatively defining biological and economic reference points in data poor fisheries. Final Report on FRDC Project 2010/044. Canberra, Australia.

Zischke, M.T., Giffiths, .S.P. and Tibbetts, I.R. (2012). Catch and effort from a specialized recreational pelagic sport fishery off eastern Australia. *Fisheries Research* **127**, 61-72.

# QUESTIONNAIRES USED TO GATHER DATA FROM FISHERIES STAKEHOLDERS

## Preliminary Questionnaire

Dear fisheries stakeholder,

You are receiving this email as a recognised and important stakeholder in either the Queensland east coast line fisheries (Coral reef fin fish and Spanish Mackerel) or crab pot fisheries (mud, sand and spanner crab). We would appreciate 10 minutes of your time to read and reply to this email.

Not surprisingly, a common theme coming from the Ministers' Fisheries Review public consultation process is the need for better quality and more relevant fisheries data. The Australian Government, through the Fisheries Research and Development Corporation, has recently funded a research project that is exploring the strengths and weaknesses of fisheries data. The following paragraphs are taken from the research proposal and summarise the current situation, and need for this research.

*Historically fisheries data moved in a single direction, with fishers collecting data that are used by researchers and managers to manage fishers' activities within sustainable long-term goals. Historically this was a sound system that informed the management of fisheries and enabled the development of suitable management objectives and tools (input and output controls).*

*However, today the same fisheries data is being utilised for multiple purposes other than core fisheries management and includes conservation objectives (EPBC Act), marine parks planning, third party accreditations, impact assessments and resource allocation. Not surprisingly, the quality and relevance of data collected is increasingly being questioned by all stakeholders. Given this notable shift in the interest and demands on fisheries data, it is timely that new and novel data and data collection methods are investigated, and existing systems are reviewed and improved to better meet current needs. Further, increasing distrust of fisheries data by stakeholders is a significant hurdle in monitoring, assessing and managing fisheries. Concerns about the accuracy of commercial logbook data and catch estimates derived from recreational diary and phone surveys persist. Options for empowering all fishery stakeholders in the design of collection methods, data ownership and utility of data beyond core business requirements need to be explored to improve data quality and stewardship, and confidence in assessments/analyses that utilise these data.*

The primary goal of this research is to explore new data types and new data collection methods that may be relevant to current day fisheries activities. Importantly this project has a deliberately broad focus when asking these questions. Traditionally, fisheries data was the domain of fisheries managers, researchers and stock assessment scientists with little encouraged interest or ownership by other stakeholders. This focus meant collecting data on catch and effort, while important economic or social data may have been overlooked.

This project is particularly interested in the views of all fisheries stakeholders about fisheries data and the types of data and methods of data collection used. We want to ensure that stakeholders other than the traditional users (management agencies and scientists) have data that are relevant to their needs.

Simply, we want to ask you what data you want to represent your fishery interest? Fishers themselves may rely on different data for their business purposes and it seems counter-productive to have different information systems operating in tandem. We believe that the people who collect and record the data (predominantly fishers themselves) should also not be over-burdened by excessive reporting conditions and it is important to bear this in mind when designing new systems.

The first activity for the research project is a review of stakeholders' views on the current data collection fields and methods. Are you happy with the current state of fisheries data and how it is

collected? Are there any data you are unhappy with, would like to improve, or do you think there is a need to collect different types of data? As this is a first point of contact for the project our initial objective is to gather a broad overview of stakeholder opinions. As a first step in reviewing fisheries data processes we would like you to answer the two questions below. We will be contacting you in the future to gather more detailed responses to specific data related issues.

- 1. What is the most obvious or valuable strength of fisheries data as it is currently collected?**
- 2. What is the most obvious or limiting weakness of fisheries data as it is currently collected?**

In answering these questions, please think as broadly as possible. As an example, as a research scientist with experience in the line fisheries answers like the following may be given –

- 1. What is the most obvious or valuable strength of fisheries data as it is currently collected?**  
*The time-series of the commercial logbook data is the most obvious strength, as longer time-series means greater certain in trends.*
- 2. What is the most obvious or limiting weakness of fisheries data as it is currently collected?**  
*Catch and effort fields could be completed at a smaller time scale. In particular days of zero catch are very important though are often not reported. Catch averaging across all days of a trip disguises useful and powerful effort data.*

Finally we emphasise that while completing this exercise keep in mind that the focus of this exercise is on “data” as raw rather than the analytical products derived from those data. Also your answers to the questions could be focused on your sector or more broadly across the fishery.

