STRATEGIES TO IMPROVE ITQ MANAGED FISHERIES

Professor Caleb Gardner

Institute for Marine and Antarctic Studies (IMAS)
College of Sciences and Engineering
University of Tasmania

IMAS previously provided a submission to the inquiry on "The Fisheries Quota System" which covered the main issues and problems that have arisen with quota systems as implemented in Australia. These are not unique to Australia and have been discussed extensively in fisheries management worldwide.

We now have a list of the problems and issues so are confronted with the next step – what can be done? How can we keep the desirable aspects of ITQs but solve the problems? There's often a perception that it's too late to change course and that ITQs are now locked in place in their current structure, however this has not been the history overseas.

This submission attempts to give the inquiry committee some options for altering ITQ fisheries based on experiences of other countries. It's helpful to understand that Australian fisheries tend to be the extreme of ITQ management in some respects, perhaps because we were early adopters and had less opportunity to learn from experiences elsewhere.

Australian ITQ fisheries tend to have been implemented with much greater intent to reduce employment and increase rent (private) payments i.e. they are they are at the extreme in prioritising efficiency and rent payments to quota investors above employment and economic benefits to regional communities. Australian fisheries management is unusual in the privatisation of economic yield and the absence of elements to produce a community return from commercial fisheries. This is surprising because Australian legislation is unusually clear that this should be a management objective. More positively, Australian ITQ fisheries are at the leading edge of modifications that deal with over-runs, bycatch and other difficult biological elements of ITQs in multi-species fisheries.

The tables below provide examples of changes that have been made to ITQ fisheries. This extensive list demonstrates that ITQ fisheries can be improved if there is a will. The examples are split into four categories:

1. Strategies to increase economic benefit to the community by increasing employment. Most involve a reduction in efficiency and economic rent (page 2).

2. Strategies to increase economic benefit to the community by managing the flow of rents. Most involve directing the economic rent from the fishery away from private firms and towards the community (page 8).

3. Strategies to increase economic performance of private firms. These benefit the private holders of ITQ shares and may involve reduced community benefit (page 15).

4. Strategies to improve decision making by government (page 17).

These examples are given not because they're all good ideas or suited to Australia (although many are), but to emphasise that there are many options for adjusting the management ITQ fisheries. None of the examples found in the literature involved compensation payments to quota share holders or any other payout as often occurs in Australia when management changes are made.

Many of the examples conflict with other options because they're addressing different objectives. This shows that a critical first step in improving ITQ managed fisheries is being explicit on objectives for the fishery. Does the government want fisheries that prioritise employment or efficiency? Food supply to consumers or economic rents? Rent payments to private shareholders or the community? New entrants or capital growth in shares? These questions are ideally resolved by elected representatives and clearly defined in objectives of legislation.

Current Australian Commonwealth legislation is already clear that fisheries should be managed to maximise economic benefit to the Australian community. If this objective is to be taken seriously in Australia then changes to the implementation of ITQ fisheries must occur. This is because our current systems cannot be said to be maximising community benefit while they are structured to reduce seafood supply (by TACs below MSY), reduce employment (by transferable catch shares and reduction of input controls), and reduce public economic return (by enabling privatisation and export of rents).

1. STRATEGIES TO INCREASE ECONOMIC BENEFIT TO THE COMMUNITY BY INCREASING EMPLOYMENT		
Subdivide ITQ catch shares into different shares for different spatial regions, seasons for harvesting, different sizes, and other market traits.		
A part of the total allowable catch (TAC) is now reserved for smaller Baltic vessels to maintain employment in regional communities	Sweden	Brady, M. and Waldo, S. (2009). Fixing problems in fisheries-integrating ITQs, CBM and MPAs in management, Marine Policy 33, 258-263.
Quotas have been divided into smaller regional areas with local landing provisions to reduce consolidation and maintain landings into coastal towns.	USA Pacific Coast groundfish trawl, North Pacific halibut and sablefish, Gulf of Mexico Snapper	Ropicki, A., Willard, D. and Larkin, S. L. (2018). Proposed policy changes to the Gulf of Mexico red snapper IFQ program: Evaluating differential impacts by participant type, *Ocean & Coastal Management* 152, 48-56.
Take management of regional ITQ shares PLUS regulate trading between regions to keep small towns viable.		
Municipal areas were required to approve (and could veto) transfers of quota between regions. This needed to be paired with a control that the quota was allocated to vessels and could not be separated and sold to remote investors.	Observations from Iceland	Agnarsson, S., Matthiasson, T. and Giry, F. (2016). Consolidation and distribution of quota holdings in the Icelandic fisheries, Marine Policy 72, 263-270.
Quota holders allowed to operate as usual but new rules controlled which area they could sell their quota shares into. This gradually	Norway	Hannesson, R. (2013). Norway's experience with ITQs, *Marine Policy* 37, 264-269.

