

# Conflicting perceptions of quota-based systems in Australian fisheries

Sean Pascoe<sup>A,\*</sup> , Eriko Hoshino<sup>B</sup>, Trevor Hutton<sup>A</sup> and Alistair J. Hobday<sup>B</sup>

For full list of author affiliations and declarations see end of paper

## \*Correspondence to:

Sean Pascoe  
CSIRO Oceans and Atmosphere,  
Queensland Biosciences Precinct, 306  
Carmody Road, Saint Lucia, Qld 4067,  
Australia  
Email: [sean.pascoe@csiro.au](mailto:sean.pascoe@csiro.au)

## Handling Editor:

Max Finlayson

Received: 4 August 2021

Accepted: 18 December 2021

Published: 7 February 2022

## Cite this:

Pascoe S *et al.* (2022)  
*Marine and Freshwater Research*  
73(4), 419–427. doi:[10.1071/MF21227](https://doi.org/10.1071/MF21227)

© 2022 The Author(s) (or their  
employer(s)). Published by  
CSIRO Publishing.

This is an open access article distributed  
under the Creative Commons Attribution-  
NonCommercial-NoDerivatives 4.0  
International License ([CC BY-NC-ND](https://creativecommons.org/licenses/by-nc-nd/4.0/))

OPEN ACCESS

## ABSTRACT

Individual transferable quotas (ITQs) have been implemented in many fisheries in Australia and elsewhere, primarily in response to stock management challenges. However, unanticipated economic and social outcomes are also apparent, particularly for small-scale fishers. In December 2020, the Australian Senate initiated an Inquiry into the operations of ITQ management systems in Australian fisheries. Submissions were made by individual fishers, industry organisations, fisheries managers, research groups and others, detailing their perceptions on performance in terms of environmental, social and economic outcomes. We summarise the key points raised in the submissions, identifying areas where claims and perceptions were similar or diverse for the different groups. We find that the individual fishers who made submissions were largely negative about the impacts of ITQs in terms of all three outcome domains, whereas industry organisations and others were mostly positive overall. Social issues, particularly ownership of quota by non-fishers (i.e. investors), were flagged by most groups as a problem with the current system. Addressing these concerns with ITQ systems may be difficult. Enshrinement as user rights means that small-scale fisheries and local communities may be disadvantaged in the long-term due to past trade-offs favouring economic and ecological sustainability over social impacts.

**Keywords:** economic impacts, quota managed fisheries, ITQs, lease-dependent, senate inquiry, social impacts, stakeholder perceptions, resource sustainability.

## Introduction

Individual transferable quotas (ITQs) are primarily a market based instrument aimed at improving economic efficiency of the fleet (Hannesson 1996), while also having the additional feature of fostering resource sustainability. The economics of ITQs originated in the 1970s (Christy 1973; Moloney and Pearse 1979). ITQs were first applied to some fisheries in the Netherlands and Iceland in the late 1970s (Chu 2009). In 1986, New Zealand was the first country to introduce ITQs as a primary and nation-wide program for fisheries management (Marchal *et al.* 2016). Canada and the USA followed suit in the 1990s, implementing ITQ management systems in a limited number of fisheries (McCay 1995; Smith and Smith 2001). By the early to mid-2000s, ITQs had been implemented in over 20 countries and for over 250 different species (Chu 2009). By 2018, rights based management (which mostly involve the use of ITQs) were in place in over 120 countries covering over 850 stocks, representing ~40% of nationally administered stocks globally (derived from data provided by Mindereroo Foundation 2021).

Australia was one of the early adopters of ITQs, which have now been in operation in Australian fisheries for over 35 years. Australia introduced ITQs into the Southern Bluefin Tuna fishery in 1984 (Geen and Nayar 1988), with several State fisheries operating under ITQs from the late 1980s (Pascoe *et al.* 2019). By 2019, 31 ITQ fisheries were in operation in both State and Commonwealth managed fisheries (Pascoe *et al.* 2019), with new ITQ fisheries since being introduced into several State fisheries (e.g. in NSW and Qld). Most Australian ITQ fisheries are single species in nature, although several multispecies fisheries are also subject to ITQ management. Combined, ITQ fisheries were responsible

for ~A\$1.1 billion in terms of gross value of production in 2017–2018, representing almost 60% of the total Australian wild-caught fishery production (Pascoe *et al.* 2019).

ITQs aim to enhance both sustainability and economic performance of fisheries when implemented alongside a total allowable catch (TAC), which limits the total catch and prevents overfishing of the stocks. The ITQ allocates an individual share of the TAC – a quasi-property right to the use of the resource which is transferable (the ‘T’ in ITQ) between fishers, enabling fishers to adjust their fishing operation to maximise their individual returns and correspondingly increasing or decreasing the amount of catch they may take individually. This trade may be through short-term transfers through leasing quota, or permanent transfers through sale or purchase of quota.

