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Fisheries Research and Development Corporation

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Senate Inquiry—
The Fisheries Quota System

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Executive summary

The Fisheries Research and Development Corporation (FRDC) has prepared this submission for consideration by the Senate Standing Committees on Rural and Regional Affairs and Transport, specifically addressing:

> "The fisheries quota system and examining whether the current 'managed microeconomic system' established around a set of individual transferable quotas results in good fishing practice".

A total of six terms of reference were addressed on economic, ecologically sustainable and social considerations of the effects of Individual Transferable Quotas (ITQs). As a research and development funding organisation, the FRDC has focused its responses on the evidence-based science that inform ITQs. Evidence-based science provides a fundamental foundation for Australia's fisheries management regime. It should be noted that the 'current system' is operating at a point in time. Given the dynamic nature of the environment in which fisheries operate, especially with added stressors such as climate change, a multi-pronged and adaptive approach is often required such as with the use of harvest strategies and Management Strategy Evaluation (MSE). The knowledge generated by research can illuminate the pitfalls and opportunities in this dynamic environment, as well as market, societal and ecological changes. While it may be perceived as a suitable management system now, these changes require constant monitoring and adaptive behaviours.

ITQs are only one of many instruments used to manage commercial fisheries, but they are not a standalone instrument with respect to fisheries management. Subject to consultation on the Inquiry's terms of reference, we have framed this submission around commercial fishing and not included recreational or Indigenous cultural fishing; however, quota can be applied to other non-commercial fishing activities, e.g. recreational fishing for Southern Bluefin Tuna.

The subject of ITQs is complex; and the terms of reference for this Inquiry require considerable thought with respect to how they are interpreted. As such, a key purpose of this submission is to highlight the definitional complexities arising from the terms of reference to ensure that those contributing to the discussion have a clear and common understanding of these concepts, for example, what is meant by the 'fisheries quota system' and 'ITQs'; and what might 'good community outcomes' actually mean.

This submission provides a summary of FRDC-funded research on ITQs—both completed and new.

Finally, the submission highlights key literature of evidence-based science investigating ITQs. This includes FRDC research projects, as well as national and international publications, with links to these publications.

A list of Australian fisheries, where ITQs have been introduced, is also provided.

1. Introduction

On 7 December 2020, the Senate moved that the following matter be referred to the Rural and Regional Affairs and Transport References Committee for inquiry and report by 24 June 2021.

Terms of reference

The fisheries quota system

The fisheries quota system and examining whether the current 'managed microeconomic system' established around a set of individual transferable quotas results in good fishing practice, with particular reference to:

a. good fishing practice that is ecologically sustainable with an economic dynamic that produces good community outcomes,

b. how the current quota system affects community fishers,

c. whether the current system disempowers small fishers and benefits large interest groups,

d. the enforceability of ecological value on the current system, and the current system's relationship to the health of the fisheries,

e. whether the current system results in good fishing practice that is ecologically sustainable and economically dynamic, and produces good community outcomes,

f. any other related matters.

Management of Australian fish stocks must be consistent with the objectives of the principles of ecologically sustainable development (CoA, 1992), the Food and Agriculture Organization of the United Nations Ecosystem Approach to Fisheries (FAO, 2003), and the Guidelines for the Ecologically Sustainable Management of Fisheries (DEWA, 2007), fisheries management as governed by Australia's Commonwealth *Fisheries Management Act* (1991) and State and Territory Acts. In this regard, management must strive to sustainably manage the impacts of each fishery, and the cumulative effect of all fisheries, on targeted fish stocks and the aquatic ecosystems within which they occur, while optimising the economic and social benefits that fishing generates for the community.

To deliver ecological, social and economic outcomes for commercial fishing and the Australian community, a range of fishery management tools are applied to manage, reduce or minimise the impacts of this activity. The tools are based on any combination of biological, temporal, seasonal, spatial, gear, vessel, method, catch and effort criteria. The best combination of tools for each fishery will differ because the key contributors to risk, and the relative effectiveness and efficiency of these tools, vary depending on specific objectives of the fishery, species targeted, fishing methods used and areas of operation. Quota is only one tool in the range available.

In the context of the Inquiry, the use of catch (quota) based systems is therefore only one potential method to manage the harvest levels of target species. Furthermore, as 'best fishery management' requires dealing with all ecological, social and economic risks, quota-based systems must work effectively in combination with many other management tools.

The fisheries quota system—useful definitions*

ITQ: Individual transferable (catch) quota

A type of quota (a proportion of the total allowable catch (TAC)) allocated to a person (individual fishers, vessel owners etc.) or other legal entities and which can be sold (transfer of ownership) or leased to others. This is an output control, used to limit the impacts of a fishery by directly limiting the catch of a person/entity in combination with the TAC.

ITE: Individual transferable effort quota

ITE is a proportion of the total allowable effort (TAE) that is allocated to a person or entity and which can be sold (transfer of ownership) or leased to others. ITEs can be used in concert with ITQs in some situations in fisheries with TACs. Effort shares can be traded permanently or temporarily. This is a control that may be used to indirectly limit the impacts of a fishery when catch quotas are not used. (Note: ITE is an extension from catch based controls—the effort rather than the catch is tradable.)

TAC: Total allowable catch

The total catch allowed to be taken from a resource in a specified period (usually a year) to meet the management objectives of the fishery as defined in a fishery management plan or regulation. The TAC may be allocated to the eligible person(s) in the form of quotas, as specific quantities or proportions. (Note: TAC is a control used to limit the ecological impacts of a fishery by directly limiting the total catch.)

TAE: Total allowable effort

This refers to an upper limit on the amount of effort (such as number of vessels, days fished, length of net, number of hooks or fishing operations) that can be applied in the fishery in a specific period (usually a year), as defined in a fishery management plan or regulation. (Note: TAE is the effort based equivalent of TAC. Under a TAE, rather than controlling catch, total allowable effort is controlled.)

MEY: Maximum economic yield

MEY is the level of catch and fishing effort where the difference between the full costs of exploiting the resource (cost of labour, capital including depreciation, materials and an allowance for 'normal' profit) and the return from selling the output of the resource (i.e. revenues) is maximised, i.e. the net economic return. MEY for a single species fishery is generally greater than the maximum sustainable yield (MSY). However, in multi-species fisheries, the MEY level of catch of individual species may be greater or less than its MSY level, because whole-of-fishery MEY is determined by the set of species caught together, not individual species.

MSY: Maximum sustainable yield

The highest theoretical equilibrium yield (catch) that can be continuously taken (on average) from a stock under existing (average) environmental conditions.

* These are our best assessments of the definitions. Please note that interpretation does vary (see Food and Agriculture Organization Fisheries Terms Portal http://www.fao.org/faoterm/collection/fisheries/en/).

Developing a quota-based management system involves four components. These include:

i. the species, areas and time scale for which total allowable catches (TACs) will apply,

ii. the basis of setting the TACs,

iii. how these TACs will be allocated (such as by ITQs),

iv. how these allocations can be used and traded.

Depending on the fishery, TACs may cover a single stock/species; multiple TACs covering different target species and/or different areas of a fishery; the total catch for a group of species or partial stocks/species when these are shared with other jurisdictions.