restored fishing economies in regional towns.		
Sub-dividing quota into different gear / vessel types		
Similar approach to spatial divisions in quotas but applied to gear types. Quotas were split across netting and trawl in the sole fishery with a conversion system to shift effort from netting away from more ecologically destructive trawl gear.	France	Bellanger M., Macher C., Merzéréaud M., Guyader O. and Le Grand C. (2018). Investigating trade-offs in alternative catch share systems: An individual-based bio-economic model applied to the Bay of Biscay sole fishery, Canadian Journal of Fisheries and Aquatic Sciences 75(10), 1663-1679.
Quota was divided into three different vessel size categories to prevent it consolidating onto a small number of large vessels with low employment.	Canada	Dawson, R. (2006). Vertical integration in the post-IFQ halibut fishery, *Marine Policy* 30, 341-346.
Sub-dividing quota into different gear / vessel types PLUS regulate trading to shift catch to boats with more employment benefit		
Two different licence categories were created to maintain employment in smaller fishing regions. These were "regular quota" (large trawlers) and hook and line quota. Leasing ("transfers") were only allowed in one direction-towards the small hook and line fishers.	Observations from Iceland	Agnarsson, S., Matthiasson, T. and Giry, F. (2016). Consolidation and distribution of quota holdings in the Icelandic fisheries, Marine Policy 72, 263-270.
Splitting of existing catch shares into new categories linked to vessel sizes with controls on trading to shift catch to higher employment, smaller vessels.	Gulf of Mexico snapper, Bering Sea pollock, BSAI king and tanner crab, North Pacific halibut and sablefish, Pacific Coast groundfish trawl	Ropicki, A., Willard, D. and Larkin, S. L. (2018). Proposed policy changes to the Gulf of Mexico red snapper IFQ program: Evaluating differential impacts by participant type, *Ocean & Coastaarticipantnt* 152, 48-56.
Quota holders allowed to operate as usual but new rules controlled which vessel types they could sell their quota shares into. This gradually restored employment on small vessels.	Norway	Hannesson, R. (2013). Norw'y's experience with ITQs, *Marine Policy* 37, 264-269.
Change the allocation of the catch share so it must be linked to a registered vessel licence so you must own a vessel in survey to own quota. Linked to this are systems that require the quota holder to be aboard when the catch is taken.		
This reduces the separation between fishers and ITQ shareholders. It reduces the likelihood of catch shares being held by investors.	Observations from Iceland	Gunnlaugsson, S.B., Saevaldsson, H., Kristofersson, D.M. and Agnarsson, S. (2020). Resource rent and its distribution in Iceland's fisheries, *Marine Resource Economics* 35, 113-135.

		And Agnarsson, S., Matthiasson, T. and Giry, F. (2016). Consolidation and distribution of quota holdings in the Icelandic fisheries, Marine Policy 72, 263-270.
"Contract Fishing" or leasing was disallowed	Iceland	Eythórsson, E. (2000). A decade of ITQ-management in Icelandic fisheries: consolidation without consensus, Marine Policy 24, 483-492.
Stated intent was to ensure that the person owning the catch shares is not a passive remote investor but an active fisher who is more engaged in stewardship.	US NE Groundfishery	Da-Rocha, J.-M. and Sempere, J. (2017). ITQs, Firm Dynamics and Wealth Distribution: Does Full Tradability Increase Inequality?, Environmental and Resource Economics 68, 249-273.
The Netherlands provides a strong incentive for investors to sell shares to owner-operators. A fisher can cease fishing and lease shares out to other fishers (i.e. become an investor). But if they are not fished by an owner-operator for more than 5 years, the ITQ shares are forfeited to the government.	Netherlands	Hoefnagel, E. and de Vos, B. (2017). Social and economic consequences of 40 years of Dutch quota management, Marine Policy 80, 81-87.
Employment could be increased by requiring catch to be taken by individual that owns quota units (i.e. blocking leasing of quota shares). It was proposed that non-owner skippers be allowed for a limited period to work the boat in case of illness, etc. To own quota units, an individual would be required to own a licensed fishing vessel and to have a "skipper's ticket". At the end of a specified period of not meeting these criteria, an owner would be required to sell or forfeit quota units. Proposed an adjustment period to introduce retrospectively.	Tasmania, Australia	Bradshaw, M. (2004). The Market, Marx and Sustainability in a Fishery, Antipode 36(1), 66-85.
The Tasmanian abalone ITQ system was originally proposed to require catch to be taken by quota holders.	Tasmania, Australia	Harrison, 1984. Australian Fisheries.
ITQ share owners were required to be aboard vessels when catch was taken to increase potential for private rents to trickle down to the benefit of the regional community	Gulf of Mexico Snapper, North Pacific halibut and sablefish, Pacific Coast	Ropicki, A., Willard, D. and Larkin, S. L. (2018). Proposed policy changes to the Gulf of Mexico red snapper IFQ program: Evaluating differential