Proponents suggest that explicit harvest rights given to the users of a resource in the form of an ITQ create an incentive to minimise the cost of catching their TAC shares, while at the same time maximising the revenue by fishing at times when prices are high (Grafton *et al.* 2006). Different costs and fishing abilities lead to variation among fishers in profits. With the addition of transferability comes the choice of fishers to either continue fishing or transfer (by sale or lease) their quota holdings to other fishers. Fishing effort, and its broader ecosystem effects, should therefore decrease if the fishers that purchase quota are more efficient, and thus spend less time fishing, than those who choose to sell or lease their quota. ITQs have proved an effective remedy for overcapitalisation in many fisheries (Branch 2009).

Although both theory and empirical evidence suggest a robust link between ITQs and economic performance of the fishery (Grafton *et al.* 2000; Costello *et al.* 2008), examples of negative effects also exist, particularly with respect to social outcomes (Hoshino *et al.* 2020b). Some of the negative social effects of ITQs are associated with the perceived inequitable approach taken in the initial ITQ allocation process (Matulich and Sever 1999; Copes and Charles 2004). The allocation process can be particularly difficult when there are different stakeholder groups involved who have different interests and hold different values (Plagányi *et al.* 2013). Other studies of ITQ programmes have also found concentration of fishing power and quota ownership over time leads to fewer and larger companies or owners, and in some cases, increased vertical integration across harvesting, processing and marketing (Yandle and Dewees 2008; van Putten and Gardner 2010; Agnarsson *et al.* 2016; Brinson and Thunberg 2016).

Concentration of fishery or quota ownership by large companies can raise social concerns as those who have access to capital can monopolise the quota market. These extensions of corporate control has sometimes been at the expense of small-scale local interests (Munk-Madsen 1998;

Pinkerton and Edwards 2009). For instance, the development of monopoly powers in the fishery has increased inequality in the distribution of fishery profits, and eroded social norms and cultural heritage in fishing communities (McCay 1995; Sumaila 2010). This has proven to be a particular problem for some groups within Australian fisheries, as benefits of ITQs are not necessarily equally distributed across fishers (van Putten and Gardner 2010; Hoshino *et al.* 2020a).

Varying experiences with the benefits and costs of ITQs in different fisheries and for different fisher groups prompted a call for an inquiry into the quota system by the Australian Commonwealth Government Senate on 7 December 2020. In particular, the Inquiry was directed to examine whether the current ‘managed microeconomic system’ established around a set of ITQs results in good fishing practice. The specific terms of reference included

‘whether the current system results in:

- good fishing practice that is ecologically sustainable with an economic dynamic that produces good community outcomes;
- how the current quota system affects community fishers;
- whether the current system disempowers small fishers and benefits large interest groups;
- the enforceability of ecological value on the current system, and the current system’s relationship to the health of the fisheries;
- whether the current system results in good fishing practice that is ecologically sustainable and economically dynamic, and produces good community outcomes; and
- any other related matters’.

A total of 47 submissions were made to the Inquiry during the open period (7 December 2020–12 March 2021), of which three were confidential and not published on the Inquiry website.<sup>1</sup>

Here, we summarise the key claims in the publicly available submissions by broad stakeholder group to provide an overview of how different stakeholders perceive the costs and benefits of ITQs in Australia. We seek to present a balanced overview and summary of current sentiment based on these submissions around the efficacy of ITQs in achieving environmental, economic and social benefits in Australian fisheries, and note some of the difficulties in modifying existing ITQ systems.

## Methods

The 44 available submissions were divided into three overlapping groups of 30 submissions and reviewed by three

<sup>1</sup>All other submissions are available at: [https://www.aph.gov.au/Parliamentary\\_Business/Committees/Senate/Rural\\_and\\_Regional\\_Affairs\\_and\\_Transport/Fisheriesquota/Submissions](https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Rural_and_Regional_Affairs_and_Transport/Fisheriesquota/Submissions)

co-authors, such that each submission was reviewed by two individuals (i.e. Reviewer 1: 1–30; Reviewer 2: 1–15, 31–44; Reviewer 3: 16–44). A score was assigned for each of four major categories: ecological impacts, social impacts, economic impacts and overall impacts (an overall view of the combined outcomes). A score of +1 was allocated if the submission indicated a favourable ITQ outcome, –1 if a negative outcome was indicated, and 0 if the submission suggested no change as a result of ITQ. If the impact category was not mentioned or discussed, then the score was left blank. The scores of the reviewers for each of the submissions for each category were averaged.

For the purposes of presenting the results, we classified the available 44 submissions into three stakeholder groups, based on information provided with each submission. These were a group consisting of fishers ( $n = 15$ ); a group consisting of Industry Associations ( $n = 15$ ); and a composite group containing submissions from ‘others’ ( $n = 14$ ), including managers, scientists, post-harvest groups, non-fishing quota owners, conservation groups and local councils. The composite groups was necessary due to the small number of submissions from each sub-groups. Most of the ‘other’ group could be considered science-based, as either producing or relying on scientific input for decision making.

