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Citation for published version:

Cross, H 2021, 'Challenging quota market efficiencies: A case-study of Scotland (United Kingdom)', *Marine Policy*, vol. 126, 104384. <https://doi.org/10.1016/j.marpol.2020.104384>

Digital Object Identifier (DOI):

[10.1016/j.marpol.2020.104384](https://doi.org/10.1016/j.marpol.2020.104384)

Link:

[Link to publication record in Heriot-Watt Research Portal](#)

Document Version:

Peer reviewed version

Published In:

Marine Policy

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Challenging quota market efficiencies: A case-study of Scotland (United Kingdom)

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Keywords: Fixed Quota Allocation (FQA); Producer Organisation (PO); Lease Quota; Market efficiencies

Abstract:

Exploring fisheries access through the lens of market-based policies, this study investigates complexities surrounding the temporary accumulation or dispensation of quota units, which define rights to land catch in UK commercial sea-fishing. The study examines quota transaction behaviours from Scotland's ten industry membership groups, known as Producer Organisations (POs), by analysing their annual 'Production and Marketing Plans'. Integrating data from the government Fixed-Quota Allocation (FQA) database, and official 'quota-use' records, the analysis pieces together previously 'unknown knowledge' surrounding quota exchanges, in the UK offshore pelagic and whitefish sectors. Leasing and barter transactions are pervasive among those with access to quota, although a core-group of POs dominate pelagic opportunity. These dynamics suggest consolidation to a point of inefficiency, given the dependence of marginal POs in Scotland's rural areas upon marine fisheries capture and processing. Inclusive participatory scenario-modelling techniques may now offer equitable options, in a new era of fisheries management.

1. Introduction

This paper views access to and use of fish quota in the UK, through a lens of market-based policy instruments [1–3] [51], which enables those requiring access to secure from others; while those holding access opportunities they do not need, offer their quota excess [4]. This study begins by introducing where the marketable permit literature intersects with fisheries, by considering the rights to fish and quota allocation mechanisms. Acknowledging that permit markets can be influenced by multiple factors (including initial allocations, supply and demand, non-profit maximising behaviour, transaction costs, regulations, monitoring and enforcement), the study next considers the characteristics of a fair or competitive market, in which allocated quota may be traded.

1.1. The right to fish

Defining who has the right to fish, and how much may be sustainably harvested, are contentious issues [5] such that globally, most fish stocks remain unregulated¹ The adoption of rights-based approaches in major industrial fishing nations [6] has restricted access to harvesting, in efforts to address these contentions. At their inception, rights-based programmes assumed that limiting access to fish would provide the economic incentives needed for co-management, enabling resource users and government to redefine their responsibilities using longer term management visions [7–9]. Critics have argued that

¹ <http://fisherysolutionscenter.edf.org/sustainable-fisheries>

searching for economic efficiency by limiting rights to access resources, goes against fundamental human rights principles, particularly in lower income countries where lives are characterised by multiple insecurities [10]. Fishing rights, it is argued are a crucial and legitimised means of ensuring that fish worker communities, attain an equal bundle of indivisible and universal human rights [11]. Despite these oversights, support prevails for privatised fishing rights management approaches in most industrialised nations, as efficient mechanisms for minimising the race to fish and preventing further stock collapse [12].

1.2. Rights-based allocations

Management systems based upon exclusive rights, require systems knowledge of an area or stock, to build up assessments which feed models to derive appropriate ‘caps’ or harvesting limits [13]. ‘Total allowable Catch’ (TAC) levels or fixed tonnage agreements are examples requiring annual revisions, accommodating changes in stock mortality and recruitment [14]. If resulting catch ‘caps’ or limits are to be discreetly distributed among those holding rights, ‘individual transferable quotas’ (ITQs) or ‘individual vessels quotas’ (IVQs) are the most common mechanisms [15]. These sharing mechanisms require allocating or dividing proposed limits exclusively among those considered eligible, which occurs in four main ways [16,17]. Sharing systems include *political* allocations, driven by government led decisions; *uniform* allocations involve an equal share; *first possession principle* or “*grandfathering*” uses historical allocations and capital investment as guidance; alternatively, allocations may be determined through *auctioneering*. Of these, first possession or grandfathering, is considered the most common [16]. In contrast, rights sharing agreements in place-based (or area) models normally occur through ‘territorial use rights to fisheries’ (TURFs) or quota pools, where quota holders may pool together their allocations for collective use [15,18].

1.3. Quota use and market efficiencies

Ultimately, the allocation of a TAC share portion is ‘gifted’, as no direct resource rent or payment for the raw material, is taken [13]. Profit, or economic rent, may however accrue through use of quota allocations, for fishers, firms, or businesses, who are not excluded from access [19]. Most rights-based systems also allow the temporary leasing or permanent sale of quota allocations, yet despite their observed importance, studies of fisheries quota markets remain relatively few [20]. Arnason [21] defines a perfect market as able to balance supply and demand instantaneously, while being open to everyone interested in trading, with all traders acting as price takers. In a fair, well-functioning and competitive fisheries quota market, all quota holders therefore have equal opportunities to accrue economic rent (profit) by fairly competing to achieve returns on their quota portfolio [13,20]. This efficient market allows for the optimal distribution of quota among the most cost-effective operators (Newell et al., 2005) in a manner reflecting relationships between stock productivity, quota sale and quota lease prices [22]. Price signals reflect the expected present value of future rent and provide information on expected profitability [14,23] with price transparency forming the basis of decision making (Newell, 2005). Such trade in quota might lead to consolidation, if economic profit is attributed to a quota type, or if holding a ‘bank’ of different quotas is recognised as increasing resilience [24]. In fisheries management, innovations have

