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Catch-quota balancing mechanisms in the Icelandic multi-species demersal fishery: Are all species equal?



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ABSTRACT

In this study, utilization of catch-quota balancing mechanisms in the Icelandic demersal fishery, which allow for individual transferable quota to be transformed among species and transferred between years, is analyzed to determine whether annual catches closely adhere to total allowable catches on average. Icelandic landings data for 14 demersal fish species during 2001–2013 are compared to implemented total allowable catches as well as catch limits recommended by the Marine Research Institute (MRI) and a proxy for annual market values. Landings surpassed legal limits of total allowable catch in 27% of the cases (landings by species by fishing year), mostly due to species transformations, but TAC overages were not consistent for any species. Instead, catches of some species were consistently less than legal limits, with some indications that landings were related to profitability (i.e. landings were correlated with market value). However, landings surpassed MRI recommendations in 67% of the cases, and landings of four species (Atlantic wolffish, haddock, monkfish and redfish) consistently exceeded MRI recommendations. Therefore, discrepancies between scientific recommendations for catch limits and quotas selected through the political process may represent a higher risk to long-term sustainability than catch-quota balancing mechanisms.

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1. Introduction

Reducing discards is a ubiquitous issue in the management of multispecies fisheries. Discarding behavior is incentivized whenever the quota of a species runs out before quotas of more profitable species have been caught [1]. “Catch-quota balancing” regulations in fisheries managed using individual quotas include a variety of measures designed to allow fishers to match quota holdings with their actual landings and hence avoid discards. Such regulations include quota trading and retroactive catch balancing, the ability to carry forward unused quota or borrow from the next year’s allocation (“between-year transfers”), transformation of quota from one species into another, and the option to pay for catch that exceeds quota [2–4]. This study contributes to policy

development of multi-species regulations aimed at reducing discards by documenting and analyzing the system of catch-quota regulations that are implemented in Iceland.

Iceland currently employs one of the most expansive sets of catch-quota balancing mechanisms, which includes between-year transfers, species transformations, and some leniency in penalizing over-quota landings, as well as quota trading [Table 1]. In the species transformation system, individual transferable quotas (ITQs) can be transformed from one species to any other species except Atlantic cod (*Gadus morhua*). Conversion rates are set according to “cod equivalents,” which are set based on market prices (relative to cod) during the previous year. Although species transformation regulations, as they are implemented in Iceland, include limitations, they could still lead to the risk of exceeding total allowable catches (TACs) of low-abundance species. Nonetheless, species transformations have been used in some form in Iceland since 1991 (<http://www.reglugerd.is/>), yielding a long history of stable usage since the ITQ system was expanded to virtually all Icelandic fisheries [5].

The Icelandic species transformation system is of particular interest to managers and scientists outside of Iceland because they explicitly address the multi-species nature of the demersal fishery as a joint production problem. The regulations allow for flexibility when it is not possible or costly to match species composition to quotas. Similar systems have been or are currently used in other

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Table 1
List of major catch-quota balancing mechanisms used in Iceland (Icelandic Fisheries Management Act no. 38/1990 and subsequent amendments; see <http://www.fisheries.is/management/fisheries-management/the-fisheries-management-act/> for English translation, last accessed 25. October 2014).

Mechanism	Regulations and limitations
Between-years transfers	Carry-forward: unused quota can be transferred to next year up to a maximum of 15% of species quota before trade and adjustments. Carry-backward: Exceeded quota can be borrowed from the next year up to a maximum of 5% of species quota before trade and adjustments
Species transformations	Exchange rates (“cod equivalents”): based on a species previous year’s market value relative to cod (where cod=1). One-way cod transformations: No species can be transformed into cod, but cod can be transformed into other species. No more than 5% total quota cod equivalent value can be exchanged. No more than 1.5% total quota can be transformed into a single species
Grace take	5% over a species quota can be landed after using catch-balancing mechanisms, but it must be auctioned. 20% of earnings are kept; the other 80% are forfeit to the Directorate of Fisheries. Referred to as “grace take” for this study
Surrender	If landings of a species exceed the grace take limit, 100% of its revenues are billed by the Directorate of Fisheries and there is risk of license revocation
Other	Permanent trade of catch shares and annual leases of quota allowed. Day-trip long-line vessels can land up to 16% over their quota of cod, haddock, or wolffish

fisheries (e.g. past use in the New Zealand ITQ system, present multiuse provisions in the ITQ system for US Gulf of Mexico Grouper-Tilefish that allow a portion of the red grouper [*Epinephelus morio*] quota to be harvested under gag [*Mycteroperca microlepis*] quota [US Code of Federal Regulations 50 CFR Part 622]). In addition, most ITQ systems include quota stocks that are species aggregates, effectively allowing unlimited transformation of quota between the species within a quota aggregate.