The distributions of the scores against each of the outcome areas was assessed graphically for each of the three groups to illustrate the level of coherence in viewpoints. Ordinal logistic regression was also used to estimate the relative likelihood (i.e. proportional odds ratios) that each group would suggest that ITQs had a positive (or negative) ecological, economic and social outcome. The models and associated proportional odds ratios were estimated using the ‘polr’ function (Venables and Ripley 2002) in the R software (ver. 4.1.2, R Foundation for Statistical Computing, Vienna, Austria, see <https://www.R-project.org>).

Several sub-categories of impact were also scored, as a preliminary review suggested these represented common themes across the submissions. These included discussion of sustainability and discards under ecological impacts; local communities, ‘small fishers’ and consumers under social impacts; and lease-dependent fishers (who own little or no quota), and other costs and autonomous adjustment under economic impacts. The same scoring approach as for the broader categories was applied.

Key messages were also summarised for each of the submissions by the authors (3–99 words per submission as short text, with an average of 37 words). These summaries were analysed using quantitative content analysis methods (Roberts 2000), with the summaries scanned using the wordclouds.com online software and the results presented as a word cloud (which captures the most common themes). The summaries were also qualitatively assessed by the project team manually. Such approaches have been applied in

other environmental management applications to identify and assess the importance of drivers of performance (e.g. Kulevich *et al.* 2020).

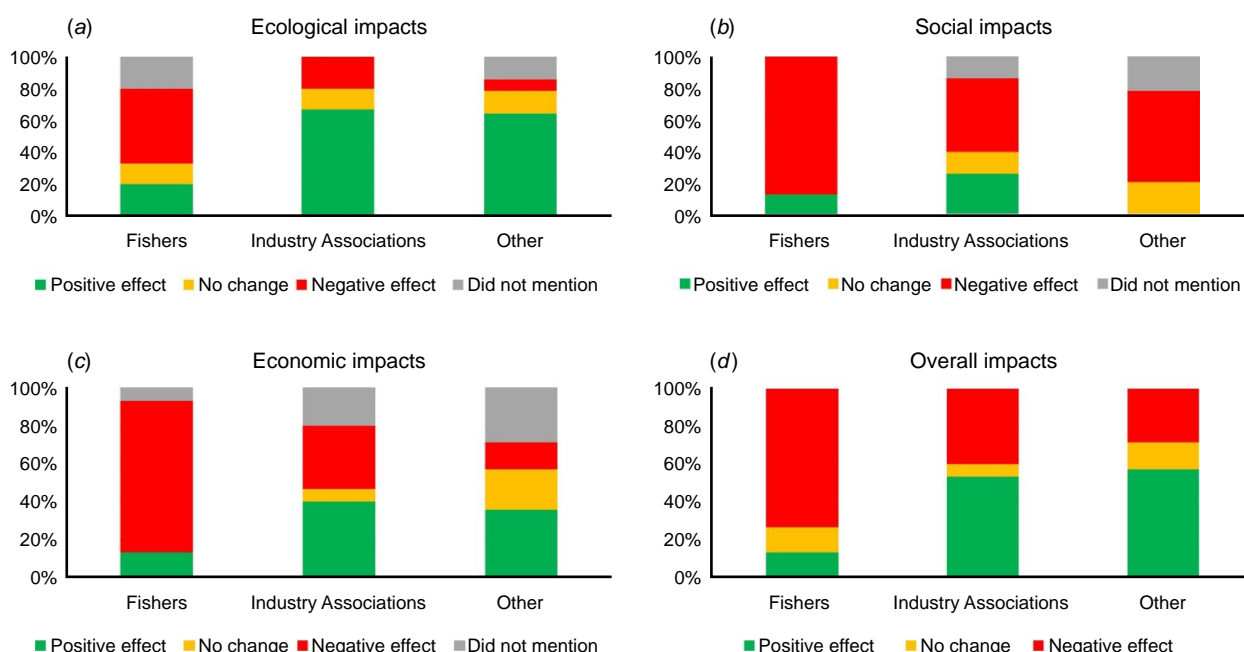
## Overview of responses

Of the 44 available submissions, most (40) reported direct involvement with ITQ fisheries.<sup>2</sup> Two fishers and two Industry Associations did not have direct involvement with ITQs, but were associated with fisheries moving to ITQ control. The subjective assessments (i.e. positive, no change, negative) of the submission reviewers were highly consistent. Instances where one reviewer suggested no significant effect (i.e. score of 0) and the other a positive effect (i.e. score of 1) occurred in less than 5% of the assessments across all measures and submissions, and less than 1% in the case of one reviewer suggesting no effect and the other a negative effect. These cases were subsequently treated in the analysis as a positive and negative effect respectively. No instances occurred where one reviewer suggested a positive effect and the other a negative effect.