occurred, aimed at fostering trust. In Iceland, a real time monitoring system² for marketing and managing cod quota leasing increases communication both within and between the state and market [25]. Given that markets are broad social networks of actors with varying roles, the Icelandic system facilitates connections (personal ties) among cod fishers, brokers, and traders, reducing price disparities of available quota while encouraging management for greater resource efficiency [22,26]. Quota markets do not always function efficiently however, due to disparities aligned with the initial allocations, unequal opportunities to access capital, price distortions influenced by speculative investments, and high transactions costs (Newell, 2005) [27]. Furthermore, while it is anticipated that in an efficient market, quota consolidation through sale or leasing, should be expected, linked with reduced opportunity for small-scale fleets and declining opportunities in remote rural fishing areas [28]. For example, in the Gulf of Mexico, red snapper quota lease prices vary regionally and with personal contact networks with implications in terms of profit access [29]. Further, in the halibut and sablefish ITQ programmes of Alaska and Seattle, remote and often absent quota shareholders ('slipper skippers') are found to reap extensive profits by leasing ITQ allocations to hired, working skippers, while keeping themselves removed from the practices and management of fishing [30]. To summarise, maintaining consistency in lease quota markets has been identified as crucial for industry longevity and effective fisheries management [27,31,32]. It is from a stance of understanding lease quota market stability, that this research has developed.

1.4. Research questions

The case-study presented, looks to understand quota leasing behaviour in the context of the United Kingdom. Specifically, the study addresses two overarching research questions: (1) What evidence is there for quota leasing in the context of the UK? And (2) What are the suggested drivers behind quota leasing activity? The overarching aim of the research is to discern the opportunities for the UK quota market to operate more efficiently and understand potential challenges to doing so. The paper proceeds with an introduction to the UK quota system and then focuses upon Scotland as a case-study, and the data used.

2. The UK context

2.1. Fishing rights and quota units

The political debates surrounding quota allocation in the UK have become increasingly complicated, given various articulations of challenges and opportunities, presented by a British Exit from Europe [25,33]. At the core of the Brexit debate, from a UK perspective is the Common Fisheries Policy (CFP) which uses 'total allowable catch' (TAC) or capped levels to regulate the harvesting of key pelagic and demersal stocks. From each TAC level, derived catch shares are distributed among EU Member States, using a 1983 agreement which uses both historical catches (1973–1978) and local specifics, such as presence of fisheries dependent communities³. This historical basis of European TAC sharing assures "each Member State relative stability of fishing activities for the stocks considered" [34]. Member states also retain rights to exchange, all, or part of their quota allowances [34].

² In Iceland, all transfers of quota must be registered by vessels on the website of the Directorate of Fisheries (<http://www.fiskistofa.is/>).

³ This clause is known as The Hague Preferences. Source <https://fisheriesalliance.eu/key-issues/each-their-fair-share-quotas-distribution/>

To illustrate the breadth of stock decision making under the CFP, European Ministers in December 2019, derived TAC limits for 89 fish stocks in the North East Atlantic, North Sea and in international fisheries accessed by EU vessels⁴. Inside the Brexit debate, UK fishers are currently demanding higher catch shares (TACs) of capped European stocks and greater autonomy over their Exclusive Economic Zone [35]. The proposed transition to an EU Coastal State member has various fisheries related domestic disputes, including equality of access under the UK quota allocation system, particularly for smaller vessels. Since 1999, the UK government has used ‘Fixed Quota Allocation’ (FQA) units as the metric with which to divide European derived TAC shares, among domestic industry actors. There are currently around 8 million FQAs 'in circulation' in the UK⁵. Most (~98%) are awarded to registered industry groups, known as Producer Organisations (POs), whose membership significantly aligns with larger (‘over 10 m’) boats. A government quota pool is used to portion remaining units (~2%) to associates of smaller (‘10 m and under’) vessels, on the premise that small boats operate mainly in the nearshore, targeting quota-less stocks, such as shellfish.

Rights to FQA units are not owned in the UK, but rather privileged [13], in a ‘grandfathering’ system which rewards historical catch records and capital investment of the POs [36]. Each PO creates a tailored management programme to divide FQA units among members. These systems may involve ITQs, quota pools or a mix, determined by the target catch and member capacity. Once allocated, FQA units may be freely swapped (bartered) or leased domestically, between and among the POs, in a relaxed and informal aftermarket [37]. UK quota leasing guidelines do not attach any conditions to FQA transactions inside the UK. Rather, it is explained that: “*fishermen may utilise their allocations in a number of ways including swapping, leasing and gifting or it may not be landed at all, all of which would affect the income of FQA holders. FQA holdings are just one of the ways in which one can access quota*”⁶. By contrast, temporary quota transfers outside of the UK (with European and internationally operating actors) are formally negotiated by the Marine Management Organisation [38,39].