The basis for setting TACs is determined by calculating the total catch level that will meet the stock sustainability objective of maintaining the spawning stock at or above the threshold level that would generate MSY and therefore well above the limit level at which future recruitment (addition of new individuals to a population) could be jeopardised. In Australia, TACs are often set to achieve an MEY objective, which is usually more conservative as maximum gross profit requires more of the stock to be left in the water than the MSY threshold. The methods and basis for determining the TACs for each fishery are generally specified within a formal harvest strategy.

Most quota-based fisheries operate under an Individually Transferable Quota (ITQ) system. Under this system, the annual TAC is divided by the number of quota units (shares) in the fishery to determine a kilogram/quota amount, with the individual quota an eligible holder receives for the year being calculated by multiplying this amount by the number of quota units they hold.

An ITQ system requires a process for conducting an initial allocation of quota units. This is often based on a fishery-by-fishery agreed legislative formula which generally includes a mechanism that recognises historical participation in the fishery, although allocations on the basis of other criteria are possible. The ability to trade quota units (either as a permanent transfer or lease) can allow an ITQ system to operate as an economic instrument allowing fishing effort to adjust autonomously.

While the quota units are tradable, there may—depending on the fishery—be additional administrative rules for the operation of the quota system that, for example, limit the maximum unit holding that can be held by a single person/entity, placing conditions on the transfer of the quota, or requiring a minimum number of units be held in order to fish. Furthermore, where there is more than one TAC in a mixed-species fishery, a minimum holding for a range of species may be required to go fishing to ensure that likely catches of each species are covered by the quota.

Any discussion about the impact of ITQs requires clarity around definitions. The main purpose of this submission is to highlight the definitional complexities in the terms of reference (see section 2) to ensure that those contributing to discussion have a clear and common understanding of these words, e.g. what is meant by the ‘fisheries quota system’ and ‘ITQs’; and what might ‘good community outcomes’ may mean.

The submission also provides a summary of FRDC-funded research on ITQs—completed research (see section 3a) and new research (see section 3b). This demonstrates the scope and breadth of FRDC investment to date. Key partners for FRDC undertaking this research include Australian, state and territory governments, FRDC advisory bodies, the fishing sectors (commercial, recreational and Indigenous), and Australia’s leading research providers including the Commonwealth Scientific and Industrial Research Organisation (CSIRO), universities, government organisations and experts.

Finally, the submission highlights key literature (evidence-based science) investigating ITQs. This includes FRDC research projects, as well as national and international publications with links to the publications. A list of Australian fisheries, where ITQs have been introduced, is also provided (see Appendix 2).

2. Explanation of key words in the terms of reference

a. Good fishing practice that is ecologically sustainable with an economic dynamic that produces good community outcomes

"good fishing practice"

A narrow definition of this would be the choice of fishing technologies (vessels, gear types etc.) which are used to harvest the stocks within sustainable limits.

"Good practice" is a normative concept but has recently become more broadly defined in fisheries and includes codes of practices inclusive of, for example, fish handling practices and labour welfare practices. Good fishing practice results from a combination of many factors including fisheries management measures, industry codes of practice, improved knowledge and monitoring, control and enforcement, and the objective to do the least ecological damage.

ITQs may reduce the likelihood of some 'bad' fishing practices by encouraging long-term stewardship through decisions about fishing practices in protecting the long-run value of the fishing right. However, theory would suggest that an ITQ on its own is insufficient to reduce the likelihood of 'bad' fishing practices (van Putten et al. 2014). It requires the implementation of a range of other management measures in addition to achieve this.

There may be a greater incentive in some ITQ fisheries in Australia for some groups of fishers (e.g. those who are lease dependent) to undertake unsafe fishing due to potential economic incentives to fish in unsafe conditions (Emery et al. 2014). This is likely to be due, in part, to fishers needing to cover lease costs or purchase costs, and be more responsive to changes in expected revenue when market conditions change.

"ecologically sustainable"

Broadly, this term refers to:

> "use of natural resources within their capacity to sustain natural processes while maintaining the life-support systems of nature and ensuring that the benefit of the use to the present generation does not diminish the potential to meet the needs and aspirations of future generations" (Australian Government, 2007, p. 10).

In fisheries this requires management which ensures that fishing activities do not pose a risk of unsustainable or unacceptable impacts on the marine ecosystem.

ITQs may indirectly incentivise some 'bad' fishing practices, such as discarding, particularly in multi-species fisheries, and the potential for high-grading (retaining only the highest value fish). These aspects may be minimised when TACs are set appropriately and the quota trading market is well functioning, allowing fishers to adjust their quota holdings as required.

"economic dynamic"

Refers to the creation of economic incentives for fishery participants to make decisions regarding fishing behaviour and quota market participation. For example, this requires that quota units are distributed across the fishing fleet within a fishing season in a way that achieves economic efficiency and net economic returns to be maximised (see Leon et al. 2013).

ITQs involve the allocation of a share of a total allowable catch (TAC) to individual fishers, giving individuals rights to the use of a share of the resource. The TAC is the mechanism by which total catch is limited, aimed at achieving the overall resource sustainability objectives, and in some cases other objectives. Through being able to transfer these user rights (the 'T' in ITQ), fishers can adjust their operations to minimise their costs and maximise their revenues. Hence, ITQs are an economic instrument designed to ensure that the level of catch which has been set using other instruments (e.g. harvest strategy decision rules to set the TAC) is caught in a way that is economically efficient.

An ITQ system is highly dependent on the quota market functioning as required (van Putten et al. 2011) to enable the transfer of the units to the most efficient catchers each season. The functioning of the quota market in facilitating the autonomous adjustment in response to changing biological and economic conditions that is central to ITQ performance is particularly important in Australia where, historically, initial allocations of quota units was predominantly allocated on the basis-of-catch history. Where there are problems in ITQ market design or administrative settings, inefficiencies may occur (Knuckey et al. 2018). There can also be structural issues which produce less than ideal quota market conditions (for example, asymmetrical information, strategic behaviours, management measures), resulting in less efficient distribution of quota.

"good community outcomes"

The National Strategy for Ecologically Sustainable Development 1992 (COAG 1992) to which all Australian states, territories and the Commonwealth Government are signatories, refers to "community well-being and welfare" and distinguishes it from "individual" well-being and welfare. The strategy also refers to the "broad community". It is inferred that this refers to all residents of the state or territory, or Australia in the case of the Commonwealth's fisheries policy. It can therefore be assumed that "community outcomes" refer to impacts on social and economic dimensions of well-being of a given community at a collective (rather than individual) level. This is also consistent with the components of human and community well-being included in the Ecologically Sustainable Development assessment framework for wild-catch fisheries (Fletcher et al. 2002).

In practice, definition of the term "community" is highly context-dependent, and should be drawn from relevant fisheries policy, at both the primary legislation (i.e. fisheries management act) level and the specific fisheries management policy level. In a number of jurisdictions, "community" is named as an intended beneficiary of fisheries management in the high-level objectives of fisheries management legislation while in other jurisdictions it is not (see Table 1 on the following page). The specificity of the term "community" also varies across jurisdictions (e.g. Australian community versus community).