Reduced ownership by remote investors.	fixed-gear sablefish	impacts by participant type, Ocean & Coastal Management 152, 48-56.
Quota holder required to be aboard when catch is taken.	Halibut, Canada	Dawson, R. (2006). Vertical integration in the post-IFQ halibut fishery, *Marine Policy* 30, 341-346.
Allow some lease trading (intra-season transfers) but limit this to keep ownership and rents linked to people / community.		
Rules were introduced to (i) require shareholders to own a vessel and annual individual quota is allocated to the vessel, then (ii) a rule to ensure that these vessels are active with 50% of the ITQ must be caught by the vessel it's allocated to .	Observations from Iceland	Gunnlaugsson, S.B., Saevaldsson, H., Kristofersson, D.M. and Agnarsson, S. (2020). Resource rent and its distribution in Iceland's fisheries, *Marine Resource Economics* 35, 113-135.
Increase fisher income by unionising the fishing fleet PLUS use government involvement to regulate the lease price or fishing fee.		
The fleet unionised and had government involvement in setting payments. This was to ensure lease fishers received a minimum fixed portion of catch value or a fixed lease price. This prevented the use of an open market for quota leasing which was previously used to reduce fisher income.	Observations from Iceland	Gunnlaugsson, S.B., Saevaldsson, H., Kristofersson, D.M. and Agnarsson, S. (2020). Resource rent and its distribution in Iceland's fisheries, *Marine Resource Economics* 35, 113-135.
Unionisation was used to increase returns to fishing employees and communities. Collective action occurred with two strikes by fishers to force lower lease payments to quota holders / higher catch fees to fishers.	Observations from Iceland	Eythórsson, E. (1996). Theory and practice of ITQs in Iceland. Privatization of common fishing rights, Marine Policy 20, 269-281.
Prevent monopolies and reduce risk of quota market failure with maximum quota holding limits		
Maximum holding limits of quota shares for different fish species set as a percent of the total (using a system based on "cod-equivalents").	Observations from Iceland	Agnarsson, S., Matthiasson, T. and Giry, F. (2016). Consolidation and distribution of quota holdings in the Icelandic fisheries, Marine Policy 72, 263-270.
Consolidation constrained with caps on number of shares that can be held.	Gulf of Mexico snapper.	Ropicki, A., Willard, D. and Larkin, S. L. (2018). Proposed policy changes to the Gulf of Mexico red snapper IFQ program: Evaluating differential impacts by participant type, Ocean & Coastal Management 152, 48-56.
Maximum (and minimum) quota unit holdings originally proposed for the Tasmanian abalone ITQ system, in combination with a requirement for catch to be taken by quota holders.	Tasmania, Australia	Harrison, 1984. Australian Fisheries.
Limit the amount of catch that can be taken by single vessel or operator		

Many countries (Inc. Australia) use rules on quota share ownership to limit consolidation, but the employment benefits of these are thwarted to some extent by annual leasing. So use limits on units that can be caught per vessel / operator.	Suggestions from New Zealand	Bodwitch, H. (2017). Challenges for New Zealand's individual transferable quota system: Processor consolidation, fisher exclusion, & Māori quota rights, Marine Policy 80, 88-95.
Maintain employment by setting a minimum number of vessels in the fishery		
The fishery originally set a limit of a minimum of 220 vessels. Government had the ability to keep vessels above this limit using input controls in conjunction to ITQs (eg reduce season length or vessel gear limits). Eventually policy shifted in favour of lower employment/higher rents and the rule was scrapped (which is another example of changing management of an existing ITQ fishery).	Tasmania, Australia	van putten, I. and C. Gardner (2010). Lease quota fishing in a changing rock lobster fishery, Marine Policy 34, 859-867.
Create new quota and opportunities for new entrants into an ITQ fishery		
A new allocation was introduced for a portion of the TAC, and was available to citizens regardless of whether they already had quota shares. These were issued outside the existing ITQ shares and were a different category. They had simple separate effort controls (handline only, 14 hour day limits, regional competitive TAC). TAC was reduced for existing shareholders to maintain stocks.	Observations from Iceland	Agnarsson, S., Matthiasson, T. and Giry, F. (2016). Consolidation and distribution of quota holdings in the Icelandic fisheries, Marine Policy 72, 263-270.
Enable new entrants by reducing rent yield and therefore price of quota shares		
The introduction of a return to the community from harvesting of fisheries resources (ie catch fee) not only provided community benefit but also lowered quota share sale price and increased access to new entrants.	Observations from Iceland	Matthiasson, T (2008). Rent Collection, Rent Distribution, and Cost Recovery: An Analysis of Iceland's ITQ Catch Fee Experiment, Marine Resource Economics 23, 105-117.
Reduce contraction in ports of landing and processor employment with "processor quota"		
Uses ITQs with consolidation and regional controls for receipt of product into processors in addition to the usual ITQs on landings. These were introduced after ITQs on harvests. The ITQs left many processors stranded unless they controlled market share by buying catch quota.	Alaska, USA	Matulich, S.C. and Sever, M. (1999). Reconsidering the Initial Allocation of ITQs: The Search for a Pareto-Safe Allocation between Fishing and Processing Sectors, Land Economics 75, 203-219.

Promote cooperative use of quota shares		
Can be used to achieve benefits like efficient capital usage with less loss of community distribution as is more typical with ITQs.	USA	Criddle, K.R. and Macinko, S. (2000). A requiem for the IFQ in US fisheries?, Marine Policy 24, 461-469.
Cancel existing fishing licences (with 10 years lag)		
Clearly a drastic response to concerns about loss of community benefit with ITQs but in 2007, Parliament in the Faroe Islands initiated a reset prompted by the societal inequality created by ITQ systems. They cancelled existing harvesting licenses, with this scheduled for 10 years to enable operators to de-invest.	Faroe Islands	Danielsen, R. and Agnarsson, S. (2018). Fisheries policy in the Faroe Islands: Managing for failure?, Marine Policy 94, 204-214.
Require bundling of quota sales of different species in attempt to keep quota ownership with fishers rather than remote investors / share traders.		
Applies to permanent sale rather than annual leasing and forces quota of different species to be kept together into functional groupings that are used by owner-operators.	Northeast multispecies groundfish, Atlantic scallops, Gulf of Mexico snapper.	Ropicki, A., Willard, D. and Larkin, S. L. (2018). Proposed policy changes to the Gulf of Mexico red snapper IFQ program: Evaluating differential impacts by participant type, Ocean & Coastal Management 152, 48-56.
Change the fishery to ITE from ITQ		
Shifting to ITE was not proposed in WA but this paper makes the point that ITEs can be used to produce all the same ecosystem benefits with fewer of the economic and social problems of ITQs. Most fisheries can be easily shifted from ITQ to ITE by increasing the constraining effect of input controls (eg reduce gear limits) and decreasing the constraining effect of output controls (eg raise the catch allocation per share).	Western Australia	Penn, J.W., Caputi, N. and de Lestang, S. (2015). A review of lobster fishery management: the Western Australian fishery for Panulirus cygnus, a case study in the development and implementation of input and output-based management systems, ICES Journal of Marine Science 72, 22-34.
The process of shifting a fishery from ITQ to ITE occurred in a Tasmanian fishery, essentially by accident. But this experience showed that the change can be made easily and quickly if desired and leads to an immediate increase in employment.	Tasmania, Australia	Emery, T.J., Hartmann, K., Green, B. S., Gardner, C. and Tisdell, J. (2014). Does 'race to fish' behaviour emerge in an individual transferable quota fishery when the total allowable catch becomes non-binding?, Fish and Fisheries 15, 151-169.
Regulate the ITQ share leasing market so that it provides specific employment goals		
ITQ shares provided to First Nation communities is leased to fishing firms. These firms are required to	Canada	Edwards, D.N. and Pinkerton, E. (2019a). Rise of the investor class in the British Columbia Pacific halibut fishery, Marine Policy, 109, 103676.