The key results for the main categories are summarised in Fig. 1. Fishers had predominately negative perceptions of ITQs across all categories, including ecological impacts, where only 20% believed that ITQs had improved the fisheries ecologically. The two other groups, in contrast, were generally positive with regard to ecological outcomes, but also mixed in terms of the social and economic outcomes. From the ordered logit analysis (Table 1), submissions from Industry Associations were over six times more likely to express a neutral or positive perception around ecological outcomes than fishers, almost nine times more likely to express a neutral or positive perception around economic outcomes, and ~5 times more likely to express a neutral or positive perception around the overall outcomes under ITQs than fishers. Similarly, submissions from the ‘other’ groups were ~10 times, 13 times and 7 times more likely to express a neutral or positive perception around the ecological, economic and overall outcomes respectively under ITQs than fishers. In terms of social outcomes, perceptions elicited from the submission in the ‘others’ category were not significantly different to those of fishers, whereas submissions from the Industry Associations were generally more positive but significant only at the 10% level.

Over half of the fishers submitted that ITQs had a negative effect on sustainability (Fig. 2). This view contrasted with Industry Associations, who generally noted that sustainability and other ecological impacts had improved since the introduction of ITQs. A majority of fishers also noted that discarding had increased (i.e. a negative effect) with the introduction of ITQs, which in part contributed to their negative sustainability conclusions. Other groups also noted that ITQs has had a negative effect in terms of

<sup>2</sup>For the purposes of the paper, comments and statements are not attributed to individual submissions, although all submissions are available.



**Fig. 1.** Distribution of (a) ecological, (b) social, (c) economic and (d) overall impact scores by stakeholder group ( $n = 44$  submissions).

increased discards, although the proportion of submissions raising the issue of discards was lower in the other groups (Fig. 2).

A key focus of the Inquiry was on social impacts, particularly relating to 'small fishers'. With the exception of the management organisation group, nearly all submissions noted that ITQs were associated with predominantly negative social impacts (Fig. 1). These were predominantly linked in the submissions to two main issues: autonomous adjustment – which resulted in reduced fleet activity, consolidation of ownership from small family business to large corporates (i.e. processing companies), declines in employment and flow-on benefits to the local community; and the quota market disadvantaging smaller fishers who had less financial ability to compete for quota against investors and larger operators.

These views were not universally held, however, with some fishers and Industry Associations reporting that some local communities had benefited from ITQs (Fig. 3), mostly through increased security and higher incomes of the remaining fleet. One Industry Association suggested that the allocation system used in their fishery favoured small fishers over larger fishers, and also that many smaller fishers were able to exit the fishery with a financial return if they chose to do so (i.e. no one was or is being forced out).

Effects on consumers were mixed (Fig. 3). Negative effects were generally associated with reduced landings (due to a reduced TAC) and loss of access of consumers to locally caught fish. Conversely, positive effects were linked to better quality product and security of supply. Industry Associations made fewest reference to consumers (40% of submissions), whereas ~75% of submissions from both

other groups commented on consumer impacts, with the mixed 'Other' group only slightly more positive than the fishers in terms of the overall impacts on consumers.

Perceptions of economic impacts due to ITQs were also highly varied across the different stakeholder groups. As with the other outcomes, fishers were largely negative with respect to the effects of ITQs on economic performance (Fig. 1). This was largely associated with impacts on lease-dependent fishers, who were seen to have higher costs due to the need to lease quota, as well as the impacts on other costs (i.e. management costs) associated with ITQs (Fig. 4). Although the other groups also noted these negative aspects of ITQs (Fig. 4), they were generally more positive (or rather less negative) about the overall economic impacts of ITQs (Fig. 1). Several submissions noted a key benefit of ITQs being a reduction in the race to fish, resulting in lower costs to fishers and overall improved economic performance.

Nearly all submissions noted that ITQs resulted in decreased fleet size (autonomous adjustment). However, the effect of this was not seen to be the same by all stakeholders. Fishers, for example, associated decreased fleet size with reduced community benefits (social outcomes), whereas the other groups tended to associate autonomous adjustment with improving sustainability by reducing over-capacity, or improving economic performance of the remaining fleet.

## Content analysis of key messages

Issues around quota ownership were raised in most submissions. Textual analysis of the summary of key issues and



**Table 1.** Ordered logit regression results.

	Value	s.e.	Significance	Proportional odds ratio
Ecological outcomes				
Industry Association	1.815	0.799	**	6.14
Other	2.308	0.887	***	10.05
-1 0	0.312	0.575		
0 1	1.156	0.612	*	
Social outcomes				
Industry Association	1.677	0.935	*	5.35
Other	1.068	0.969		2.91
-1 0	1.792	0.762	**	
0 1	2.556	0.818	***	
Economic outcomes				
Industry Association	2.196	0.958	**	8.99
Other	2.563	0.970	***	12.98
-1 0	1.722	0.766	**	
0 1	2.309	0.805	***	
Overall				
Industry Association	1.625	0.772	**	5.08
Other	1.923	0.782	**	6.84
-1 0	1.066	0.576	*	
0 1	1.605	0.604	***	

Note: the proportional odds ratio represents the degree to which the group members are likely to express a positive or zero (0|1) outcome compared to fishers (the base group). Probabilities are significant at: \*\*\*, 1% level of significance; \*\*, 5% level of significance; \*, 10% level of significance.

notable comments for each submission revealed these key issues. After terms such as 'Quota' and 'ITQ', the most common terms were 'ownership' (raised in 15 submissions), 'investors' (10 submissions) and 'foreign' (raised in 10 submissions). These top three issues are all related, with ownership by investors (foreign or domestic) seen as an overall major issue. The key themes raised are depicted as a word cloud in Fig. 5 (excluding the terms 'Quota' and 'ITQ'), with the size of each word reflecting its relative predominance across submissions.