Table 1: Reference to "community" in fisheries management acts by jurisdiction

Jurisdiction	Fisheries management act	Reference to "community"
Commonwealth	*Fisheries Management Act 1991*	Refers to the "Australian community" as the intended beneficiary of net economic returns generated from management of its fisheries.
New South Wales	*Fisheries Management Act 1994*	Includes the objective "to provide social and economic benefits for the wider community of New South Wales".
Northern Territory	*Fisheries Act 1988*	Includes the objective to "promote the optimum utilisation of aquatic resources to the benefit of the community".
Queensland	*Fisheries Act 1984*	No direct reference—the objects of the Act are to achieve ecologically sustainable development (which is inclusive of community well-being).
South Australia	*South Australian Fisheries Management Act 2007*	Includes an objective to allocate access to the fisheries resource in a manner which "achieves optimum utilisation and equitable distribution of those resources to the benefit of the community". Includes a further objective to ensure "fishing activities are to be fostered for the benefit of the whole community".
Tasmania	*Living Marine Resources Management Act 1995*	Refers to the needs and interests of the "Tasmanian community".
Victoria	*Fisheries Act 1995*	No direct reference to "community".
Western Australia	*Aquatic Resources Management Act 2016*	Refers to the objective to manage use of aquatic resources having "regard to the economic, social and other benefits".

Relevant fisheries policies also refer to the interests of various scales or levels of "community":

- Australian (i.e. national) community,
- Traditional Owner community,
- state or territory community,
- regional coastal community,
- commercial fishing community (inclusive of harvesters and quota holders),
- recreational fishing community.

Definition of "good" community outcomes should also draw on relevant fisheries policies. For example, the Commonwealth Government's *Fisheries Management Act 1991* specifies maximisation of net economic returns as the desirable outcome for the Australian community. In South Australia, fisheries performance indicators include a range of social and economic variables, including contribution to gross state product. It could be inferred that a higher economic contribution to the state's economic well-being is a preferred "community outcome".

Further insight into the definition of "good community outcomes" may be gleaned where fisheries management changes trigger regulatory impact assessment processes. These policy documents have applied the term "community" at a range of scales from specific groups of fishery participants (e.g. small vessel operators, large vessel operators and crew) to regional communities hosting fishing fleets to the state-level community. Similarly, good and bad outcomes for specific communities have been identified in social and economic impact assessments, including increased profitability of fishing operations accruing to fishers who remain in the fishery and hold quota; increased economic returns through quota unit trading accruing to the community of quota unit holders; reduction of flow-on effects for fleet hosting coastal communities (see Frusher et al. 2003; Williamson et al. 1998).

Evaluation of fishery outcomes, regardless of the management system, is often made more difficult by the lack of clear articulation of the scale of community, preferred community outcomes, and how benefits across multiple communities should be balanced or traded off. It is on the basis of the articulation of these that an assessment of a good (or otherwise) community outcome, can be made.

b. How the current quota system affects community fishers

There are many participants involved with the utilisation of fisheries resources, with differing interests in, and receiving different benefits from, those resources. This creates complexity in determining the overall effect or impact of any fisheries management measure, including ITQs, as many are often used in concert. Identifying what types of "communities" have 'standing' in evaluations of the current quota system is an important first step

Who are community fishers?

The term "community fishers" has not been used in Australia and to our knowledge is rarely, if at all, used elsewhere. Alternative terms that may be more relevant to the Inquiry include "fishing community", "community of fishers", and "community of ITQ holders". Clarity around which community(ies) are in focus, will make assessments of what outcomes are occurring, possible

Who are the members of a fishing community?

Like any community, the components that make up a fishing community is dynamic and changes over time, but they are largely recognised to have (adapted from Clay & Olson 2007):

- a certain level of visible connection to the industry (boats, gear, fishing-related businesses) and other infrastructure elements (such as jetties and ports),
- connections among on-land and at-sea networks through connections in the supply chain (i.e. wholesale/retail outlets, processing facilities, and marketing/ export/ transport companies),
- multiple household- and family-level ties to fishing and fishing-related activities (i.e. supply business, shipyards for maintenance),
- the dependence on, and cultural connection to, fishing for small to large boat; family to industrial; commercial to recreational fishing; and even fishing-related tourism that involves little actual fishing activity.

Who are the members of a community of fishers?

A community of fishers is made up of many participant categories (all of whom fish) but are labelled according to their main activity. Individuals can, however, be a participant in more than one group. The make up of the community of fishers evolves and changes over time. These groups that make up the community of fishers include:

a. Indigenous fishers accessing the resource for traditional or cultural reasons,
b. Indigenous fishers fishing commercially,
c. Indigenous fishers fishing recreationally,
d. commercial full-time fishers,
e. commercial part-time fishers (with a source of other employment),
f. commercial part-time fishers that fish occasionally ('lifestyle fishers' or nearing retirement),
g. commercial fishers who also fish recreationally,
h. avid non-Indigenous recreational fishers,
i. non-avid non-Indigenous recreational fishers.

Who are the community of ITQ holders?

A community of ITQ holders includes a number of different types of ITQ holders: owners, lessors and those that have third-party interests. Depending on the rules of each fishery, quota holdings may be bounded by regulations as to who is able to own quota and how much any one person or entity can own (e.g. there can be minimums and maximums). Like a community of fishers, a community of ITQ holders evolves over time as ownership of quota changes hands. However, at any one time the "community" is extremely diverse and individuals will have different ITQ histories, motivations and behaviours.

Based on the type of holder and the allocation history, the ITQ-holding "community" can be categorised into three groups.

Quota owners who were initially allocated quota

In Australia, quota is generally initially allocated to fishers operating in the fishery at the time of ITQ implementation. Catch history is often the key criteria in an allocation formula. Once allocated, recipients are made up of those who:

a. fish their quota,
b. sell their quota and exit the fishery,
c. sell their quota, and then lease in quota if they wish to continue fishing,
d. lease out some or all of their quota to earn a return,
e. bequeath or transfer their quota to other family members,
f. hold quota as an asset that can be liquidated at a desired time (but do not lease out).

Quota owners who obtain quota post-allocation

Active fishers who buy quota. The reasons for obtaining quota can be:

a. to add to current quota holdings in order to maintain or expand their fishing operation,
b. to enter the fishery.

Non-fishers who buy quota. The reasons for obtaining quota can be:

c. to secure supply (e.g. processors, exporters),
d. to diversify their asset portfolio (e.g. in a superannuation fund) and/or to earn a return on investment through leasing (e.g. quota received as an inheritance).

Quota lessees

Those that lease quota are:

a. active fishers who need more quota for a profitable fishing operation,
b. active fishers who need to reconcile catch with quota (i.e. their current quota does not cover all of their catch),
c. fishers who were not eligible to receive an initial allocation and now operate their own boat (e.g. ex-crew members, skippers),
d. new entrants unable to, or not wanting to, buy quota,
e. processors/wholesalers wanting to secure supply (sub-lease to fishers),
f. commercial part-time fishers (with a source of other employment) who supplement their income through fishing,
g. commercial part-time fishers who fish occasionally ('lifestyle fishers' or those nearing retirement), whose lifestyles entail some levels of discretionary fishing and often during favourable times of the year.

c. Whether the current system disempowers small fishers and benefits large interest groups

"current system"

Current system in this instance is limited to the ITQ quota management system, noting that licencing and other management arrangements also have an effect on the distribution of benefits of fishery management for different fishery participants. Because ITQs and TACs go together, these arrangements include the TAC-setting, quota administrative arrangements and quota trade mechanisms through which fishers access quota in order to harvest within a quota period. One cannot be altered without affecting the effectiveness of other management elements.