participate in employment programs for First Nation people.		
Tasmanian government use this system to provide Aboriginal employment opportunities by selectively leasing state-held units to an Aboriginal community.	Tasmania, Australia	https://www.abc.net.au/news/2022-03-18/indigenous-tasmanians-commerical-abalone-fisheries-deal/100916392
Change the objectives of the government's harvest strategy to include employment and other economic indicators besides MEY (or proxies).		
This is rarely done formally but one example occurs in France with a process called the "co-viability" approach. Most ITQ harvest strategies target MEY and forego other possible objectives like employment or supply of seafood to retailers. It drives different TAC decisions to what would occur in Australia.	France	Bellanger M., Macher C., Merzéréaud M., Guyader O. and Le Grand C. (2018). Investigating trade-offs in alternative catch share systems: An individual-based bio-economic model applied to the bay of biscay sole fishery, *Canadian Journal of Fisheries and Aquatic Sciences* 75(10), 1663-1679.
Regulation to promote sale or forfeit of "sleeper holdings"		
"Sleeper holdings" refers to the problem of quota shareholders not using quota and can occur for a range of reasons. This behaviour may prevent the full usage of economically viable fisheries. "Use it or loose it" strategies are common in other industries.	Australia	Connor, R. and Alden, D. (2001). Indicators of the effectiveness of quota markets: The South East Trawl Fishery of Australia, Marine and Freshwater Research 52, 387-397.

2. STRATEGIES TO INCREASE ECONOMIC BENEFIT TO THE COMMUNITY BY MANAGING THE FLOW OF RENTS		
Create new transferrable catch shares and give these to indigenous and recreational fishers and enable access to be reallocated with markets between these groups and existing ITQ share holders.		
Provides a market-based approach to the difficult government problem of allocating catch to different users.	Opinion on options for Icelandic Fisheries	Arnason, R. (2005). Property Rights in Fisheries: Iceland's Experience with ITQs, Reviews in *Fish Biology and Fisheries* 15, 243-264.
Create new transferrable catch shares and give these to communities, regions or groups rather than private individuals		
Proposed as a solution for industry-government conflict.	Opinion on options for Icelandic Fisheries	Arnason, R. (2005). Property Rights in Fisheries: Iceland's Experience with ITQs, Reviews in *Fish Biology and Fisheries* 15, 243-264.

"The community development quota (CDQ) program in Alaska is built around royalty leasing, and it is widely celebrated as a success precisely because of the royalty leasing arrangements, not in spite of them…this exposes the fallacy in the long-standing notion that catch assignments must be permanent."	Applied in USA	Macinko, S. and Bromley, D.W. (2004). Property and fisheries for the twenty-first century: seeking coherence from legal and economic doctrine, Vermont Law Review 28, 623-661.
Difficult to implement after ITQ shares have been given private firms but new shares can be issued to cooperatives or communities (also called "community quota funds (CQFs).	Opinion from western USA ground fishery	Russell, S. M., Oostenburg, M. V. and Vizek, A. (2018). Adapting to Catch Shares: Perspectives of West Coast Groundfish Trawl Participants, *Coastal Management*, 46(6), 603-620.
ITQs allocated to coops or regional "producer organisations" rather than individuals.	Applied in France	Bellanger, M., C. Macher and O. Guyader (2016). A new approach to determine the distributional effects of quota management in fisheries. Fisheries Research 181, 116-126.
Combined a change in catch allocation to shares held by a community with coop system for fishers to reverse loss of regional fishing towns.	Denmark	Dinesen, G.E., Rathje, I.W., Højrup, M., Bastardie, F., Larsen, F., Sørensen, T. K., Hoffmann, E. and Eigaard, O. R. (2018). Individual transferable quotas, does one size fit all? Sustainability analysis of an alternative model for quota allocation in a small-scale coastal fishery, Marine Policy 88, 23-31.
Pacific Halibut quota was allocated to Indigenous communities but needed refinements in regulations to prevent quota leaking out to investment firms.	Alaska, USA	Carothers, C., Lew, D.K., et al. (2010) Fishing rights and small communities: Alaska halibut IFQ transfer patterns. Ocean and Coastal Management, 53 (9) (2010), pp. 518-523
Proposed for Indigenous community in Torres Strait Rock Lobster	Australia	van Putten, I., Lalancette, A., Bayliss, P., Dennis, D., Hutton, T., Norman-Lopez, A., Pascoe, S., Plaganyi, E. and Skewes, T. (2013). A Bayesian model of factors influencing indigenous participation in the Torres Strait tropical rock lobster fishery, Marine Policy 37, 96-105.; and van Putten, I., Deng, R., Dennis, D., Hutton, T., Pascoe, S., Plagányi, E. and Skewes, T. (2013). The quandary of quota management in the Torres Strait rock lobster fishery, Fisheries Management and Ecology 20, 326-337.
Local "fishery guilds" were established with quota only provided to groups using less	Netherlands	Dinesen, G.E., Rathje, I.W., Højrup, M., Bastardie, F., Larsen, F., Sørensen, T. K., Hoffmann, E. and Eigaard, O. R. (2018).