3. Methodology

3.1. Producer organisations (POs) in Scotland: A case-study

Of the approximately 8 million FQA units circulating in the UK, around 4.8 million are held by ten Producer Organisations (POs) in Scotland⁷. All of Scotland’s POs receive their FQA allowances through the devolved Fisheries Administration, ‘Marine Scotland’. As found for the wider UK, Scotland does not have specific rules governing the quota market, [50] except that leasing or purchasing of FQA units from groups outside the UK, must be negotiated through Marine Scotland. Unlike in England however, where more than half the value of FQA units held by POs is earned by foreign entities, in Scotland 99% of FQA units afford money to Scottish quota holders [40].

⁴ <https://www.consilium.europa.eu/en/policies/eu-fish-stocks/tacs-and-fishingopportunities/>

⁵ <https://www.fqaregister.service.gov.uk/>

⁶ <https://www.fqaregister.service.gov.uk/>

⁷ Source FQA Register: To illustrate, this figure was 4803,576 Fixed Quota Allocation (FQA) units on 4th November 2020.

4. Data sources

This analysis of the quota market in Scotland uses both qualitative and quantitative data from four main sources, these are detailed below.

i) Producer Organisation (PO) Production and Marketing Plans

For three consecutive years (2015–2017), each of Scotland’s ten POs submitted a ‘Production and Marketing plan’ to Marine Scotland. These thirty documents are all publicly available online⁸ offering transparency in terms of Scotland’s quota movement. These plans provide the core data set in this study. Unfortunately, comparative plans are not publicly available for POs in England, Wales or Northern Ireland and may only be accessed by contacting individual organisations (pers. comm: Fisheries Manager, MMO). As only one PO outside of Scotland responded to a request for information, the focus of this study is limited to Scottish PO activity. Furthermore, Scotland’s most recent plans (2018 forwards) are now considered commercially sensitive and will not be made open access (pers. comm: Policy Manager, Marine Scotland). The available plans were however, submitted annually to the Scottish Government, between December and March, presenting a production and marketing synopsis of the previous year, alongside a projected intention for the year ahead. These thirty available documents, broadly covering the time-period 2014–2017, allow investigation of PO narratives concerning quota allocation and use.

ii) The UK Fixed Quota Allocation (FQA) Register

To further contextualise Scotland’s Producer Organisations (POs), current information concerning quota holdings has been extracted from the UK FQA register⁹. This has been compiled through the Marine Management Organisation (MMO) and as a record, covering all twenty-three UK-registered POs is commended as a progressive step towards transparency [37]. Illustrating real time holdings of quota units, information through the FQA database is discernible at the licence, vessel, registered holder, PO, and fisheries administration level. For POs, the database lists all registered holders of FQA units, the number of units currently held by each entity (in real time) and the fish stocks to which these quota units correspond. Daily fluctuations in the FQA register indicate quota transactions such as through sale, leasing, or barter. However, FQA changes are not defined in terms of actors involved, nor transaction prices. This caveat provides opportunity to use Scotland’s PO ‘production and marketing plans’ to discuss transactions involving quota and prices involved. The FQA register itself does not enable users to search back reflectively on PO quota holdings through time. Given this mismatch between a core dataset (‘production and marketing plans’ published between 2015 and 2017), and current real time FQA holdings in 2020, additional data sources have been used in this analysis.

⁸ <https://www2.gov.scot/Topics/marine/Sea-Fisheries/management/17681/producerinterbranch/pmplans>

⁹ <https://www.fqaregister.service.gov.uk/>

iii) Quota Use Statistics

Information reflecting the documented use (or uptake) of FQA units by all POs in the UK is released annually by the MMO¹⁰. This data therefore provides further detail to reflexively summarise activity in Scotland in the time covered by the PO plans. Quota-use statistics present an annual synopsis of changes in FQA units relative to initial PO allocations at the start of the year, as would have occurred through quota trading or leasing behaviour. Interpreting this data as positive (accumulation) or negative (loss) in terms of FQA units for specific stocks, it becomes possible to build a picture of the quota transactions described in the PO plans.

iv) FQA Trading and Swapping Records

Given that the UK Fisheries Administrations (Marine Scotland and the Marine Management Organisation) are responsible for negotiating all quota transactions outside of the UK, information documenting this activity has been sought¹¹.

5. Content analysis (CA)

Scotland's PO 'production and marketing plans' provide a bounded sample of texts, which are considered to hold previously 'unknown information' regarding quota use [41]. These texts, are used here to investigate the significance of quota leasing in the UK, using Scotland as a devolved case-study region. Content analysis (CA) is a technique often applied to explore qualitative textual information [42]. The process of qualitative CA involves two main steps: data immersion and data reduction [43]. Immersion refers to familiarisation with the whole text [42], in preparation for coding or reduction. The purpose of this familiarisation is to illuminate tangible or 'new knowledge' [41]. Qualitative coding here refers to identification of nominal or mutually exclusive 'categories' of descriptive information [43].

This inductive coding approach was used to explore, categorise, and reduce the information contained within the thirty PO plan documents. Information was identified and extracted from each report, as a whole text extract, then stored inside a data matrix. The matrix identifies the source report (PO and year). The text extract itself was then both categorised and sub-categorised, allowing deeper classification. Table 1 provides an example extract from the data matrix. An 'open coding' approach was used [43] which allows both categories and sub-categories of information to 'emerge from' and be 'grounded within' the data itself.