If you are unsure of the intent of this project and/or email, or have any other questions, please contact either Andrew Tobin or Wayne Sumpton (contacts listed below).

We appreciate the time taken to assist

Sincere regards

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## Line Fishery Questionnaire

### Preamble

G'day. I'm \_\_\_\_\_ from FFRC (JCU) wondering if you have 5-10 minutes to answer a few questions about fisheries data.

Sweet! This survey is part of a research project jointly funded by DAF and the Australian Government via the FRDC. The project is exploring improvements to fisheries data – whether and where improvement(s) may be needed, how improvements could be made etc.

Rather than consider all different fisheries, we are interested in mackerel and reef fishing. Do you participate in either of these?

Sweet! Ok, let's get started then.

At the end - Thanks for your time!

Ask for contact details if they want further info/feedback.

### The Data – Who, What, How, Accuracy

#### **LINE FISHERY: Recreational fishers**

Q1. Do you think that the collection of recreational catch and effort data is necessary?

Why?

Q2. What is your understanding of the methods used to collect recreational catch data in Queensland? (List Keywords)

Q3. What is your view on the quality of this data (1 – poor, 10 – excellent)?

1      2      3      4      5      6      7      8      9      10  
Elaborate

Q4. Have you ever been asked to provide data or provided data voluntarily (e.g. keen angler, participated in phone survey/diary surveys, LTMP boat ramp surveys)? YES / NO ?

Specify

Q5. What is the main purpose(s) of the data collected from recreational fishers? Name and rank up to three (1 being the most important)

Monitoring fishery	WTO – export approval	Close us down
Stock assessment	Resource allocation	Reduce access
Sustainability	Managing the fishery	Knowing where you fish
Other (specify)	Other (specify)	Other (specify)

Q6. Are you aware of the data collected by commercial fishers accessing the reef fish or Spanish Mackerel fishery? YES / NO ?

Q7. Do you think the data collected from the commercial sector is accurate (1- not at all accurate, 10 – very accurate?)

1            2            3            4            5            6            7            8            9            10  
Elaborate -

Q8. How could the collection of commercial data be improved?  
Give a copy of commercial logbook page if they are interested.

### **The Data – Improvements**

#### **LINE FISHERY: Recreational fishers**

Q9. If you were asked would you be willing to participate in recreational fishing surveys?

Q10. Do you report your fishing activity on any web forums or social media channels?  
How often?

Q11. Would you be more likely to participate in data collection if it were more convenient e.g. using a phone app or via text message?

Q12. What incentive/s would you need to collect and make your data available?

None- it is the right thing to do.

A free phone app (tidal info for example with a catch recording app)

Lotteries – the chance to win something.

Other - Specify

Q13. Have you ever fished in a state or territory that has a recreational licence?

Q14. Would you support a recreational fishing licence in Queensland?

## **Demographic Data**

Survey location: boat ramp      tackle shop                      fishing club  
elsewhere    club member  
Age 5-14   15-29   30-44   44-59   60 +  
Target Species: Mackerel   Reef fish   Both  
Days fishing last year (in any fishery - overall avidity):  
Vessel size:  
# fishers:  
Rejection rate – a tally of rejections

### Fisheries Summary Reports

<https://www.daf.qld.gov.au/fisheries/monitoring-our-fisheries/data-reports/sustainability-reporting/queensland-fisheries-summary>

### Fishnet

<https://www.daf.qld.gov.au/fisheries/services/fishnet>

Through Fishnet Secure you can access your own catch history, to get access to Fishnet Secure you can contact licensing.

### Qfish

<http://qfish.daff.qld.gov.au/>

### Stock Status

<https://www.daf.qld.gov.au/fisheries/monitoring-our-fisheries/data-reports/sustainability-reporting/stock-status-assessments>

### Recreational Data

<https://www.daf.qld.gov.au/fisheries/monitoring-our-fisheries/data-reports/recreational-data-requests>