environmentally harmful methods. Also used to ensure supply of product to regional processors.		Individual transferable quotas, does one size fit all? Sustainability analysis of an alternative model for quota allocation in a small-scale coastal fishery, Marine Policy 88, 23-31.
Charge ITQ shareholders for government costs		
Motivates industry to be active in reducing costs of government. Such as helping collect stock assessment data or reporting into enforcement systems.	Observations from Iceland (where there is cost-recovery) and US surf clam and pacific halibut (where there is not).	Chávez, C. and Stranlund, J.K. (2013). Who Should Pay the Administrative Costs of an ITQ Fishery?, Marine Resource Economics 28, 243-261.
Under-charging for government costs equates to subsidy and this led to ramping up of ITQ share prices in Iceland, making the industry vulnerable to any deterioration in finances (eg higher interest rates).	Iceland	Gunnlaugsson, S.B., Kristofersson, D. and Agnarsson, S. (2018). Fishing for a fee: Resource rent taxation in Iceland's fisheries, Ocean & Coastal Management 163, 141-150.
"*why should public agencies with authority over fishery management continue to use public funds to support fishery scientific research, regulatory enforcement efforts, and decision making processes? The public funds could be supplanted by landings taxes or annual fees*."	USA	Huppert, D. (2005). An Overview of Fishing Rights. Reviews in Fish Biology and Fisheries 15, 201-215.
Provide a return to the community by introducing a rent tax or royalty (note –recovery of at least some portion of government costs is common in Australia but this section deals with the separate issue of access payment)		
"*In this case society retains both the right to fish and appropriate rents*."	Opinion on Swedish ITQ fisheries	Brady, M. and Waldo, S. (2009). Fixing problems in fisheries-integrating ITQs, CBM and MPAs in management, Marine Policy 33, 258-263.
Payment from industry to the community (government) for access so that there is a community benefit from commercial fishing.	Suggestion for New Zealand	Boyd, R.O. and Dewees, C.M. (1992). Putting theory into practice: Individual transferable quotas in New Zealand's fisheries, Society & Natural Resources 5, 179-198.
Implemented after ITQs were established in abalone. Was a response to public concern about enrichment of a small number of individuals from a public resource. (note the Tasmanian Government subsequently scrapped this payment).	Tasmania, Australia	Kailis, G. (2013). Unintended consequences? Rights to fish and the ownership of wild fish. Macquarie Law Journal 11, 99-123.

Notes that the success in stock management of many ITQ fisheries that are now operated by leasee fishers demonstrates that stock outcomes are dependent on regulation, not whether the resource rent goes to private firms or government.	Global	Macinko, S. and Bromley, D.W. (2004). Property and fisheries for the twenty-first century: seeking coherence from legal and economic doctrine, Vermont Law Review 28, 623-661.
Introduced in Iceland due to lobbying for community benefit from the harvesting of public fishery resources.	Iceland	Matthiasson, T (2008). Rent Collection, Rent Distribution, and Cost Recovery: An Analysis of Iceland's ITQ Catch Fee Experiment, Marine Resource Economics 23, 105-117.
Notes that catch fees widely used in many countries with smaller presence in the scientific literature on management of ITQ fisheries.	Namibia, UK, Chile, Russia, Estonia, South Pacific Nations as examples	Hannesson, R. (2005). Rights Based Fishing: Use Rights versus Property Rights to Fish, Reviews in Fish Biology and Fisheries 15, 231-241.
Proposed as a solution that can be introduced years after ITQs created to address the diminished community return from lower direct employment, processing, vessels etc with ITQs	Alaskan crab	Abbott, J. K., Leonard, B. and Garber-Yonts, B. (2022). The distributional outcomes of rights-based management in fisheries, Proceedings of the National Academy of Sciences119(2), 2109154119.
Large community concern about inadequate public return from valuable private harvesting of public resource. So catch payments implemented but later was found these were set too low. The problem was a fixed (low) fee instead of using royalty leasing.	Iceland	Eythórsson, E. (2000). A decade of ITQ-management in Icelandic fisheries: consolidation without consensus, Marine Policy 24, 483-492.
Two options proposed for setting a royalty in early days of ITQs in NZ. These were to base it on a fraction of either the beach price or the lease price. Was not implemented.	New Zealand	Australian Fisheries Magazine, 1987.
Strong community support in Iceland for creating economic benefit from fisheries resources. So taxes were introduced although initially set too low, in part because some quota holders were financially unstable from paying high prices for shares. Was resolved by introducing royalty leasing gradually.	Iceland	Gunnlaugsson, S.B., Kristofersson, D. and Agnarsson, S. (2018). Fishing for a fee: Resource rent taxation in Iceland's fisheries, Ocean & Coastal Management 163, 141-150. Gunnlaugsson, S.B., Saevaldsson, H., Kristofersson, D.M. and Agnarsson, S. (2020). Resource rent and its distribution in Iceland's fisheries, Marine Resource Economics 35, 113-135.
Retain shares in public ownership, or gradually transition to public ownership, and royalty lease these.		