This approach avoids use of preconceived categories which it is assumed, will emerge from the data. In the example extract, the focus (main category) is 'transactions' and the sub-category which emerges is labelled 'transaction partners'. In presenting results from this analysis all 'Production and Marketing Plan' source documents are cited, using the acronym PMP.

¹⁰ <https://www.gov.uk/government/statistical-data-sets/quota-use-statistics>

¹¹ <https://www.gov.uk/government/publications/fishing-quota-trading-and-swaps>

Table 1: Illustrating the extraction of text from Scotland’s Producer Organisation ‘Production and Marketing Plans’ (PMPs) written between 2014-2016

PO	PMP year	<i>Text Extract</i>	Category	Sub-category
North East	2015	<i>In general, leasing is from agents, other PO’s domestically and internationally.</i>	Transactions	Transaction Partners
Klondyke	2016	<i>Overall, four swaps with UK POs and one with a Dutch group</i>	Transactions	Transaction Partners
Aberdeen	2015	<i>Haddock lease sourced through individual agents and through the PO</i>	Transactions	Transaction Partners
Fife	2016	<i>Nephrops (North Sea) from a Member who has sold his boat.</i>	Transactions	Transaction Partners

6. Results

6.1. Scotland’s producer organisations (POs): fixed-quota allocation (FQA) management background

Scotland’s PO ‘production and marketing plans’ from 2017, reflect upon the activity of 377 vessels during the seasons of 2016. Of these boats, 47% were registered with one group, the ‘Scottish Fisheries Organisation’ (SFO). In 2016, twenty-nine PO vessels (8%), were small (‘10 m and under’) and the total recorded value of catch (or turnover) for all Scotland’s ten member groups, was £ 405 million (Table 2). The highest turnover was achieved by the SFO (£170 million); the lowest was £ 290,000 achieved by Orkney. To manage their FQA unit allowances, each PO adopted a specific management system. For Western, Fife, Shetland and the SFO, quota pools enabled vessels to use or uptake quota as needed for demersal or whitefish stocks (cod, haddock, plaice, and monkfish). By comparison, Lunar PO describe an Individual Transferable Quota (ITQ) system for whitefish.

FQA unit share outs to POs, derived from the UK and devolved governments, are annually converted to harvestable tonnes of fish, corresponding with the European ‘total allowable catch’ (TAC) levels for each stock. In general, the annual European Council fisheries meetings in Brussels (November - December) are considered a temporal constraint on fishery productivity by Scotland’s POs; as during the meeting period, all fisheries are closed, yet stocks are in ‘*prime condition*’ and markets are in ‘*periods of peak demand*’ which ‘*ignores the biological realities of the marine ecosystem and indeed the requirements of the market*’ (Scottish Fisheries Organisation PMP, 2016). Instead, there is an argument for delaying the meeting and closing the fisheries between February to March “*when fish are preparing to spawn*” (SFO PMP, 2016). As EU decision making occurs, TAC limits are annually redefined; and the UK FQA unit system is translated into unit tonnes of catch. This relationship can be illustrated using monkfish. When UK shares of European TAC caps on North Sea monkfish increased between 2014 and 2016 (Table 3), the tonnes of catch allowed for each FQA unit of that stock, also rose (Fig. 1).

Table 2: Characteristics of Scotland’s ten PO groups during 2016, as summarised in the Production and Marketing Plans of 2017.

Producer Organisation	Total landed tonnes	Total turnover (£)	Small Vessels	Large Vessels	Quota Management System in Operation
Orkney	70,522	289,124	0	14	ITQs (all)
Western Scotland	48,200	8,737,802	8	34	Pool (whitefish) & ITQs (nephrops)
Fife	50,429	10,100,100	2	28	Pool (whitefish) & ITQs (pelagic)
Aberdeen	188,288	10,895,125	5	14	ITQs (whitefish)
Northern	66,624	17,500,000	4	23	ITQs (all)
North East	217,623	24,641,064	1	23	ITQs (all)
Klondyke	506,953	28,445,000	0	3	Pool (all)
Lunar	650,164	41,142,479	0	4	Pool (pelagic) & ITQs (whitefish)
Shetland	1,300,517	92,877,198	1	37	Pool (whitefish) & ITQs (pelagic)
SFO*	1,697,974	169,876,548	8	168	Pool (whitefish/ nephrops) & ITQs (pelagic)

**Scottish Fishermen’s Organisation*

Table 3: Documented changes in the UK share of European derived ‘total allowable catch’ (TAC) levels for four main stocks.