Issues around ownership of quota by investors was a recurring theme in many of the submissions. Most saw investors as contributing to the key problems in the system, particularly relating to issues facing lease-dependent fishers. Some detailed analyses included in submissions suggested that investors were the main (if not only) beneficiary of ITQs, with the reduced profitability of local lease-dependent fishers highlighted as a concern in many of the

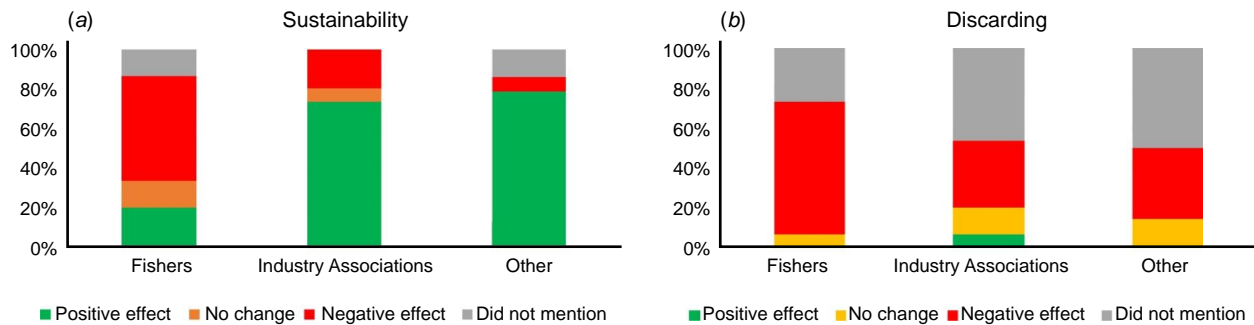
submissions. Similarly, consolidation of quota ownership – whether as an investment or to be used by the purchasing (often corporate) fishers was also often raised as an issue. Several submissions noted that investors were often located outside the region of the fishery, such that benefits generated were not realised in local communities. Some submissions were particularly concerned about foreign ownership of quota, both in terms of diverting ITQ benefits to outside Australia but also in terms of potentially controlling the market for the seafood product. These submissions generally advocated limits on quota holdings by non-active fishers.

Not all submissions, however, were anti-investor. Two Industry Association submissions noted that many of the 'investors' in the fishery were previously fishers who had retired or left the fishery for family reasons. These fishers, they claimed, still lived in the local community and contributed to community benefits.

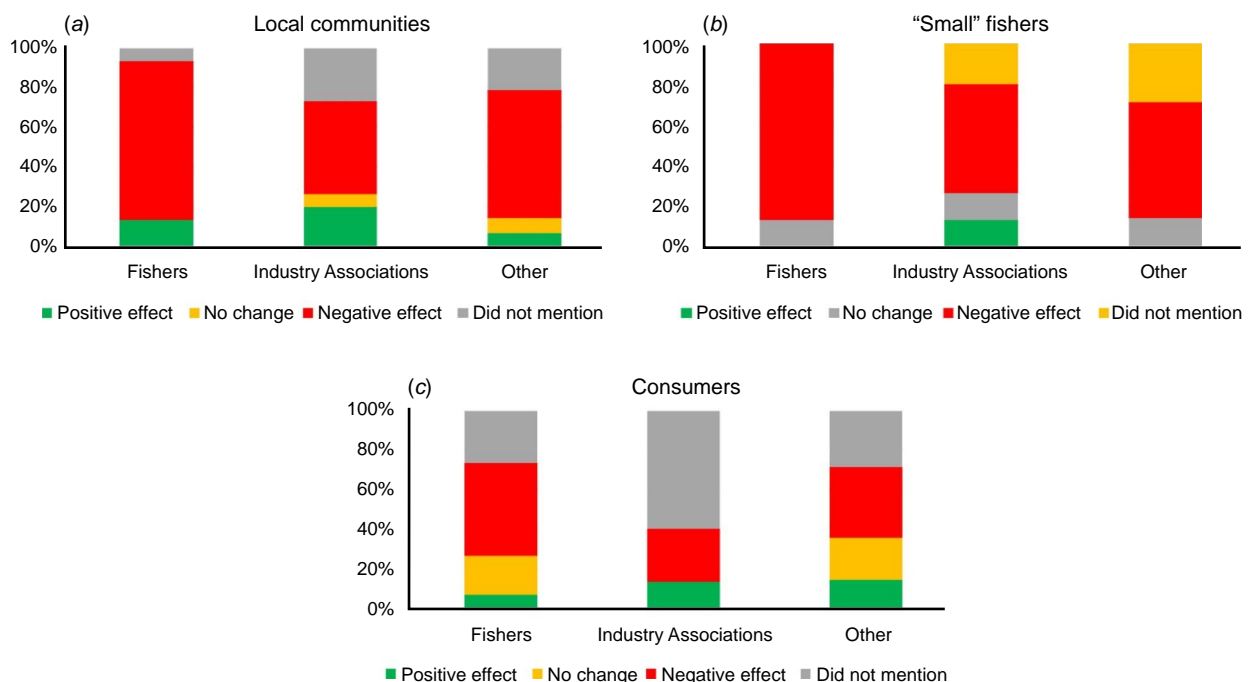
Two submissions noted that fish processors who had purchased quota benefited financially by leasing quota to fishers, but this also secured a reliable seafood supply to enhance their own business viability. From the fisher perspective, however, the perception is that they are locked in to supplying processors at a below-market price. Two other submissions noted that fishers were afraid of speaking out in a fear of being denied access to quota and market. Finally, the cost of purchasing ITQs, and access to quota, was noted as a barrier to entry for new fishers. Again, this was often associated with issues around concentration of quota ownership and the role of investors in the quota market.