"*most, if not all, ITQ programs feature leasing. The presence of leasing is important precisely because the literature has been adamant that IFQ assignments must be permanent..Why this insistence on permanent allocations? Because it is held that IFQs work because they are property rights... A bigger challenge, however, is presented by the empirical evidence of programs featuring widespread leasing. They work just fine…The fact that a program based around royalty leasing does not collapse, exposes the fallacy in the long-standing notion that catch assignments must be permanent." " let's wean ourselves off the obsessive focus on property rights altogether, and start thinking about management and governance*."	USA	Macinko, S. and Bromley, D.W. (2004). Property and fisheries for the twenty-first century: seeking coherence from legal and economic doctrine, Vermont Law Review 28, 623-661.
Successfully applied in Tasmania for many years with a small portion of shares in the abalone fishery	Tasmania	Abalone Fishery Advisory Committee – AbFAC Meeting Number 96, 7 July 2020
Transition back to public ownership by taxing ITQ rents and using these to buy units on market to return fisheries to public ownership. Shares are then leased to commercial fishers. Ultimately, all rents from fisheries will go to the public rather than investment firms.	Proposed for USA.	Huppert, D. (2005). An Overview of Fishing Rights. Reviews in Fish Biology and Fisheries 15, 201-215.
Retention of some shares by government and leasing of these was proposed in the early days of ITQs in NZ. Was suggested to give the public some return but not implemented.	New Zealand	Australian Fisheries Magazine, 1987.
Proposed to maximise community economic benefit.	Australia	Bradshaw, M. (2004). The Market, Marx and Sustainability in a Fishery, Antipode 36(1), 66-85.
Retaining quota shares in the ownership of National Government, local government or community groups avoids the loss of benefit / equity that occurs when these assets are given away to a small group of private individuals	Opinion on options for Icelandic Fisheries	Eythórsson, E. (1996). Theory and practice of ITQs in Iceland. Privatization of common fishing rights, Marine Policy 20, 269-281.
Sell or auction the rights to the highest bidder instead of giving them away		

"*This solves both the allocation of rights and distribution of wealth in a single blow*."	Opinion on Swedish ITQ fisheries	Brady, M. and Waldo, S. (2009). Fixing problems in fisheries-integrating ITQs, CBM and MPAs in management, Marine Policy 33, 258-263.
Used markets (auction) to allocate shares, rather than giving to some individual firms	Russia, Estonia, Chile.	Lynham, J. (2014). How have catch shares been allocated? Marine Policy 44: 42-48.
Make the duration of ITQ shares for a limited period only, not permanent		
Difficult to implement with existing systems but there's no loss of function with fixed-term shares (eg 10 years) and provides more management flexibility. Shares can be auctioned or leased at the start of each cycle.	Baja California, Mexico	Christopher Costello, Daniel Kaffine, Natural resource use with limited tenure property rights. Journal of Environmental Economics & Management, 55 (1) (2008), pp. 20-36
Same observation from NZ "*A better option, which allows government to capture more of the expected future rents, may have been to make these free allocations for a shorter period so that some charge could be made for their continued allocation in the future*."	New Zealand	Boyd, R.O. and Dewees, C.M. (1992). Putting theory into practice: Individual transferable quotas in New Zealand's fisheries, Society & Natural Resources 5, 179-198.
Proposed reducing duration of shares to 5 years to improve public benefit through periodic auction of access.	Geoduck fishery, Washington, USA. Red Shrimp and Cod, Chile	Huppert, D. (2005). An Overview of Fishing Rights. Reviews in Fish Biology and Fisheries 15, 201-215.
Community benefit by duty taxes on sale of ITQ shares		
This was designed to address the windfall gain problem. Public assets (quota shares) were given away for free at the start of ITQ management which is inequitable and minimises community benefit. Resolved with a fee when sold. This system can be introduced years after the ITQs are allocated.	Iceland	Gunnlaugsson, S.B., Saevaldsson, H., Kristofersson, D.M. and Agnarsson, S. (2020). Resource rent and its distribution in Iceland's fisheries, Marine Resource Economics 35, 113-135.
Same proposed for BC, Canada	Canada	Grimm, D., Barkhorn, I., Festa, D., Bonzon, K., Boomhower, J., Hovland, V. and Blau, J. (2012). Assessing catch shares' effects evidence from Federal United States and associated British Columbian fisheries, Marine Policy 36, 644-657.
Recover public ownership of a portion of the quota each year without compensation, as an alternative to resource rentals		
A portion of the TAC or quota shares can be recovered to public	Proposed in Iceland	Eythórsson, E. (2000). A decade of ITQ-management in Icelandic fisheries:

ownership each year and then leased at a market price for a limited term, or redistributed by other criteria to communities or regions in order to re-establish employment and economic returns to regional communities.		consolidation without consensus, Marine Policy 24, 483-492.
Create "set asides" which is a portion of the TAC outside that allocated to commercial ITQ share holders and can be used for a range of different objectives all designed to provide community benefit		
Their options included: (1) allocate to existing share holders; (2) allocate to new entrants; (3) annual auction to fund projects (either open auction or closed to a select group of shareholders e.g., only to new entrants, in underserved communities).	Applied in USA West Coast groundfish with 10% catch allocated to government.	Nayani, S. and Warlick, A. (2018). Implementation Challenges for Quota Set-Asides: Policy Analysis to Inform Fisheries Management Decision-Making, Coastal Managemen,46(6), 638-655.
Introduced many years after ITQ management and is leased to fund government research priorities.	Applied in Tasmanian SRL fishery @ 1%	
Controls on foreign ownership		
There are controls on foreign ownership that are applied at the minister's discretion. This is an attempt to reduce flow of resource rents out of the jurisdiction, given that all resource rents go to private ITQ shareholders. So probability of community benefit is higher if these shareholders reside in Australia.	Western Australia	Penn, J.W., Caputi, N. and de Lestang, S. (2015). A review of lobster fishery management: the Western Australian fishery for Panulirus cygnus, a case study in the development and implementation of input and output-based management systems, ICES Journal of Marine Science 72, 22-34.
Controls on foreign ownership to reduce flow of rents to shareholders living outside the region.	Icelandic Fisheries	Arnason, R. (2005). Property Rights in Fisheries: Iceland's Experience with ITQs, Reviews in *Fish Biology and Fisheries* 15, 243-264.
Set a limit on the proportion of catch that can be controlled by foreign firms "total allowable level of foreign fishing".	Pollock Fishery in Alaska, USA.	Matulich, S.C. and Sever, M. (1999). Reconsidering the Initial Allocation of ITQs: The Search for a Pareto-Safe Allocation between Fishing and Processing Sectors, Land Economics 75, 203-219.

3. STRATEGIES TO INCREASE ECONOMIC PERFORMANCE OF PRIVATE FIRMS		
Facilitate cooperative "risk pools" amongst fishers in multispecies fisheries		
"Risk pools" are used for balancing bycatch exceedences across licences. For example if one fisher has spare quota of species X, they can share it with another fisher.	Opinion from western USA ground fishery	Russell, S. M., Oostenburg, M. V. and Vizek, A. (2018). Adapting to Catch Shares: Perspectives of West Coast Groundfish Trawl Participants, *Coastal Management*, 46(6), 603-620.
Improve access to local markets with regulations on direct product sale		
Enable direct sales from vessels (as these are often banned in ITQ fisheries) to provide diversity of markets and business models.	Suggestions from New Zealand	Bodwitch, H. (2017). Challenges for New Zealand's individual transferable quota system: Processor consolidation, fisher exclusion, & Māori quota rights, Marine Policy 80, 88-95.
Regulate for effective market in trades of quota lease and sale.		
A stock-market like structure has been set up to control leasing transactions; leasing transaction must now take place openly and anonymously. This was to reduce market failure from asymmetry of information, which had facilitated domination of large firms.	Implemented in Iceland	Eythórsson, E. (2000). A decade of ITQ-management in Icelandic fisheries: consolidation without consensus, Marine Policy 24, 483-492.
Caps on total share holdings are not only introduced for social objectives but also to reduce problems in market function, such as asymmetry of power.	USA	Anderson, L. G. (2008). The Control of Market Power in ITQ Fisheries, Marine Resource Economcis 23, 25–35.
Quota sale and lease markets perform better if they're anonymous so creation of trading platforms and brokers is helpful.	Queensland, Australia	Innes, J., Thebaud, O., Norman Lopez, A. and Little, L.R. (2014). Does size matter? An assessment of quota market evolution and performance in the Great Barrier Reef fin-fish fishery, Ecology and Society 19.
Systems to manage overcatch, bycatch and discarding in ITQ fisheries		
Various systems have been used around the world including payment to government of any revenue from over-catch, carry-forwards of quota across time periods, and trading systems where overcatch of one species can be deducted from quota of another species with penalty.	New Zealand, Australia	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. Pascoe, S., Innes, J., Holland, D., Fina, M., Thébaud, O., Townsend, R., Sanchirico, J., Arnason, R., Wilcox, C. and Hutton, T. (2010). Use of Incentive-Based Management Systems to Limit Bycatch and Discarding, *International Review of Environmental and Resource Economics* 4, 123-161.
ITQ systems can encourage fishers to dump lower value catch (eg animals of a less desirable market	Wisconsin, California, New	Anderson, L.G. (1994). An Economic Analysis of High-grading in ITQ Fisheries