North Sea Stocks (IV)	2014	2015	2016
Cod	+5%	+5%	+52%
Haddock	-15%	+52%	+78%
Whiting (incl. EU waters of IIa and IV)	-15%	-14%	-3%
Monkfish (Anglerfish) (incl. West of Scotland)	-10%	+20%	+56%

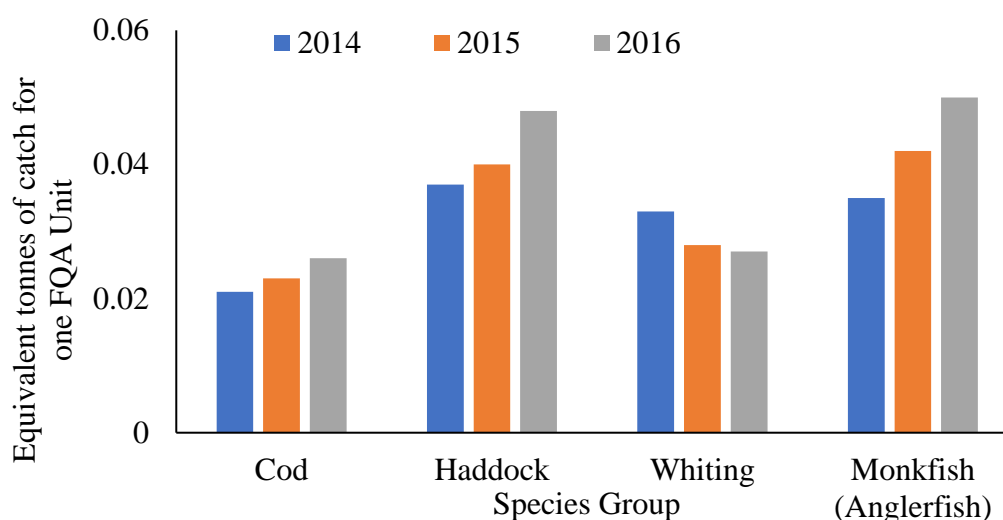


Figure 1: Showing the equivalent in catch tonnes of one ‘fixed quota allocation’ (FQA) unit, for four major North Sea stocks between 2014 and 2016. Information derived from PO Production and Marketing Plans (*Source: North East PMP, 2014; 2015, 2016*)

6.2. Current target stocks (2020)

The current FQA portfolio of ~4.8 million FQA units among Scotland’s ten Producer Organisations (POs), conveys rights to access and harvest 76 distinct fish stocks. However, approximately 85% of FQA units (4.1 million), correspond with nineteen stocks aligned with nine species groups (Table 4). Of these, most FQA units are currently held for West Scotland mackerel (27%) and North Sea haddock (11%) stocks.

Table 4: Nineteen main stocks and their corresponding Fixed Quota Allocations (FQAs) as held by Scotland’s ten Producer Organisations in 2020¹²

Species Group	Stock (as defined in the MMO records)	FQA Units	Prop of total FQAs
Anglers	North Sea	143,659	0.03
	West of Scotland	20,342	0.004
Atlanto-Scandian Herring (ASH)	-	139,820	0.03
Haddock	VIa	76,564	0.02
	VIb	32,506	0.01
	North Sea	537,082	0.11
Mackerel	Flex box (IVa)	89,806	0.02
	North Sea	9,310	0.002
	West of Scotland	1,317,804	0.27
Horse Mackerel	North Sea	25,858	0.005
	West of Scotland	95,381	0.02
Whiting	Northern blue whiting	398,103	0.08
	North Sea	212,652	0.04
	West of Scotland	35,874	0.001
Cod	North Sea	291,266	0.06
Herring	North Sea	308,355	0.06
	West of Scotland	260,900	0.05
Nephrops	North Sea	72,274	0.02
	West of Scotland	73,347	0.02

6.3. FQA holdings in 2020

Holders of FQA units are known as ‘registered entities’ or holders. These are diverse, but broadly include limited liability partnerships (LLPs); private persons; vessel agents; fishing vessel companies; and units held for ‘common benefit’. The Scottish Fishermen’s Organisation (SFO) boasts the greatest number of ‘registered entities’ (Table 5), a portfolio which includes Barra Atlantic Ltd processors, a business holding additional FQAs with POs outside the SFO. By contrast, Klondyke lists only three ‘registered holders’ of quota units. Lunar is the only PO showing vertical integration into the processing sector, through the registered umbrella ‘Lunar Group’ company.

¹² Source: <https://www.fqaregister.service.gov.uk/> (Accessed November 2020)

Table 5: Current FQA unit holdings for Scotland’s ten Producer Organisations (POs)¹³

PO	FQA Units	No. of large vessels	No. of reg. entities	FQA units per entity (mean)	FQA units per entity (max.)	Entities with zero FQAs
Western Scotland	48,200	26	56	861	12,494	23%
Fife	58,024	19	28	2,072	13,197	25%
Orkney	65,650	14	20	3,282	27,463	50%
Northern	76,916	13	33	2,330	12,156	15%
Aberdeen	203,640	24	36	5,656	40,372	8%
North East	220,300	18	44	5,006	49,006	18%
Klondyke	506,953	3	3	169,884	292,143	0%
Lunar	650,164	4	12	54,180	290,352	17%
Shetland	1,300,117	31	49	26,533	163,974	10%
SFO	1,673,612	134	225	7,438	215,096	30%
Total	4,803,576	286	506			

Of the FQA units currently circulating, 35% are held by the Scottish Fisherman’s Organisation (SFO) whose membership has seemingly declined by 42 vessels since 2016, yet still accounts for 47% of all PO vessels. Only three small (‘10m and under’) vessels are currently identified across all POs in Scotland¹⁴. All POs except one (Klondyke) currently exhibit registered entities holding zero FQA units. This ranges between 50% (Orkney) to 10% (Shetland). Despite holding the largest FQA unit allowance, the mean quota unit size for an entity registered with the SFO is 7,438 units. By comparison, the mean unit holding for Lunar is 54,180 and for Shetland 26, 533 units. Klondyke represents an anomaly, as the average number of FQAs held by an entity is 169,884 units. The mean distribution of FQA holdings among Scotland’s POs indicates a degree of dominance for three groups (Klondyke, Lunar and Shetland), whose quota allocations overall and per registered entity are disproportionately larger than for the other seven PO groups.