# Queensland East Coast Line Fin Fish Fisheries Logbook

Boat Name Floating Beauty		Boat Mark WYZ		Commercial Fisher's Name Sam Ganksee		Commercial Fisher's Licence No. 12345		Logbook No.		Page No.						
Boat Activity Codes 0... Fishing 1... Searching 2... Stomping 3... Not fishing		Logbooks are to be completed each day. Departure location and time must be completed prior to the commencement of each RQ fishing trip.				If not fishing for an extended period please specify: ..... TO ..... TO .....										
Departed from Gladstone						On ..... at ..... am/pm						Quota Reporter PRIOR, TRANSHIPMENT or AMENDMENT Notices 5				
Effort Details																
Date (dd/mm/yy)		1.../2.../07..		2.../2.../07..		3.../2.../07..		4.../2.../07..		5.../2.../07..		6.../2.../07..				
Boat Activity Code		0		0		0		3		0		1				
Location	Latitude (or Grid)		H14		H14		H14		H18							
	Longitude (or Site)		18		19		17		2							
No. of Tenders		2		2		2		2		2						
Number of Crew		3		3		3		3		3						
No. of Lines		6		6		6		6		6						
1=Handline/Rod 2=Trolling		1		1		1		1		1						
Species Targeted		Coral Trout		Coral Trout		Coral Trout		Coral Trout		Coral Trout						
														Trip Totals (No. and est. wt. of fish)		
Catch Details																
Species		Form		No.		kg		No.		kg		No.		kg		
RQ - CT	Coral Trout	L		48		50		32		35		38		41		
		D		1		3						2		2		
		F														
RQ - RTE	Red Throat Emperor	D		2		6								2		
		F		3		2						5		3		
RQ - Other Species	Cods/Groper	D		9		34						1		4		
		F														
RQ - Other Species	Flowers/Camouflage Rockcod	L														
		D						8		23				8		
RQ - Other Species	Spangled Emperor	D														
		D		5		30		3		18				8		
RQ - Other Species	Other Sweetfish/Emperor Macabre	D		5		4								5		
		D														
RQ - Other Species	Large Mouth Nannygai	D														
		D														
RQ - Other Species	Small Mouth Nannygai	D														
		D		2		6						5		11		
RQ - Other Species	Green Jobfish	D												7		
		D										5		9		
RQ - Other Species	Other Jobfish	D														
		D														
RQ - Other Species	Stripy Snapper	D														
		D														
RQ - Other Species	Hussar	D														
		D														
RQ - Other Species	Other Snappers	D/F														
		D														
RQ - Other Species	Tuskfish	D														
		D														
RQ - Other Species	Other RQ	D/F		10		42								10		
		D														
RQ - Other Species	Other RQ	D/F														
		D														
SM - Spanish	Spanish Mackerel	D														
		F														
		Form						Trip Total Boxes of Fillet		CT		0		RTE		
Non-RQ Species	Pink Snapper															
	Pearl Perch		D		2		4									
	Teraglin															
	Amberjack		G						3		21					
	Yellowtail Kingfish															
	Cobia															
	Mahi Mahi															
	Spotted Mackerel															
	Other Mackerel		D								5		9			
	Grass Sweedip															

Example



**CRAB FISHERY (Managers, Assessment Scientists, Researchers, NGO's)**

Q1. Are you a:

Manager          Assessment scientist          Research scientist          NGO employee

Other \_\_\_\_\_

Q2. What is the main purpose(s) of the data you collect? Name and rank up to three ( 1 being the most important).....

Monitoring fishery	WTO – export approval	Close us down
Stock assessment	Resource allocation	Reduce access
Sustainability	Managing the fishery	Knowing where you fish
Other (specify)	Other (specify)	Other (specify)

Q3. How well do you think SOCI data is reported by fishers in this fishery?

1 Very poorly    10 Very well

1          2          3          4          5          6          7          8          9          10

Q4. How could SOCI reporting be improved in this fishery?

Q5. What additional data would you like collected? Rank three in order

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

Q6. How accurate do you think the data collected from the recreational sector is for this fishery? (1- not at all accurate, 10 – very accurate?)

1          2          3          4          5          6          7          8          9          10

Elaborate –

Q7. Any suggestions for improving the collection of recreational data?

Q8. On a scale of 1-10 .... How accurate do you think the data collected from the commercial sector is for this fishery? (1- not at all accurate, 10 – very accurate?)

1          2          3          4          5          6          7          8          9          10

Elaborate -

Q9. Any suggestions for improving commercial data?

## Crab Fishery Questionnaire

### Preliminary Data

Survey location: boat ramp    tackle shop    fishing club    Home Phone

Age <20    21 to 30    31 to 40    41 to 50    51 to 60    61 to 70    >70

Target Species: Mud    BSC    Both

Days fishing last year:

Vessel size:

# fishers:

Rejection rate – a tally of rejections

### The Data – Who, What, How, Accuracy

#### **CRAB FISHERY: Commercial fishers**

Q1. What is the main purpose(s) of the data you collect? Name and rank up to three (1 being the most important)

Monitoring fishery	WTO – export approval	Close us down
Stock assessment	Resource allocation	Reduce access
Sustainability	Managing the fishery	Knowing where you fish
Other (specify)	Other (specify)	Other (specify)

Q2. Is it clear to you as a fisher why you are asked to collect the data (fields) you collect? (1 – unclear, 10 – clear)

1      2      3      4      5      6      7      8      9      10

Elaborate -

Q3. Do you consider the current data collection hard (1) or easy (10)?