size) and increase overall mortality. High grading can also take the form of higher depletion in areas/times with higher value product. If this is undesirable, then regulations such as bans on release/dumping may be required.	Zealand and Iceland.	Regulation Programs, Marine Resource Economics 9, 209-226. Arnason, R. (1994). On Catch Discarding in Fisheries, Marine Resource Economics 9, 189-207. Mace, P. M., Sullivan, K. J., and Cryer, M. 2014. The evolution of New Zealand's fisheries science and management systems under ITQs. ICES Journal of Marine Science, 71: 204–215.
Trip limits to prevent market gluts and better management of processor capacity		
Ideally done by processors but this often fails as processors need to compete for market share and maintain goodwill with suppliers. So regulation can lead to better results.	Whiting, USA	Guldin, M., Warlick, A., Errend, M. N., Pfeiffer, L. and Steiner, E. (2018b). Shorebased Processor Outcomes Under Catch Shares, Coastal Management, 46(6), 587-602.
Prevent inefficient, wasted effort by "refishing" of locations where other fishers have already visited		
Three strategies are used in various fisheries – centralised control; sharing of effort data amongst the fleet; and "TURFS" or separate spatial areas for each fisher.	New Zealand	Bisack, K.D. and Sutinen, J.G. (2006). A New Zealand ITQ Fishery with an In-Season Stock Externality, Marine Resource Economics, 21(3), 231-249.
Increasing security of shares		
Examples include making shares permanent if not already; adjusting penalties so that these are applied to fishers, not the ITQ shareholder; changes to the registration process to enable ITQ shares to be more easily secured for finance. These all encourages demand for shares and capital growth in share price for existing holders.	Opinion on options for Icelandic Fisheries	Arnason, R. (2005). Property Rights in Fisheries: Iceland's Experience with ITQs, Reviews in *Fish Biology and Fisheries* 15, 243-264.
Limiting or reducing catches of recreational or Indigenous fishers.		
Reducing risk will increase share price / capital growth to ITQ holders. Can be done by reducing access of recreational and Indigenous fishers. Share price also helped by reducing Illegal fishing.	Analysis of US fisheries	Grainger, C.A. and Costello, C.J. (2014). Capitalizing property rights insecurity in natural resource assets, Journal of Environmental Economics and Management 67, 224-240.
Further subdividing ITQ catch shares into different shares for different spatial regions, seasons for harvesting, different sizes, and other market traits.		
Depending on how transfers evolve, this may increase fleet specialisation and efficiency	Opinion on options for Icelandic Fisheries	Arnason, R. (2005). Property Rights in Fisheries: Iceland's Experience with ITQs, Reviews in *Fish Biology and Fisheries* 15, 243-264.

4. STRATEGIES TO IMPROVE DECISION MAKING (note these include contrary opinions)		
Increase autonomy of <u>ITQ shareholders</u> for decisions such determining the stock status and setting the total allowable catch.		
In theory, ITQ shareholders will be motivated to protect long-run profitability so will make better decisions on catch limits.	Opinion on options for Icelandic Fisheries	Arnason, R. (2005). Property Rights in Fisheries: Iceland's Experience with ITQs, Reviews in *Fish Biology and Fisheries* 15, 243-264.
Government costs can be reduced because "the TAC-setting authority does not have to engage in extensive data collection and calculations to set the best possible TAC. It only needs to adjust the TAC until the share quota price is maximized."	Opinion on options for Icelandic Fisheries	Arnason, R. (2012). Property Rights in Fisheries: How Much Can Individual Transferable Quotas Accomplish?, Review of Environmental Economics and Policy 6, 217-236.
Government retained authority but increased input from ITQ shareholders who were also owners of fishing operations. Led to improved stock and profit outcomes.	Observation on Swedish vendace ITQ fishery	Brady, M. and Waldo, S. (2009). Fixing problems in fisheries-integrating ITQs, CBM and MPAs in management, Marine Policy 33, 258-263.
Reduce autonomy of <u>ITQ shareholders</u> in decisions such determining the stock status and setting the total allowable catch.		
A survey of small scale fishers in Iceland reported that involvement of ITQ shareholders in decisions such setting the total allowable catch led to higher catches in the short term and decreased sustainability and profitability over the long term.	Survey of Icelandic fishers	Chambers, C. and Carothers, C. (2017). Thirty years after privatization: A survey of Icelandic small-boat fishermen, Marine Policy 80, 69-80.
ITQ shareholders lobbied for TACs that reduced profitability, because they were focused on revenue, not long run profit.	Observation of Australian rock lobster	Gardner, C., Hartmann, K., Punt, A.E. and Jennings, S. (2015). In pursuit of maximum economic yield in an ITQ managed lobster fishery, *Fisheries Research* 161, 285-292.
"*For example, it is common for catch rights in one region to be wholly if not partially owned by investors in a distant nation who may have no interest in a fishery other than as a short-term place to put capital*"	Opinion on Australian fisheries	Gibbs, M.T. (2009). Individual transferable quotas and ecosystem-based fisheries management: it's all in the T, *Fish and Fisheries* 10, 470-474.
Emphasises the need for all the traditional regulations in fisheries (rather than ITQs) to avoid overfishing. An individual fisher has the same incentives to overcatch with/without ITQs.	Global	Parslow, J. (2010). Individual transferable quotas and the "tragedy of the commons", Canadian Journal of Fisheries and Aquatic Sciences 67, 1889-1896.

Increase economic yield with target reference points and decision rules that can't be blocked by industry		
The theory that ITQ shareholders will support management that maximisies economic yield fails in practice, often because of high private discount rate. So government needs to force these improvements by applying harvest strategies – don't attempt to manage by consensus.	Observation from targeting maximum economic yield in Tasmania	Gardner, C., Hartmann, K., Punt, A.E. and Jennings, S. (2015). In pursuit of maximum economic yield in an ITQ managed lobster fishery, Fisheries Research 161, 285-292.
Managers had diminished ability to overcome political lobbying for higher catches by "investor class" after ITQs. So harvest strategies and decision rules are more critical.	Tasmania	Bradshaw, M. (2004). A combination of state and market through ITQs in the Tasmanian commercial rock lobster fishery: the tail wagging the dog?, *Fisheries Research* 67(2), 99-109.
Same observation but from Chilean fisheries		C.P. Leal, R.A. Quiñones, C. Chávez. What factors affect the decision making process when setting TACs?: the case of Chilean fisheries. Mar. Policy, 34 (2010), pp. 1183-1195