Six submissions (predominantly from Industry Associations and scientists) noted that, although ITQs are not perfect, they are better than the alternative – namely input controls – in terms of improving sustainability and economic outcomes. One submission noted that output control via competitive TACs also provided sustainability benefits, but allowing them to be individual and tradable (i.e. adding in the 'I' and the 'T') created a system with positive economic benefits. However, as noted in several of these submissions, removing overcapacity – essential to achieve these positive outcomes – is detrimental to local communities in some cases, as it reduces participation in the fishery. One submission noted that ITQ are not 'one-size-fits-all' and should not be applied to all fisheries as a universal approach. Instead, its applicability to a specific fishery should be assessed based on the characteristics of the fishery.

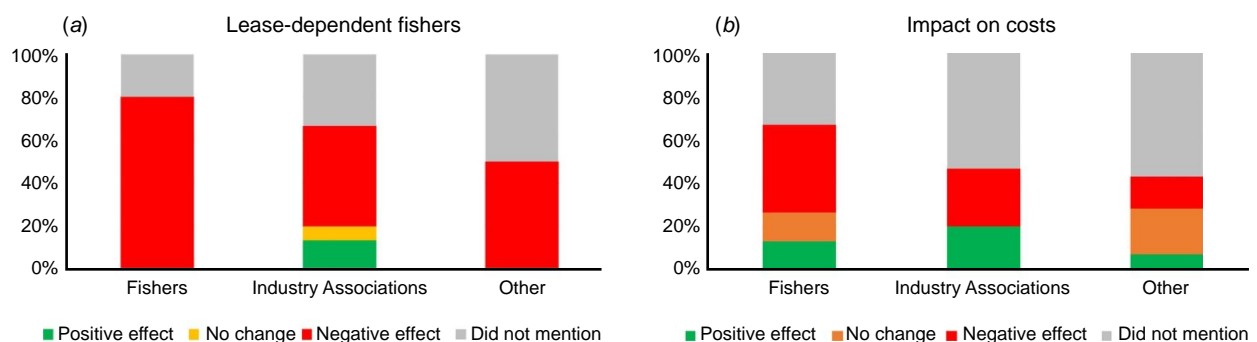
The fishers who made independent submissions generally saw themselves as highly disadvantaged by ITQs. In two cases, the fishers were not yet subject to ITQ management, but wanted to prevent it happening based on expectations and information gained from other fishers in other jurisdictions (and published studies thereof). This contrasts with the views of Industry Organisations, which were overwhelmingly supportive of ITQ management, while still acknowledging some negative aspects. This suggests that either (i) the fishers who made submissions may not have been



**Fig. 2.** Summary of key ecological impacts [(a) sustainability and (b) discarding] reported by stakeholder group in their submissions ( $n = 44$ ).



**Fig. 3.** Summary of impacts on (a) local communities, (b) 'small' fishers and (c) consumers by stakeholder group as noted from submissions ( $n = 44$ ).



**Fig. 4.** Perceptions of economic impacts on (a) lease-dependent fishers and (b) costs by stakeholder group ( $n = 44$ ).



**Fig. 5.** Word cloud of key issues related to ITQs in Australia noted in the summary created by the authors for each submission.

representative of the larger body of fishers; (ii) that the Industry Organisations may not be in touch with the smaller-scale fishers in their organisation (if any); or (iii) that the Industry Organisations take a broader perspective on the impacts of ITQs on the whole fishery rather than individual circumstances.

As noted by a reviewer of an earlier draft of this analysis, the Industry Organisations largely represent quota owners rather than fishers who may be more lease-dependent. A recent study by Hoshino *et al.* (2020a) found that quota ownership status can have a significant effect on perceptions of fishery performance. The views expressed by the fishers who made submissions were also substantially more negative than those found in a national survey of ITQ fishers (Pascoe *et al.* 2019),<sup>3</sup> further suggesting that the fisher group may not be representative of the broader fisher community.