"disempowers"

Economically, this may arise in quota trading markets due to differences in bargaining power or information held by participants seeking access to quota units through purchase or lease at a competitive market price. Disempowerment may be heightened due to concentration of quota holdings because concentration provides an opportunity for strategic market behaviour. Socially, disempowerment may occur or be exacerbated by unequal access to information on unit availability and price, or access to decision makers especially where consultative arrangements favour one type of ITQ holder (e.g. quota unit owners).

"small fishers"

This term is not formally defined for Australian fisheries. It generally refers to single-vessel operators. Small fisher may also imply that the fishing takes place from a smaller vessel relative to other vessels in the fleet or from a fishery with a lower catch quantity or value. It can encompass owner-operators (i.e. skipper is the holder of quota units being harvested) as well as lessee or part-lessee fishers (i.e. the skipper leases in at least part of the quota being caught by that vessel/fishing entitlement). Many quota fisheries in Australia are operated by single vessel and family-operated businesses.

"Small fisher" is distinct from a fisher operating within a fleet of vessels owned by the same firm.

"large interest groups"

In the context of ITQs this could refer to:

- large institutional investors,
- industry associations,
- quota owners who hold a substantial amount of quota in a fishery,
- vertically integrated seafood firms (i.e. firms which own fishing vessels, quota units, and are licenced fish receivers, processors and fish wholesalers),
- environmental non-governmental organisations.

d. The enforceability of ecological value on the current system, and the current system's relationship to the health of the fisheries

"ecological value"

The term "ecological value' is not typically found in fisheries management legislation. More generally, ecological value refers to the "perceived importance of an ecosystem, which is underpinned by the biotic and/or abiotic components and processes that characterise that ecosystem" (Aquatic Ecosystems Task Group 2012). Ecosystems have their highest ecological value when they are undisturbed (Cordell et al. 2005).

Fishing of any form—irrespective of the management system introduced—will have some impact on ecological value (Jennings & Kaiser 1998). Changes in ecosystem structure as a result of commercial fishing have been seen globally (Blaber et al. 2000), however, it should be noted that other anthropogenic activities beyond fishing also change ecosystem structure.

Fishing is a selective process to an extent, and fishers will—to the best of their ability—target species that will provide the most value to their business. That is, fishers will not actively seek to catch species that have no commercial value, although these are sometimes caught incidentally as bycatch. Bycatch policies aim to minimise incidental catch. This can make fishing more selective which can result in the unintended consequence of impacting ecological value though changing ecosystem structure by selectively harvesting only parts of it.

Hence there is a potential tension between minimising bycatch and maximising ecological value in the presence of commercial fishing.

The setting of TACs for each species as part of an ITQ management system provides a mechanism through which changes in ecological value can be directed. How these TACs are determined will depend on the objective of fisheries management and the trade-offs between these objectives. For example, having a dominant objective of maintaining fishing activity in regional communities may result in a different set of TACs, and potentially a different spatial distribution of catch, than those established under a purely economic-focused objective. As a consequence, ecological value will also be affected differently.

The concept of "ecological value" also has other interpretations. Under the ecosystem services approach, ecological value would reflect the anthropomorphic benefits the ecosystem produces. This may be instrumental values—such as the value of fish produced (a provisioning service) or cultural values such as the value of conserving biodiversity or the non-market cost to society through the capture of threatened, endangered or protected (TEP) species or habitat damage. A recent FRDC project (FRDC 2015-202; Pascoe et al. 2018) found that including non-monetary values for non-commercial species in harvest strategies in multi-species fisheries changes TACs, allowing for some of the additional biodiversity or TEP or habitat outcomes to also be achieved. This is currently not the case in Australian fisheries however, and non-market values for most non-commercial species of interest or habitats are not available (see FRDC project 2018-068; Coglan et al. 2021).

"enforceability"

The ability to realise the intended outcomes, including maintenance or enhancement of ecological value, of any fisheries management system is reliant on the presence of an effective compliance regime. An effective compliance system requires a risk-based/intelligence driven compliance system supported by tools such as vessel monitoring systems, observers and cameras.

e. Whether the current system results in good fishing practice that is ecologically sustainable and economically dynamic, and produces good community outcomes

It should be noted that the 'current system' is operating at a point in time. Given the dynamic nature of the environment in which fisheries operate, especially with added stressors such as climate change, a multi-pronged and adaptive approach is often required such as with the use of harvest strategies and Management Strategy Evaluation (MSE). The knowledge generated by research can illuminate the pitfalls and opportunities in this dynamic environment, as well as market, societal and ecological changes. While it may be perceived as a suitable management system now, these changes require constant monitoring and adaptive behaviours.

f. Any other related matters

Other matters relevant to this Inquiry include:

- One of the main advantages of implementing a fishery ITQ system is that it can potentially prevent overfishing for economic benefit, increasing the net economic return. This means that some of this net return can possibly be collected to secure a return for the owners of the resource (the Australian public). In Australia, mechanisms to secure a return to resource owners are generally not included in the initial implementation of an ITQ system (or any fisheries management system) and any rents earned are now capitalised in the quota itself. In new ITQ fisheries, where this has not already occurred, there are mechanisms for capturing rents including various forms of charges or an auction of the ITQs. The estimation and collection of rent is a complex task and would vary across fisheries. In Iceland, for example, resource rent charges implemented by public agencies are considered mechanisms to ensure "good community outcomes" at the state level.
- ITQ systems have almost exclusively been used to control catch and improve economic benefits in commercial fisheries, with shares of the TAC to other user groups being made (either explicitly or implicitly) before individual unit allocations of quota are made. Little attention has been paid to the potential for modified ITQ systems to be used to resolve inter-sectoral shares between commercial fishers and for example, recreational, charter and Indigenous sectors.

3. Summary of the FRDC science specifically addressing ITQs relevant to the terms of reference

a. Completed FRDC research projects

The FRDC has invested in research to address many aspects of ITQs (see Table 2). This research maps to the terms of reference (a to f) raised in this Inquiry to varying degrees (see Table 3).