1      2      3      4      5      6      7      8      9      10

Elaborate -

Q4. Do you get the support you need to complete logbooks correctly (1 – no support or 10 – great support)?

1      2      3      4      5      6      7      8      9      10

Elaborate -

Q5. Are there any current logbook fields you would like removed altogether? Name and rank up to three ( 1 being the most important)

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

Q6. Are there any fields you think should be added that may benefit you or your fishery? Name and rank up to three ( 1 being the most important)

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

Q7. Are you aware of what data held by government agencies is available to you as a commercial fisher?

Yes / No. Elaborate

(Inform fishers about what is available)

Fisheries Summary Reports

<https://www.daf.qld.gov.au/fisheries/monitoring-our-fisheries/data-reports/sustainability-reporting/queensland-fisheries-summary>

Fishnet

<https://www.daf.qld.gov.au/fisheries/services/fishnet>

Through Fishnet Secure you can access your own catch history, to get access to Fishnet Secure you can contact licensing.

Qfish

<http://qfish.daff.qld.gov.au/>

Stock Status

<https://www.daf.qld.gov.au/fisheries/monitoring-our-fisheries/data-reports/sustainability-reporting/stock-status-assessments>

Recreational Data

<https://www.daf.qld.gov.au/fisheries/monitoring-our-fisheries/data-reports/recreational-data-requests>

Q8. Would you like more -

INPUT (consultation) into data collection processes?

Yes / No. Elaborate -

OUTPUT (data access, reports summaries) from data collection?

INPUT Yes / No. Elaborate -

Q9. Should your data be transparent (available) for all stakeholders to see? Please choose from these options -

- Yes – individually identifiable
- Yes – but with individual identity protected
- Yes – but only when data is summarised across a group of “like” fishers (Status quo – same as now eg. 5 boat rule)
- Yes – but only when data is summarised across the whole of the sector.
- No - never.

Q10. Catch-per-unit-effort is an important metric used in assessing and monitoring crab fisheries. CPUE is best measured at the kilograms caught / pot lift.

a) Do you think the crab fishery CPUE data is accurate (1 – very inaccurate, 10 – very accurate)?

1      2      3      4      5      6      7      8      9      10

b) If not accurate, do you think the CPUE is too high or too low? Elaborate

**For commercial fishers, reflecting on other sectors**

Q11. What fisheries data is collected from recreational fishers? (Write their response as key words)

None	DAF Rec fisher surveys (RFISH/SWRFS)
LTMP Data	Boat ramp surveys
Other _____	

Q12. ON a scale of 1-10 (where 1 = very inaccurate, and 10 = very accurate), how accurate do you think the data collected from the recreational sector is?

1      2      3      4      5      6      7      8      9      10

Elaborate -

Q13. Any suggestions for improving the collection of recreational data?

**The Data – Improvements**

**CRAB FISHERY: Commercial fishers**

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Q1. a) Would you be interested in electronic logbook data reporting

Yes / No

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b) Can you think of any benefit(s) that would provide to your fishery business?

Elaborate -

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Q2. Would you be willing to collect additional information on bycatch or u/s catch rates?

Yes / No    Elaborate -

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Q3. How well do you think Species of Conservation Interest (SOCI) is reported by fishers in this fishery? (1 Very poorly 10 Very well)

1      2      3      4      5      6      7      8      9      10

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Q4. How could SOCI reporting be improved?

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Q5. Do you collect any additional data for your own personal use or business? Yes / No. Specify

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Q6. Would this data benefit the whole fishery if others collected the same data? Yes / No

Should more fishers collect it? Yes / No

Q7. Would you be prepared to be involved in collecting new types of data (photos of catch, set a couple of pots in specific locations).

Yes / No

What incentives could motivate you to do this?

Q8. What incentives do you think could improve the accuracy of the data being collected?

**CRAB FISHERY: Recreational fishers**

Q1. Do you feel that the collection of recreational catch and effort data is necessary?  
Why?

Q2. What is your understanding of the methods used to collect recreational catch data in Queensland?  
(List Keywords)

Q3. What is your view on the quality of this data (1 – poor, 10 – excellent)?