Finally, one submission noted that fishers are often resistant to change and see the loss of individual freedom under an ITQ system around catching what and how much they like as a major deterrent to their acceptability by industry. This would also cloud their perceptions around other features of an ITQ program, including impacts on sustainability and economic performance. This observation is consistent with the views expressed in the submissions by fishers, who overwhelmingly suggested that ITQs resulted in a reduction in sustainability and economic outcomes (as well as social outcomes).

### What is the future of ITQ systems?

ITQs in Australia and elsewhere are seen as a successful management approach to reducing overfishing and overcapacity (Pascoe *et al.* 2019). Disquiet among some sectors of the seafood industry, however, has attracted the attention of the National Government. The Terms of Reference for the Inquiry were specifically focused on social outcomes, particularly effects on 'small' and 'community' fishers. Four of the six terms of reference made specific reference to the impact on these groups. As a consequence, these effects were the focus of many of the submissions. Autonomous adjustment, a key feature of ITQ management that facilitates improved sustainability and economic performance by reducing overcapacity, is also generally associated with reduced local employment and regional economic impacts (Hoshino *et al.* 2020b).

Although overall submission numbers were limited, quota ownership was a recurrent theme, mostly related to issues of ownership by non-fishers. Of concern by most submissions, when raising the issue around ownership, was the transfer of economic benefits from fishers to investors, some of which were believed to live outside the area of the fishing community (thus transferring benefits away from the local communities) or even overseas (thus transferring the benefits away from the broader Australian community). The degree to which restrictions on ownership, as

<sup>3</sup>A summary of this broader survey was also submitted for consideration by the Inquiry and is available on the Inquiry website.

proposed in several submissions, can or should be implemented is a policy question for further consideration.

The submissions, while limited, highlighted the different perceptions of different stakeholder groups about the overall benefits of adopting an ITQ program, which, while in this study focused on Australia, we believe are generalisable to other jurisdictions worldwide. Even when consistent in terms of trends (if not magnitude of trends), the submissions highlighted that a trade-off between different management objectives will continue to be necessary in many fisheries in Australia and elsewhere, where the trade-offs will predominantly be between economic and sustainability outcomes against social impacts.

The Inquiry will face several challenges while considering the future of ITQs in Australia based on the set of submissions presented. First, the Inquiry will need to consider the potential representativeness issues in the submissions themselves, reconciling the conflicting views within and between the different industry-based submissions as well as with those from the more science-based submissions. The limited number of submissions based on differing levels of information (e.g. anecdotal in some cases and more objective in others) and low consistency between submissions exemplifies the challenges with policy development in fisheries, especially when aiming to appease multiple stakeholders with differing objectives. In this regard, while focused on ITQs in particular, the Senators will have to decide on what they consider to be the key aims of fisheries management in Australia when making their recommendations, and what are the acceptable trade-offs between the key triple bottom line objectives. The report from the Inquiry is now due in March 2022, and the recommendations will then be considered by fisheries managers and legislators across the diverse Australian jurisdictions.