Table 2: List of FRDC research (completed projects) specifically addressing ITQs relevant to the terms of reference

ID	Citation with URL	Terms of reference
1	Pascoe, S., Hoshino, E., van Putten, I. & Vieira, S. (2019). *Retrospective assessment of ITQs to inform research needs and to improve their future design and performance*. FRDC Final Report 2017-159. CSIRO Oceans and Atmosphere, Hobart. CC BY 3.0.	a, b, c, d, e
2	Knuckey, I., Boag, S., Day, G., Hobday, A., Jennings, S., Little, R., Mobsby, D., Ogier, E., Nicol, S. & Stephenson, R. (2018). *Understanding factors influencing under-caught TACs, declining catch rates and failure to recover for many quota species in the SESSF*. FRDC Final Report 2016-146. Fishwell Consulting. 164 pp. CC BY 3.0.	a, d, e
3	Pascoe, S., Hutton, T., Hoshino, E., Sporcic, M., Yamazaki, S. & Kompas, T. (2018). *Maximising net economic returns from a multispecies fishery*. FRDC Project no. 2015-202. FRDC, Canberra. CC BY 3.0.	a, d, e
4	Leyland, G. (2012). *Maximising benefits of ITQ management in the Western Rock Lobster Fishery*. FRDC Final Report 2010-317. FRDC and Western Australian Fishing Industry Council. 68 pp.	b, f
5	Sen, S. (2011). *Empowering Industry RD&E: Easy-to-read guide on assisting fishing businesses adjust to implementation of quota control management in their fishery*. FRDC Final Report 2010-229. FRDC and Fisheries Economics, Research and Management. 62 pp.	b, c, f
6	Sen, S. (2012). *From Hunter to Harvester—Adapting your fishing business to quota management—A Guide*. [Product of FRDC Final Report 2010-229.] FRDC and Fisheries Economics, Research and Management. 47 pp.	b, c, f
7	Little, L.R., Begg, G.A., Goldman, B., Williams, A.J., Mapstone, B.D., Punt, A.E., Russell, M., Kerrigan, B., Officer, R., Slade, S., Muldoon, G. & Penny, A. (2009). *Modelling Individual Transferable Quotas as a Management Tool in the Queensland Coral Reef Finfish Fishery. Fishing and Fisheries Research Centre Technical Report no. 3*. FRDC Final Report 2004-030. Fishing and Fisheries Research Centre, James Cook University, Townsville. 174 pp.	a, d, e
8	Frusher, S., Eaton, L. & Bradshaw, M. (2003). *Impact of management change to an individual transferable quota system in the Tasmanian Rock Lobster Fishery*. FRDC Final Report 1999-140. 267 pp.	a, b, c, e
9	Kaufmann, B., Geen, G. & Sen, S. (1999). *Fish Futures: Individual transferable quotas in fisheries*. [Product of FRDC Project 1997-144 A practical guide to ITQs for fishery managers and the fishing industry.] FRDC and Fisheries Economics, Research and Management Ltd. 251 pp.	a, b, d, f

Table 3: Terms of reference a to f

ID	Terms of reference
a.	Good fishing practice that is ecologically sustainable with an economic dynamic that produces good community outcomes.
b.	How the current quota system affects community fishers.
c.	Whether the current system disempowers small fishers and benefits large interest groups.
d.	The enforceability of ecological value on the current system, and the current system's relationship to the health of the fisheries.
e.	Whether the current system results in good fishing practice that is ecologically sustainable and economically dynamic, and produces good community outcomes.
f.	Any other related matters.

* The terms of reference in this table are mapped to the FRDC-funded research that follows, e.g. FRDC project 2017-159 related to terms of reference a, b, c, d and e.

FRDC Project 2017-159 (relevant to terms of reference a, b, c, d, e in Table 3)

Pascoe, S., Hoshino, E., van Putten, I. & Vieira, S. (2019). Retrospective assessment of ITQs to inform research needs and to improve their future design and performance, FRDC Final Report 2017-159. CSIRO Oceans and Atmosphere, Hobart, March. CC BY 3.0.

Objectives

1. Identify the extent of use (current and proposed) of ITQs in Australian fisheries.
2. Identify the demonstrable benefits to their use in Australia, and what outcomes have emerged that were largely unintended.
3. Identify critical knowledge gaps and further research needed to improve their future design and performance.

Outputs

- FRDC final report with a summary of key knowledge gaps and areas for future research.
- Associated journal articles.
- Conference presentation.

Planned outcomes

- Fishery managers (end users) will be able to gain a better understanding of the potential adverse or unintended outcomes from an ITQ program and the extent to which they can be avoided; and how the benefits that might be realised under an ITQ program can be best achieved (i.e. the necessary conditions).
- The key beneficiaries are the fishing industry and the associated fishing communities that may otherwise be adversely impacted.

Time frame

- Final report due May 2021.

Key points

- This study examined how ITQs and individual transferable efforts (ITEs) in Australia have performed relative to sustainability, economic and social criteria; and investigated what factors may be underlying these successes or failures.
- The study includes a review of international experiences with ITQ management as well as a description of the key ITQ and ITE fisheries in each jurisdiction.
- A survey of fishers, scientists and managers was undertaken to determine their perceptions around the performance of ITQs/ITEs, and to estimate what factors may contribute to these perceptions of performance.
- Furthermore, key ITQ and ITE fisheries in each jurisdiction of Australia were identified as part of this study.

FRDC Project 2016-146 (relevant to terms of reference a, d, e in Table 3)

Knuckey, I., Boag, S., Day, G., Hobday, A., Jennings, S., Little, R., Mobsby, D., Ogier, E., Nicol, S. & Stephenson R. (2018). Understanding factors influencing under-caught TACs, declining catch rates and failure to recover for many quota species in the SESSF [Southern and Eastern Scalefish and Shark Fishery]. FRDC Project no. 2016-146. Fishwell Consulting. 164 pp. CC BY 3.0.

Objectives

1. Provide a range of papers with information on potential causes of under-caught TACs, declining catch rates and non-recovering species.
2. Hold a workshop to discuss plausible reasons for under-caught TACs, declining catch rates and non-recovering species.
3. Develop a process for assessing non-rebuilding species.
4. Develop strategies to address the under-caught TACs, declining catch rates and non-recovering species based outputs from objective 1 and 2.

Outputs

- FRDC final report including a series of management recommendations.
- An issues paper on quota ownership and trading.

Planned outcomes

- The longer-term outcomes of this project will be to understand and respond to non-recovering stocks, declining catch per unit efforts and to maximise economic yield by increasing both average production (tonnage and revenue) and profitability levels in the fishery.

Time frame

- Final report completed February 2019.

Key points

- This report includes an issues paper on quota ownership and trading, which was one of the issues investigated to look for explanatory factors to account for under-caught TACs, declining catch rates and recovery concerns for quota species in the Southern and Eastern Scalefish and Shark Fishery (SESSF).
- There was little evidence that quota ownership and trade influenced under-caught TACs for a large number of species in the SESSF. Similarly, current quota management was not considered to be a major constraint to catching TACs. This finding highlighted the need for further work and has culminated in current FRDC project 2019-165: Design aspects of well-functioning ITQ markets (CSIRO).

FRDC Project 2015-202 (relevant to terms of reference a, d, e in Table 3)

Pascoe, S., Hutton, T., Hoshino, E., Sporcic, M., Yamazaki, S. & Kompas, T. (2018). Maximising net economic returns from a multispecies fishery. FRDC Project no. 2015-202, FRDC, Canberra. CC BY 3.0

Objectives

1. Development of a methodology for maximising net economic return of a multi-species fishery as a whole, and with regard to bycatch and discard species.
2. Development of a framework to operationalise the methodology into fisheries management objectives.