6.4. Quota transactions among Scotland's POs: A legacy

In understanding the significance of transactions involving quota among Scotland’s POs, a note on linguistic complexity is helpful. No specific sales of quota are discussed or identified in the ‘production and marketing plans’ (2015–2017); although one PO does declare an ambition to purchase additional quota, to maintain catches against declining total allowable catches (TACs). This group explains that a strategy of ‘*selling cod quota*’ would enable members to diversify their catches, enabling a shift towards a multispecies fishery (North East PMP, 2016). To allow for a lack of documented sales, quota transactions are here characterised into formal and informal mechanisms. Cod quota may be formally acquired, for example, under the MMO ‘Fully Documented Fisheries’ scheme (FDF). This enables participant POs to access additional cod quota and “*experience freedom from effort restriction for twelve months*” (North East PMP, 2014). Additionally, Scotland’s POs may

¹³ Source: <https://www.fqaregister.service.gov.uk/> (Accessed November 2020)

¹⁴ Two vessels in the Fife PO and one in the Northern group.

formally register for inclusion in the Marine Scotland ‘Cod Camera Scheme’ and access additional cod quota through this activity. Two other formal mechanisms are known as ‘transfers’ and ‘banking’; both of which are dictated at the European Council and central UK government level. Transfers involve the movement of quota between (‘in-flexible’) stocks. While the release and use of ‘banked’ quota refers to carrying over unused quota from the previous year.

By contrast, informal quota acquisitions, are described in the PO plans in terms of ‘leasing’ or ‘swapping’ (barter). This evidences a ‘temporary’ informal movement of quota among those holding the right to access fish. All temporary transactions identified are illustrated in Table 6. This summary details the amounts (as tonnage) where possible. In general, the evidence indicates widespread quota leasing activity, to maintain a national functioning fishing industry in Scotland. The thirty documents detail leasing across the three consecutive study years (2015–2017). Furthermore, leasing in 2014 is reflected upon; and the projected importance of quota leasing into 2017 is discussed. Leasing of quota reportedly infiltrates Scotland’s whitefish, pelagic and shellfish sectors; largely enabled through ‘agents’ who work for the POs or on behalf of individuals. Most leasing is domestic (within the UK) and leasing activity with international actors is described as uncommon. This can be confirmed through official MMO records¹⁵. The temporary leasing of FQA units is described as a mechanism to ‘*keep the fishery open*’, avoid the risk of early closure; particularly, when TAC limits are low and when fish are ‘*on the grounds*’. One exception is the Lunar PO, who explicitly state a company decision to ‘*avoid leasing in*’ of any quota (Lunar PMP 2014; Lunar PMP 2015; Lunar PMP 2016).

¹⁵ <https://www.gov.uk/government/publications/fishing-quota-trading-and-swaps>

Table 6: Quota transactions as reported in Production and Marketing Plans. Informal transactions are defined as leased-in (IN); leased-out (OUT) or 'swapped' (Swap); Formal transactions are through the Fully Document Fishery (FDF). Roman numerals (in parenthesis) refer to generic fishing areas, where IV = North Sea and VI = Western Scotland. All values in italics refer to tonnes catch (*Continues on next page*)

PO	2014	2015	2016	2017
Fife	IN-Haddock (IV) Swap- Nephrops (IV) 120 IN- Whiting (IV)	OUT-Haddock (IV) IN- Monkfish - 120 IN- Whiting (IV) 70 IN – Nephrops (IV) 65	IN- Monkfish (IV/VI) IN- Nephrops (IV) IN- Whiting (IV) 50	IN- Haddock (IV) IN- Monkfish IN- Whiting (IV) IN- Nephrops (IV) 250
Aberdeen	IN- Haddock (IV) IN- Plaice (IV)	IN- Haddock (IV) IN- Plaice (IV)	IN- Haddock (IV)	
Lunar				
North East	FDF- Cod (IV) – 262 IN- Haddock (IV) IN- Monkfish IN- Whiting (IV) IN- Saithe (IV ¹⁶)	FDF- Cod (IV) – 287.6 IN- Haddock (IV) IN- Whiting (IV) IN- Saithe (IV ¹⁷)	FDF- Cod (IV) – 240.1 IN- Haddock (IV) IN- Monkfish IN- Whiting (IV) IN- Saithe (IV ¹⁸) IN- Hake (IV)	
Northern		IN- Monkfish (IV/VI)	IN- Monkfish (IV/VI)	IN- Monkfish
Orkney				IN- Haddock (IV)
Scottish Fishermen's Org. (SFO)	IN- Cod (IV) 889 IN- Haddock (VI) 350 IN- Mackerel (VI) 550 IN- Monkfish IN- Saithe (IV)	IN- Cod (IV) 697 IN- Haddock (IV) 750 IN- Haddock (VI) 565 IN- Mackerel (IV/VI) 1,180 IN- Monkfish IN- Saithe (IV) 750	IN- Haddock (IV/VI) IN- Monkfish IN- Saithe (IV) 1,000	

¹⁶ Total pelagic quota leased in for haddock, monkfish, whiting, saithe: 3,152 tonnes.