1            2            3            4            5            6            7            8            9            10

Elaborate

Q4. Have you ever been asked to provide data or provided data voluntarily (e.g. keen angler, participated in phone survey/diary surveys, LTMP boat ramp surveys)? Specify

Q5. What is the main purpose(s) of the data you collect? Name and rank up to three ( 1 being the most important)

Monitoring fishery	WTO – export approval	Close us down
Stock assessment	Resource allocation	Reduce access
Sustainability	Managing the fishery	Knowing where you fish
Other (specify)	Other (specify)	Other (specify)

Q6. Are you aware of the data collected by commercial fishers accessing the crab fishery (show commercial logbook page)? YES / NO ?

Q7. Do you think the data collected from the commercial sector is accurate (1- not at all accurate, 10 – very accurate)?

1            2            3            4            5            6            7            8            9            10

Elaborate -

Q8. How could the collection of commercial data be improved?

**The Data – Improvements**

**CRAB FISHERY: Recreational fishers**

Q1. If you were asked would you be willing to participate in recreational fishing surveys?

Q2. Do you report your fishing activity on any web forums or social media channels?

How often?

Q3. Would you be more likely to participate in data collection if it were more convenient e.g. using a phone app or via text message?

Q4. What incentive/s would you need to collect and make your data available?

None- it is the right thing to do.

A free phone app (tidal info for example with a catch recording app)

Lotteries.

Other - Specify

Q5. Have you ever fished in a state or territory that has a recreational licence?

Q6. Would you support a recreational fishing licence in Queensland?

**CRAB FISHERY (Managers, Assessment Scientists, Researchers, NGO's)**

Q1. Are you a:

Manager      Assessment scientist      Research scientist      NGO employee

Other \_\_\_\_\_

Q2. What is the main purpose(s) of the data you collect? Name and rank up to three ( 1 being the most important).....

Monitoring fishery	WTO – export approval	Close us down
Stock assessment	Resource allocation	Reduce access
Sustainability	Managing the fishery	Knowing where you fish
Other (specify)	Other (specify)	Other (specify)

Q3. How well do you think SOCI data is reported by fishers in this fishery?

1 Very poorly    10 Very well

1          2          3          4          5          6          7          8          9          10

Q4. How could SOCI reporting be improved in this fishery?

Q5. What additional data would you like collected? Rank three in order

4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_

Q6. How accurate do you think the data collected from the recreational sector is for this fishery? (1- not at all accurate, 10 – very accurate?)

1          2          3          4          5          6          7          8          9          10

Elaborate –

Q7. Any suggestions for improving the collection of recreational data?



Q8. On a scale of 1-10 .... How accurate do you think the data collected from the commercial sector is for this fishery? (1- not at all accurate, 10 – very accurate?)

1          2          3          4          5          6          7          8          9          10

Elaborate -

Q9. Any suggestions for improving commercial data?

# FRDC FINAL REPORT CHECKLIST

<b>Project Title:</b>			
<b>Principal Investigators:</b>	XXXX (include all recognised authors - )		
<b>Project Number:</b>	XXXX/XXX		
<b>Description:</b>	Brief one/two paragraph overview of what the project did and achieved.		
<b>Published Date:</b>	XX/XX/XXXX (if applicable)	<b>Year:</b>	XXXX
<b>ISBN:</b>	XXXXX (if applicable)	<b>ISSN:</b>	XXXXXXXXXXXXXX (if applicable)
<b>Key Words:</b>	Needs to include key subject areas and species name (see <a href="http://www.fishnames.com.au">www.fishnames.com.au</a> )		

Please use this checklist to self-assess your report before submitting to FRDC. Checklist should accompany the report.

	<b>Is it included (Y/N)</b>	<b>Comments</b>
<b>Foreword (optional)</b>		
<b>Acknowledgments</b>		
<b>Abbreviations</b>		
<b>Executive Summary</b>		
- <b>What the report is about</b>		
- <b>Background – why project was undertaken</b>		
- <b>Aims/objectives – what you wanted to achieve at the beginning</b>		
- <b>Methodology – outline how you did the project</b>		
- <b>Results/key findings – this should outline what you found or key results</b>		
- <b>Implications for relevant stakeholders</b>		
- <b>Recommendations</b>		
<b>Introduction</b>		
<b>Objectives</b>		
<b>Methodology</b>		
<b>Results</b>		
<b>Discussion</b>		
<b>Conclusion</b>		
<b>Implications</b>		
<b>Recommendations</b>		
<b>Further development</b>		
<b>Extension and Adoption</b>		
<b>Project coverage</b>		
<b>Glossary</b>		
<b>Project materials developed</b>		
<b>Appendices</b>		