Outputs

- FRDC final report including an implementation framework to achieve maximum economic yield.
- Associated journal articles.
- Presentation to the Australian Agricultural and Resource Economics Society and International Institute of Fisheries Economics and Trade conference.

Planned outcomes

- Fishers and the broader community who gain from enhanced economic performance in their fisheries via management measures and targets aimed at maximising net economic returns.

Time frame

- Final report completed June 2018.

Key points

- This study looked at what factors limit maximising economic returns in multi-species fisheries. One of those factors examined was having quota on too many additional (secondary) species, which was found to be counterproductive, as the fishery is largely constrained by the quota for the primary species caught.
- Imposing quotas also on secondary species can result in a situation where a minor species becomes a 'choke' species, restricting the total fishery for little benefit. Reducing the number of species subject to quota constraints to only those that were most important (in terms of revenue) resulted in improved economic performance of the fishery as well as lower levels of discarding. However, in the model changes in targeting ability of the fleet was not considered, so monitoring of fisher behaviour in response to proposed management regimes that only have a few species under quota would be essential.

FRDC Project 2010-317 (relevant to terms of reference b, f in Table 3)

Leyland, G. (2012). Maximising benefits of ITQ management in the Western Rock Lobster Fishery. FRDC Final Report 2010-317. FRDC and Western Australian Fishing Industry Council. 68 pp.

Objectives

1. To inform the Western Rock Lobster industry members of the opportunities that moving to ITQs provide.

Outputs

- FRDC final report.
- Education and extension programs.

Planned outcomes

- Western Rock Lobster industry members will be fully informed of the opportunities that moving to ITQs provide.
- The Western Rock Lobster industry successfully moved to interim quota without major disruption to fishing operations. The 'Going to Quota' events not only informed, but helped to focus the industry members on the transition and how best to make it work for their fishing enterprise.

Time frame

- Final report completed January 2012.

Key points

- This project informed the Western Rock Lobster industry members of the opportunities that moving to ITQs provided and to facilitate a smooth transition to ITQs.

FRDC Project 2010-229 (relevant to terms of reference b, c, f in Table 3)

Sen, S. (2011). Empowering Industry RD&E: Easy-to-read guide on assisting fishing businesses adjust to implementation of quota control management in their fishery. FRDC Final Report 2010-229. FRDC and Fisheries Economics, Research and Management. 62 pp.

Objectives

1. Interview a range of fishers from fisheries that are moving to ITQ management, to understand their areas of concern and what information they would require to better adapt their businesses to operate efficiently and profitably under ITQ management.
2. Produce a comprehensive but easy-to-read guide targeted particularly for use by fishers on 'Understanding and adapting fishing businesses to ITQ management'.
3. Examine and document the unintended consequences of ITQ implementation.

Outputs

- FRDC final report including documenting the unintended consequences of ITQs.
- A comprehensive guide for use by fishers on 'Understanding and adapting fishing businesses to ITQ management':

  Sen, S. (2012). From Hunter to Harvester—Adapting your fishing business to quota management—A Guide. [Product of FRDC Final Report 2010-229.] FRDC and Fisheries Economics, Research and Management. 47 pp.

Planned outcomes

- This project will help to reduce some of the initial resistance that occurs in moving from input controls to an ITQ managed fishery, and it will better prepare fishing businesses to operate under such an environment; especially small- to medium-sized fishing businesses which are operating in fisheries just moved or going to move to ITQ management.
- It is anticipated that management agencies will also benefit as a better understanding by operators of ITQs and how to operate with them would ease the transition to ITQs and speed up what has in the past, often been, a fairly long adjustment phase.

Time frame

- Final report completed June 2012.

Key points

- This project interviewed a range of fishers from fisheries that are moving to ITQ management, to understand their areas of concern and what information they would require to better adapt their businesses to operate efficiently and profitably under ITQ management.
- It produced a comprehensive but easy-to-read guide targeted particularly for use by fishers on 'Understanding and adapting fishing businesses to ITQ management'; and examined and documented the unintended consequences of ITQ implementation.
- The purpose of this guide is to help operators in a fishery going to or recently moved to quota, to navigate through the business decisions regarding ITQs, and to help adjust their business to the new system. (Note: This guide does not discuss the pros and cons of ITQs or the different quota allocation methods but has many publications on the subject listed at the end of the guide.)

FRDC Project 2004-030 (relevant to terms of reference a, d, e in Table 3)

Little, L.R., Begg, G.A., Goldman, B., Williams, A. J., Mapstone, B.D., Punt, A.E., Russell, M., Kerrigan, B. Officer, R., Slade, S., Muldoon, G. & Penny, A. (2009). Modelling Individual Transferable Quotas as a Management Tool in the Queensland Coral Reef Finfish Fishery. Fishing and Fisheries Research Centre Technical Report no. 3. FRDC Final Report 2004-030. Fishing and Fisheries Research Centre, James Cook University, Townsville. 174 pp.

Objectives

1. To extend the existing Management Strategy Evaluation (MSE) framework for the Great Barrier Reef Coral Reef Fin Fish Fishery (GBR CRFFF) so that management controls evaluated can include catch limits implemented as ITQs.
2. To evaluate the likely effects on the sustainability of common Coral Trout and Red Throat Emperor of regional shifts in catch distributions in response to spatial closures and potential displacement of fishing effort associated with the Great Barrier Reef Marine Park Authority (GBRMPA) Representative Areas Program.
3. To evaluate alternative management strategies for common Coral Trout and Red Throat Emperor in the CRFFF of the Great Barrier Reef in terms of the trade-offs among the objectives of the commercial, recreational and charter fisheries.

Outputs

- FRDC final report.
- The project not only provides essential information and a tool for management.

Planned outcomes

- The development of a set of algorithms which can mimic the implications of management being based on catch limits implemented as ITQs; and the development of a tool to evaluate the impacts of catch quota and spatial closure management strategies on effort dynamics. This will improve management of the harvested target species.

Time frame

- Final report completed November 2009.

Key points

- In July 2004, an ITQ system was implemented in the Queensland CRFFF. This project focused on extending the existing MSE framework for the GBR CRFFF so that management controls evaluated could include catch limits implemented as ITQs.
- The project evaluated the likely effects on the sustainability of common Coral Trout and Red Throat Emperor of regional shifts in catch distributions in response to spatial closures and potential displacement of fishing effort associated with the GBRMPA Representative Areas Program; and evaluated alternative management strategies for common Coral Trout and Red Throat Emperor in the GBR CRFFF in terms of the trade-offs among the objectives of the commercial, recreational and charter fisheries.

FRDC Project 1999-140 (relevant to terms of reference a, b, c, e in Table 3)

Frusher, S., Eaton, L. & Bradshaw, M. (2003). Impact of management change to an individual transferable quota system in the Tasmanian Rock Lobster Fishery. FRDC Final Report 1999-140. 267 pp.

Objectives

1. To assess the response (fleet dynamics) of rock lobster fishers to changes in management, including any change in the 'rules' which fishers used to influence their fishing decisions prior to and after quota implementation.
2. To evaluate the impacts (catch and effort) of rock lobster fishers on other fisheries prior to and post quota implementation.
3. To determine socio-economic changes associated with implementation of quota management and establish performance indicators relevant to managing the fishery.