¹⁷ Total pelagic quota leased in for haddock, whiting, saithe: 3,714 tonnes.

¹⁸ Total pelagic quota leased in for haddock, hake, monkfish, whiting, saithe: 5,015 tonnes.

	IN- Saithe (VI) IN- Whiting (IV)	IN- Saithe (VI) 1,000 IN- Whiting (IV) 400	IN- Saithe (VI) 1,000 IN- Whiting (IV)	
Shetland	IN- Cod (IV) Banking -Hake (IV)		IN- Cod (IV) IN- Mackerel (IV)	
Western Scotland	Swap/ IN- Nephrops (IV) 96	IN- Nephrops (IV) 60 IN- Skates/Rays IN- Whitefish	IN- Nephrops (IV)	Swap/ IN- Nephrops (VI)
Klondyke	IN- Pelagic	IN- Pelagic		

6.5. Factors shaping the UK quota market

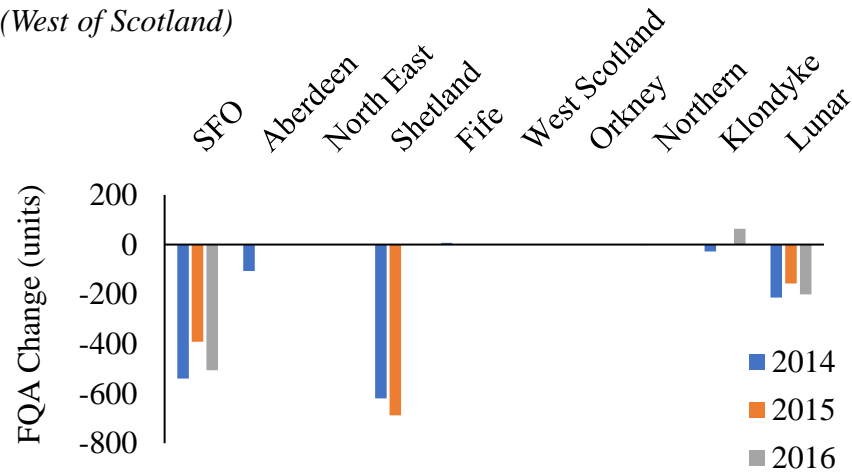
To understand specific circumstances surrounding leasing behaviour, the analysis draws upon pelagic and whitefish activities separately, considering specific examples which illustrate connectivity between the markets for end products and markets for quota.

i) Pelagic Bartering

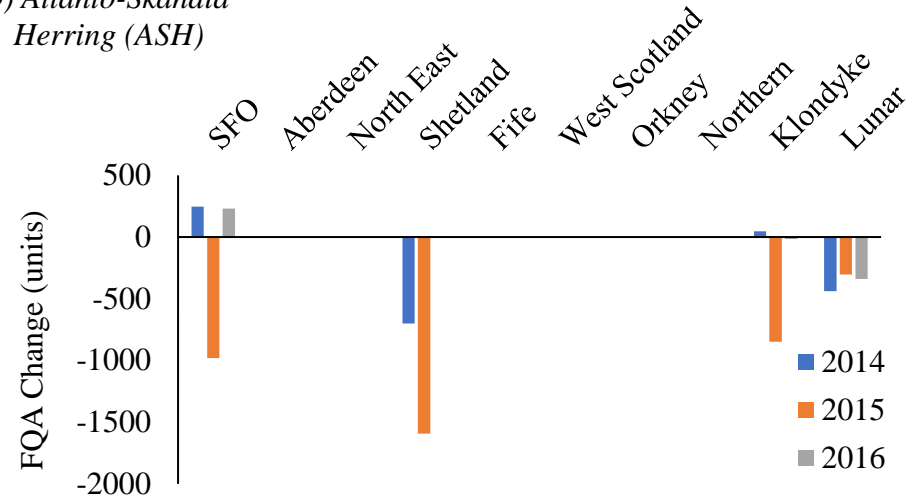
Global trading opportunities for end catch create traceable implications for FQA uptake and temporary quota transactions, as can be illustrated in terms of pelagic fishing. In November 2014, Scottish exports of horse mackerel and Atlanto-Skandia Herring (ASH) were severely disrupted, when the Russian Government introduced a ban on all fish imports from the EU and various other countries (SFO PMP, 2015). Russian sanctions were a political response to ‘a significant package of measures’ agreed by EU states intended to deter ‘Russia’s illegal annexation of Crimea and interventionist policies in eastern Ukraine’ [44]. Fish sales from Scotland were only maintained through reliance on the Scottish Government’s ‘trade credit insurance’ mechanism, which enabled one Scottish PO to continue providing ASH to established Ukrainian clients (Klondyke PMP, 2015). With the Russian-Ukrainian market closed, pelagic horse mackerel and ASH quota were used as ‘*swap currencies*’ (or barter) between 2015 and 2017 (Klondyke PMP, 2015). These units were also significantly under-used in this period, particularly by Scotland’s main FQA holders: SFO, Shetland, Klondyke and Lunar (Klondyke PMP, 2014; Klondyke PMP, 2015; Klondyke PMP, 2016; Lunar PMP, 2017; SFO PMP, 2015; Fig. 2).