Furthermore, these regulations are applied across fishing gears and fleets, thereby linking resource users. In addition, the flexibility in matching catches to quotas is appealing to fishers. As a result, the intended purpose of reducing discards appears to have been achieved (yielding the idea that the catch-quota regulations are “successful”), as the discard ban in Iceland is thought to have high compliance [6]. Successfully implementing a discard ban is an important current issue in fisheries management (for example through fully documented fisheries [7]), as implementation of a discard ban is currently underway in the EU Common Fisheries Policy [8,4], among other locations.

However, the success of any fisheries management plan hinges critically on its ability to produce intended results and enforce regulations. Most nations that have implemented species transformation systems in a more limited manner have eventually removed them [2]. The additional flexibility yields legal routes for TACs to be exceeded, and therefore the potential for landings to consistently exceed catch limits. Although regulations are only intended to allow landings to fluctuate evenly around the TAC, in some cases they have not. Therefore, purpose of this study was to evaluate how well the species transformation system in Iceland currently achieves the goal of allowing landings to fluctuate around catch limits without the TACs of some species being consistently exceeded or left unfilled. To do this, fisheries landings data were analyzed across the fourteen demersal fish species included in the Icelandic species transformation system [Table 2]. Landings data were studied in relation to both the regulatory limits of total allowable catch and the recommendations of the Marine Research Institute (MRI), the latter of which may have more biological relevance. Landings were also assigned to catch-quota balancing mechanisms (i.e. species transformations and between-year transfers) to analyze how each regulation contributes to these patterns. Finally usage of these mechanisms was related to a proxy for relative annual market value among species to determine whether regulation usage was economically driven.

2. Methods

2.1. Data sources

In the Icelandic demersal fishery, total allowable catch quotas are determined by the Ministry of Fisheries each year for fourteen species based on, but not necessarily exactly following,

Table 2
Species composition in demersal stock landings by weight (fishing years 2001–2013) and revenues (calendar years 2001–2012).

Species		% Total Catch	% Total Revenue
Common name	Scientific name		
Atlantic cod	<i>Gadus morhua</i>	41.1	47.1
Atlantic wolffish	<i>Anarhichas lupus</i>	3.3	2.7
Common dab	<i>Limanda limanda</i>	0.4	0.2
European plaice	<i>Pleuronectes platessa</i>	1.5	1.5
Greenland halibut	<i>Reinhardtius hippoglossoides</i>	3.6	6.7
Haddock	<i>Melanogrammus aeglefinus</i>	16.5	15.3
Lemon sole	<i>Microstomus kitt</i>	0.5	0.8
Ling	<i>Molva molva</i>	1.5	1.0
Long rough dab	<i>Hippoglossoides platessoides</i>	0.2	0.1
Monkfish	<i>Lophius piscatorius</i>	0.6	1.3
Redfish	<i>Sebastes</i> spp.	15.9	15.2
Saithe	<i>Pollachius virens</i>	13.2	7.3
Tusk	<i>Brosme brosme</i>	1.3	0.6
Witch flounder	<i>Glyptocephalus cynoglossus</i>	0.4	0.3

recommendations from the MRI. Total quotas are then distributed among the quota holders as ITQs. In general, catches must be balanced with quota, but the catch balancing system includes a number of mechanisms that allow individuals to balance catches in excess of quota holdings [Table 1]. Publicly available landings data were used from the Icelandic Directorate of Fisheries (www.fiskis.tofa.is) for the fishing years 2001 to 2013 and total revenue data from Statistics Iceland (www.statice.is) for 2001–2012 (data for 2013 were not available) to evaluate the correspondence of total catches with the total quotas and MRI recommendations. Each fishing year runs from 1 September to 31 August, and is indicated in a two-year format on the website (e.g. 2012/2013), but in this study notation refers only to the last year of the two-year period (e.g. 2013). For each year, the website indicates determined quotas and any adjustments to these quotas, catches and how they were accounted for (see below). Most accounting is detailed by vessel, but for this study the annual totals within the Icelandic EEZ were used (summed across vessels). Reported annual species conversion rates are also used (“cod equivalents”), which are calculated based on mean market prices of both catch and quota from the previous year. Cod equivalents represent two distinct pieces of information: (1) conversion rates for the present year (CR), and (2) an index of market value for this year (MV, which is equal to CR in the next year). Recommended total allowable catch quotas (RTACQs) were obtained from the MRI annual reports [9] after correction for gutting using species-specific ratios of gutted to non-gutted weights (the data from the Directorate of Fisheries are in gutted weights). Gutted to non-gutted ratios were

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