Outputs

- FRDC final report.

Planned outcomes

- Future rock lobster fishery assessments in Tasmania will account for catch per unit effort changes independent of changes in lobster abundances. This will enable valid comparisons of pre- and post-quota implementation data and provide managers and industry with greater certainty when recommending total allowable commercial catch amounts.
- The results of this study have provided a stimulus for the inclusion of socio-economic performance indicators a strategic plan so that industry will be better positioned to address ecologically sustainable development requirements under the EPBC Act.

Time frame

- Final report completed July 2003.

Key points

- This project assessed the response (fleet dynamics) of Tasmanian rock lobster fishers to changes in management, including any change in the rules, which fishers used to influence their fishing decisions prior to and after quota implementation.
- The project evaluated the impacts (catch and effort) of rock lobster fishers on other fisheries prior to and after quota implementation and determined socio-economic changes associated with implementation of quota management and establish performance indicators relevant to managing the fishery.

FRDC Project 1997-144 (relevant to terms of reference a, b, d, f in Table 3)

Kaufmann, B., Geen, G. & Sen, S. (1999). Fish Futures: Individual transferable quotas in fisheries. [Product of FRDC Project 1997-144 A practical guide to ITQs for fishery managers and the fishing industry.] FRDC and Fisheries Economics, Research and Management Ltd. 251 pp.

Objectives

1. Compilation of operational ITQ experiences in Australia and selected other countries.
2. Analysis of the practical difficulties faced in the implementation and operation of ITQs.
3. Develop guidelines to assist fishery managers and industry in the implementation of ITQ systems.

Outputs

- FRDC final report.
- Book *Fish Futures: Individual Transferable Quotas in Fisheries*.

Planned outcomes

- Potential benefits from the adoption of some of the strategies described in *Fish Futures*, such as allocation advisory panels and dockside monitoring systems, include: (i) a reduction in fishery management costs through improved design and implementation of ITQ systems; (ii) a decrease in litigation over quota allocation and a consequent reduction in litigation related costs; and (iii) an increase in compliance with management regulations through improved enforcement.

Time frame

- Final report/book completed October 1999.

Key points

- This book provides reference material addressing how an ITQ system might work in practice. For those interested in the policy rational for why ITQs were considered for Australian fisheries, this book provides some of that history. It describes ITQ implementation options and provides, where possible, examples of how effective these options have been in various fisheries jurisdictions; and documents the ways that these issues have been tackled by various fisheries management agencies.

b. New FRDC research projects

Two projects have been recently approved by the FRDC that specifically address ITQs. One of these, Project 2020-029, is directly relevant to assessing the impact of ITQ management on fishery performance indicators and options for adaptive management of existing ITQ systems; the other, Project 2019-165 focuses on the design and functioning of quota markets.

FRDC Project 2019-165: Design aspects of well-functioning ITQ markets (CSIRO)

FRDC Project 2019-165 addresses terms of reference a, b and c in Table 3.

Objectives

1. Advice on how managers can make use of network analysis and other high-level metrics of market structure and performance to monitor quota market performance and contribute to evidence-based decision making regarding market design and operation.
2. Better understanding, and functioning, of quota markets in case study fisheries leading to improved fishery performance.
3. Improved fisheries performance through efficient functioning of the ITQ market.
4. Contribute to evidence-based decision making regarding market design and operation.

Planned outputs

- Final report.
- Fact sheet providing general advice and guidance on the use of network analysis to contribute to evidence-based decision making regarding market design and performance monitoring of quota markets.
- A computer-based analysis system (that can be used in publicly available free software) to easily re-evaluate the ITQ market in future to see if there are any changes that may have impacted the structure and efficiency.

Planned outcomes

- The outcomes of this project will be of benefit to the Australian Fisheries Management Authority and industry: (i) understand quota market performance (in terms of efficiency) and determine the implications for different case study fisheries; (ii) understand how the structure and function of the sale and lease quota market for the case study fisheries affects the distribution of benefit among fishers and quota owners; (iii) give consideration to the implication of trade market design features on other fisheries and jurisdictions; (iv) develop insight into how the design of the sale and lease quota market features can be improved when such systems are introduced in the future; and (v) develop a better understanding of how quota market design can achieve the intended outcomes of ITQs in terms of allocative efficiency, and providing additional and clear signals of potential changes in fishing productivity and catch constraints.
- As a result of this project the government cost of monitoring and collecting data on the quota market trades may be reduced. Management practices with respect to quota market administration may be improved. At the same time the value of the fishery is increased if market inefficiencies can be addressed. In terms of equitable access to the fishery, this project will help address potential issues and reduce the risk of the loss of social licence, but these outcomes may be difficult to express in monetary terms.

Time frame

- Project start and end dates: July 2021 to December 2022.

FRDC Project 2020-029: Responding to unintended consequences—evaluating changes to fisheries under ITQ systems (Institute for Marine and Antarctic Studies)

FRDC Project 2020-029 addresses terms of reference a, b and c in Table 3.

Objectives

1. Assess the effects of adoption and ongoing management of ITQs including consequences that flow from them and the effects of the adoption on specific performance indicators.
2. Develop adaptive management options for existing ITQs that will assist in the identification of unintended and unwanted consequences and management of their impact.
3. Better support managers in planning for the mitigation and management of unintended consequences over time, including the cost of implementing change.
4. Provide options to fishery managers and stakeholders to assist in the adjustment of existing fisheries management under ITQs to avoid, or mitigate, unintended and unwanted negative consequences and/or enhance unintended but positive consequences.

Planned outputs

- FRDC final report.
- An adaptive management support tool for fisheries managers, including: (i) a checklist for identifying feasible options for the adjustment of existing ITQs; (ii) modelling capacity to understand the impact of unintended and unwanted consequences on fishery performance over time for each of the case study fisheries; and (iii) a set of key indicators for monitoring the on-going extent and effects of the recognised unintended and unwanted consequences and relevant performance areas of ITQ systems.
- In-depth case studies applying the adaptive management support tool developed in this project. The adaptive management options will be those identified through the structured review, and case studies will include a range of fisheries ITQs.

Planned outcomes

- This project aims to improve social welfare outcomes from ITQs, inclusive of ecologically sustainable development goals and objectives.

Time frame

- Project start and end dates: July 2021 to June 2022.

Summary

The FRDC is investing in projects and activities to deliver outputs and impact to achieve the research and development (R&D) outcomes of the FRDC Research and Development Plan 2020–25 (R&D Plan): (1) Growth for enduring prosperity; (2) Best practices and production systems; (3) A culture that is inclusive and forward thinking; (4) Fair and secure access to aquatic resources; and (5) Community trust, respect and value. Research aimed at ensuring fisheries are managed in ways that continue to produce outcomes that align with community values and expectations is at the heart of the new plan. FRDC will continue to support research that improves ability to articulate objectives (FRDC 2013-204), monitor performance and evaluate existing and future management systems, including ITQs, against these objectives.

4. Key literature (evidence-based science) investigating ITQs

To assist our stakeholders, key literature of evidence-based science investigating ITQs has been collated. This includes FRDC research projects, as well as national and international publications with links to the publications (see Appendix 1). This list assists in identifying key available information in relation to the terms of reference of the Inquiry. The list is not prescriptive or exhaustive.