## References

- Agnarsson S, Matthiasson T, Giry F (2016) Consolidation and distribution of quota holdings in the Icelandic fisheries. *Marine Policy* 72, 263–270. doi:10.1016/j.marpol.2016.04.037
- Branch TA (2009) How do individual transferable quotas affect marine ecosystems? *Fish and Fisheries* 10(1), 39–57. doi:10.1111/j.1467-2979.2008.00294.x
- Brinson AA, Thunberg EM (2016) Performance of federally managed catch share fisheries in the United States. *Fisheries Research* 179, 213–223. doi:10.1016/j.fishres.2016.03.008
- Christy FTJ (1973) Fisherman quotas: a tentative suggestion for domestic management. Report, National Technical Information Service, Washington, DC, USA.
- Chu C (2009) Thirty years later: the global growth of ITQs and their influence on stock status in marine fisheries. *Fish and Fisheries* 10(2), 217–230. doi:10.1111/j.1467-2979.2008.00313.x
- Copes P, Charles A (2004) Socioeconomics of individual transferable quotas and community-based fishery management. *Agricultural and Resource Economics Review* 33, 171–181. doi:10.1017/S106828050000575X
- Costello C, Gaines SD, Lynham J (2008) Can catch shares prevent fisheries collapse? *Science* 321(5896), 1678–1681. doi:10.1126/science.1159478
- Geen G, Nayar M (1988) Individual transferable quotas in the Southern Bluefin tuna fishery: an economic appraisal. *Marine Resource Economics* 5(4), 365–387. doi:10.1086/mre.5.4.42628936
- Grafton RQ, Squires D, Fox KJ (2000) Private property and economic efficiency: a study of a common-pool resource. *The Journal of Law & Economics* 43(2), 679–714. doi:10.1086/467469
- Grafton RQ, Arnason R, Bjørndal T, Campbell D, Campbell HF, Clark CW, Connor R, Dupont DP, Hannesson R, Hilborn R, Kirkley JE, Kompas T, Lane DE, Munro GR, Pascoe S, Squires D, Steinshamn SI, Turriss BR, Weninger Q (2006) Incentive-based approaches to sustainable fisheries. *Canadian Journal of Fisheries and Aquatic Sciences* 63(3), 699–710. doi:10.1139/f05-247
- Hannesson R (1996) On ITQs: an essay for the special issue of reviews in fish biology and fisheries. *Reviews in Fish Biology and Fisheries* 6(1), 91–96. doi:10.1007/BF00058521
- Hoshino E, van Putten I, Pascoe S, Vieira S (2020a) Does quota ownership affect perceptions of fishery performance? *Marine Policy* 120, 104155. doi:10.1016/j.marpol.2020.104155
- Hoshino E, van Putten I, Pascoe S, Vieira S (2020b) Individual transferable quotas in achieving multiple objectives of fisheries management. *Marine Policy* 113, 103744. doi:10.1016/j.marpol.2019.103744
- Kulevich RA, Porfirio GEO, da Oliveira OS, Zavala AAZ, da Silva BA, Constantino M (2020) Influence of sustainability reports on social and environmental issues: bibliometric analysis and the word cloud approach. *Environmental Reviews* 28(4), 380–386. doi:10.1139/er-2019-0075
- Marchal P, Andersen JL, Aranda M, Fitzpatrick M, Goti L, Guyader O, Haraldsson G, Hatcher A, Hegland TJ, Le Floch P, Macher C, Malvarosa L, Maravelias CD, Mardle S, Murillas A, Nielsen JR, Sabatella R, Smith ADM, Stokes K, Thøgersen T, Ulrich C (2016) A comparative review of fisheries management experiences in the European union and in other countries worldwide: Iceland, Australia, and New Zealand. *Fish and Fisheries* 17(3), 803–824. doi:10.1111/faf.12147
- Matulich SC, Sever M (1999) Reconsidering the initial allocation of ITQs: the search for a pareto-safe allocation between fishing and processing sectors. *Land Economics* 75(2), 203–219. doi:10.2307/3147006
- McCay BJ (1995) Social and ecological implications of ITQs: an overview. *Ocean and Coastal Management* 28(1–3), 3–22. doi:10.1016/0964-5691(96)00002-6
- Minderoo Foundation (2021) The global fishing index: assessing the sustainability of the World's marine fisheries. Report, Minderoo Foundation, Perth, WA, Australia.
- Moloney DG, Pearse PH (1979) Quantitative rights as an instrument for regulating commercial fisheries. *Journal of the Fisheries Research Board of Canada* 36(7), 859–866. doi:10.1139/f79-124
- Munk-Madsen E (1998) The Norwegian fishing quota system: another patriarchal construction? *Society & Natural Resources* 11(3), 229–240. doi:10.1080/08941929809381075
- 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. Report, FRDC, Canberra, ACT, Australia.
- Pinkerton E, Edwards DN (2009) The elephant in the room: the hidden costs of leasing individual transferable fishing quotas. *Marine Policy* 33(4), 707–713. doi:10.1016/j.marpol.2009.02.004
- Plagányi EE, van Putten I, Hutton T, Deng RA, Dennis D, Pascoe S, Skewes T, Campbell RA (2013) Integrating indigenous livelihood and lifestyle objectives in managing a natural resource. *Proceedings of the National Academy of Sciences of the United States of America* 110(9), 3639–3644. doi:10.1073/pnas.1217822110
- Roberts CW (2000) A conceptual framework for quantitative text analysis. *Quality & Quantity* 34(3), 259–274. doi:10.1023/A:1004780007748
- Smith ADM, Smith DC (2001) A complex quota-managed fishery: Science and management in Australia's south east fishery. Introduction and overview. *Marine and Freshwater Research* 52(4), 353–360. doi:10.1071/MF01029
- Sumaila UR (2010) A cautionary note on individual transferable quotas. *Ecology and Society* 15(3), art36. doi:10.5751/ES-03391-150336
- van Putten I, Gardner C (2010) Lease quota fishing in a changing rock lobster industry. *Marine Policy* 34(5), 859–867. doi:10.1016/j.marpol.2010.01.008
- Venables WN, Ripley BD (2002) Generalized linear models. In 'Modern applied statistics with S'. (Springer New York: New York, NY, USA)
- Yandle T, Dewees CM (2008) Consolidation in an individual transferable quota regime: lessons from New Zealand, 1986–1999. *Environmental Management* 41(6), 915–928. doi:10.1007/s00267-008-9081-y



**Data availability.** All data used in the study derive from the Inquiry website previously cited.

**Conflicts of interest.** The authors declare that they have no conflicts of interest.

**Declaration of funding.** This research did not receive any specific funding.

**Author affiliations**

<sup>A</sup>CSIRO Oceans and Atmosphere, Queensland Biosciences Precinct, 306 Carmody Road, Saint Lucia, Qld 4067, Australia.

<sup>B</sup>CSIRO Oceans and Atmosphere, 3–4 Castray Esplanade, Battery Point, Tas. 7004, Australia.