The base list of 'other literature' was compiled from FRDC Final Report 2017-159. Additional publications were identified and incorporated by experts in this field and from online journal searches.

5. Key ITQ and ITE fisheries in each jurisdiction (Australia)

To assist our stakeholders, key ITQ fisheries in each jurisdiction (Australia) is provided based on Pascoe et al. (2019). This list has been subsequently updated by each jurisdiction (see Appendix 2).

6. Acknowledgements

This submission was compiled by an internal FRDC governance team in partnership with an external expert panel including FRDC's Human Dimension Research Subprogram. The submission was reviewed by three external experts in the field of fisheries management, fisheries policy and socio-economics. We gratefully acknowledge this team.

We also acknowledge the reseachers who have delivered the FRDC-funded research presented in this submission and the seafood industry who has contributed to these findings.

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Appendix 1

Literature addressing ITQs: FRDC-funded projects and other literature (Australian and international)

No.	Literature addressing ITQs hyperlinked to publication if available
1	Agnarsson, S., Matthiasson, T. & Giry, F. (2016). Consolidation and distribution of quota holdings in the Icelandic fisheries. *Marine Policy*, *72*, 263–270.
2	Anderson, L.G. (1994). An Economic Analysis of Highgrading in ITQ Fisheries Regulation Programs. *Marine Resource Economics*, *9*, 209–226.
3	Annala, J.H. (1996). New Zealand's ITQ system: have the first eight years been a success or a failure? *Reviews in Fish Biology and Fisheries*, *6*, 43–62.
4	Arnason, R. (2002). A review of international experiences with ITQs: Annex to future options for UK fish quota management. *ICES Document Report*, no. 58, 71 pp.
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No.	Literature addressing ITQs hyperlinked to publication if available
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No.	FRDC-funded projects addressing ITQs (hyperlinked to the full report where available)
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10	Recently approved project funded by the FRDC: FRDC Project 2019-165: Design aspects of well-functioning ITQ markets (CSIRO).
11	Recently approved project funded by the FRDC: 2020-029 Responding to unintended consequences—evaluating changes to fisheries under ITQ systems (Institute for Marine and Antarctic Studies [IMAS]).

Appendix 2

Key ITQ and ITE fisheries in each jurisdiction (Australia) as of March 2021

Main ITQ fisheries by jurisdiction (Australia)	
Jurisdiction	Year ITQs introduced
Commonwealth	
Southern Bluefin Tuna Fishery	1984
Sub Antarctic Fisheries[a]	2002 and 2007
Southern and Eastern Scalefish and Shark Fishery	2003
Bass Strait Central Zone Scallop Fishery	2004
Torres Strait Rock Lobster Fishery[b]	2005
Small Pelagic Fishery	2009
Western Tuna and Billfish Fishery	2010
Eastern Tuna and Billfish Fishery	2011
New South Wales (by species)	
Abalone Fishery	2000
Lobster Fishery	2000
Sea Urchin and Turban Shell Fishery	2002
Australian Sardine	2019
Bass Grouper	2019
Beachworm	2019
Bigeye Ocean Perch	2019
Blue-eye Trevalla	2019
Blue Mackerel	2019
Bluespotted Flathead	2019
Cockle	2019
Ghost Nipper (Hand Gathering Fishery)	2019
Hapuku	2019
Ocean Trap and Line Fishery: Gemfish	2019
Pink Ling	2019
Pipi	2019
Silver Trevally	2019
Tiger Flathead	2019
Trawl Whiting (Eastern School and Stout Whiting combined)	2019
Yellowtail Scad	2019

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Main ITQ fisheries by jurisdiction (Australia)	
Jurisdiction	Year ITQs introduced
Northern Territory	
Demersal Fishery	2011
Timor Reef Fishery	2011
Coastal Line Fishery	2015
Offshore Net and Line Fishery	2018
Queensland	
Sea Cucumber	1991
Spanner Crab Fishery	1995
Line Fishery (Reef)	2004
Spanish Mackerel	2004
Coral Fishery	2006
Tropical Rock Lobster	2009
Barramundi	2021
Blue Swimmer Crab for all of Queensland (BC1)	2021
East Coast Mud Crab (EC1)	2021
Grey Mackerel	2021
Gulf of Carpentaria Mud Crab (GC1) (Queensland crab fisheries)	2021
King Threadfin	2021
School Mackerel	2021
Whiting (East Coast Inshore Fin Fish Fishery)	2021
South Australia	
Abalone Fishery	1985
Rock Lobster Southern Zone	1993
Australian Sardine Fishery	1995
Blue Swimmer Crab	1996
Giant Crab	2002
Rock Lobster Northern Zone	2003
Pipi	2007
Vongole (Mud Cockle)	2008
King George Whiting	2021
Snapper	2021
Southern Calamari	2021
Southern Garfish	2021

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Main ITQ fisheries by jurisdiction (Australia)	
Jurisdiction	Year ITQs introduced
Tasmania	
Abalone Fishery	1985
Rock Lobster Fishery	1998
Giant Crab	1999
Scallop Fishery	2000
Tasmanian Banded Morwong Fishery	2008
Victoria	
Abalone Fishery	1988
Scallop Fishery	1998
Giant Crab	2001
Rock Lobster Fishery	2001
Sea Urchin	2014
Banded Morwong	2020
Octopus	2020
Pipi	2020
Western Australia	
Pearl Oyster	1981
South Coast Purse Seine Managed Fishery (Sardines)	1994
Abalone: South Coast Brownlip/Greenlip	1999
Abalone: West Coast Roe's	1999
Mackerel Fishery (state wide)	2006
Gascoyne Demersal Scalefish	2006/07
Western Rock Lobster Fishery	2010
West Coast Deep Sea Crab Fishery	2013
Saucer Scallop Resource (Gascoyne)	2015
Shark Bay Crab	2016

a) Heard Island and McDonald Island Fishery, and Macquarie Island Fishery.

b) Excludes Torres Strait Traditional inhabitant fishing boats sector which is not subject to quota controls.

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Main ITE fisheries by jurisdiction (Australia)	
Jurisdiction	Year ITEs introduced
Commonwealth	
Torres Strait Prawn Fishery	1993
Southern Squid Jig Fishery	2005
Northern Prawn Fishery	2006
Queensland	
East Coast Otter Trawl Fishery	1999
South Australia	
Gulf St Vincent Prawn Fishery	2014
Western Australia	
Shark Bay Prawn Trawl	1993
Temperate Demersal gillnet/longline	1997
Exmouth Gulf Prawn Trawl	1998
Northern Demersal Scalefish	1998
Pilbara Fish Trawl	1998
West Coast Demersal Scalefish	2008

Source: Pascoe, S., Hoshino, E., van Putten, I. & Vieira, S. (2019). Retrospective assessment of ITQs to inform research needs and to improve their future design and performance, FRDC Final Report 2017-159. CSIRO Oceans and Atmosphere, Hobart. CC BY 3.0.

Updates were provided by jurisdictional fisheries agencies to the FRDC in March 2021.