Also, in 2014, the Nigerian government declared that international pelagic frozen fish importers required a new licence, causing a market disruption described, as ‘*at best problematic*’ (Klondyke PMP, 2016), given the importance of this destination for ‘*smaller size fish proving difficult to sell*’ (Klondyke PMP, 2015; Fig. 2). Motivation of the Nigeria Government was reported as ‘a desire to replace imports with indigenous production’ (SFO PMP, 2015) and in response, half the blue whiting catch of Lunar PO (14,084 tonnes) was sold for fishmeal reduction, and ‘*the remainder*’ sold into freezing and cold storage units (Lunar PMP, 2015). For others, blue whiting quota was ‘swapped out’ through barter transactions (Klondyke PMP, 2014; SFO PMP, 2015). By 2015, the European TAC allowance for North Sea whiting had fallen by 14% (SFO PMP, 2015) which induced quota scarcity and supported an increase in lease price for those able to establish export market opportunities. The higher price attainable for leasing whiting FQA units rose from £ 400 to £ 550 per tonne, between 2015 and 2016 (SFO PMP, 2015). In 2015, Lunar PO in Scotland, was able to avoid altogether the freezing and cold storage of North Sea whiting, having allocated significant financial resources to Asian Seafood Expositions (China, Korea, and Japan). These investments were considered ‘very worthwhile’ (Lunar PMP, 2015). The Scottish Fishermen’s Organisation (SFO) had also secured access to alternative Chinese markets by 2016, which remained relatively stable, offering £ 220 per tonne of processed product (SFO PMP, 2016). By 2016, the Nigerian pelagic market was still ‘*difficult*’ (Lunar PMP, 2017), although the October fisheries saw price increases; as Asian markets increasingly ‘*looked with interest at Scottish produce with a higher fat content*’ (Klondyke PMP, 201

a) Horse Mackerel
(West of Scotland)



b) Atlanto-Skandia
Herring (ASH)



c) Blue Whiting
(North Sea)

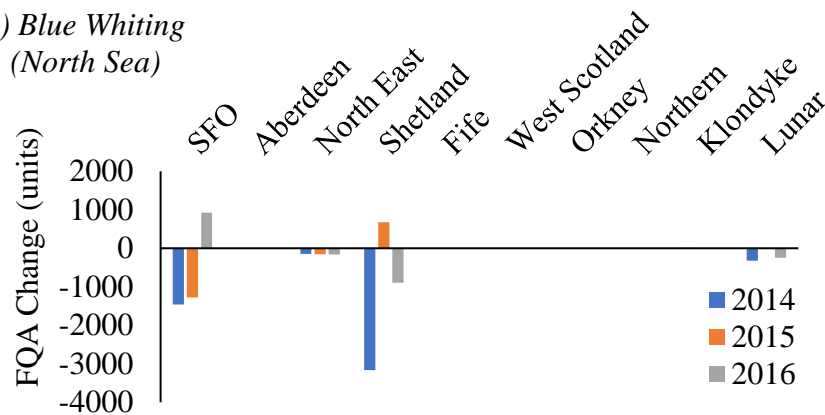


Figure 2: Changes in FQA units, where positive values indicate quota unit 'accumulation' through leasing or barter while negative values signify quota 'given up' through similar mechanisms. Graphics illustrate changes for a) Horse Mackerel, b) Atlanto-Skandia Herring and c) Blue Whiting, between 2014-2016. [Source UK Quota-Use Statistics: <https://www.gov.uk/government/statistical-data-sets/quota-use-statistics>]

Growing interest in the Dutch and German ‘maatje’ markets, specialising in immature herring soaked in brine, offered a replacement for collapsing trade in horse mackerel, Atlanto-Skandia Herring (ASH) and whiting with Russia and Nigeria. Herring catch prices were low for Scotland’s POs in June 2014, due to a failed agreement between the EU and Norway (SFO PMP, 2015; Klondyke PMP, 2015). This dispute prevented Scottish vessels entering Norwegian waters. By August, issues were resolved, but Russian-Ukrainian politics still limited widescale herring demand (Klondyke PMP, 2015; Shetland PMP, 2015). The European ‘maatje’, offered returns on North Sea stock investment while TAC reductions in 2015 and 2016 ensured scarcity of quota, bolstering demand for those with established market opportunities. Lunar PO describe the 2016 ‘maatje’ as ‘better than in 2015’ with fresh maatje catches making 25% more than frozen exports (Lunar PMP, 2016). When opportunities to lease-in quota were reduced, FQA units were instead acquired through barter, from those wanting mackerel, horse mackerel or ASH, for Far Eastern markets. As shown in Fig. 3, four POs (SFO, Shetland, Klondyke and Lunar) were able to increase their herring quota holdings in 2014–2016. This bartering is described as particularly problematic for other POs (e.g., West Scotland) whose members use herring, as bait to support creel fishing¹⁹. Some West Scotland creelers, as a result, were forced to secure herring in Ireland and Holland, which was ‘not a cheap option’ (West Scotland PMP, 2016).

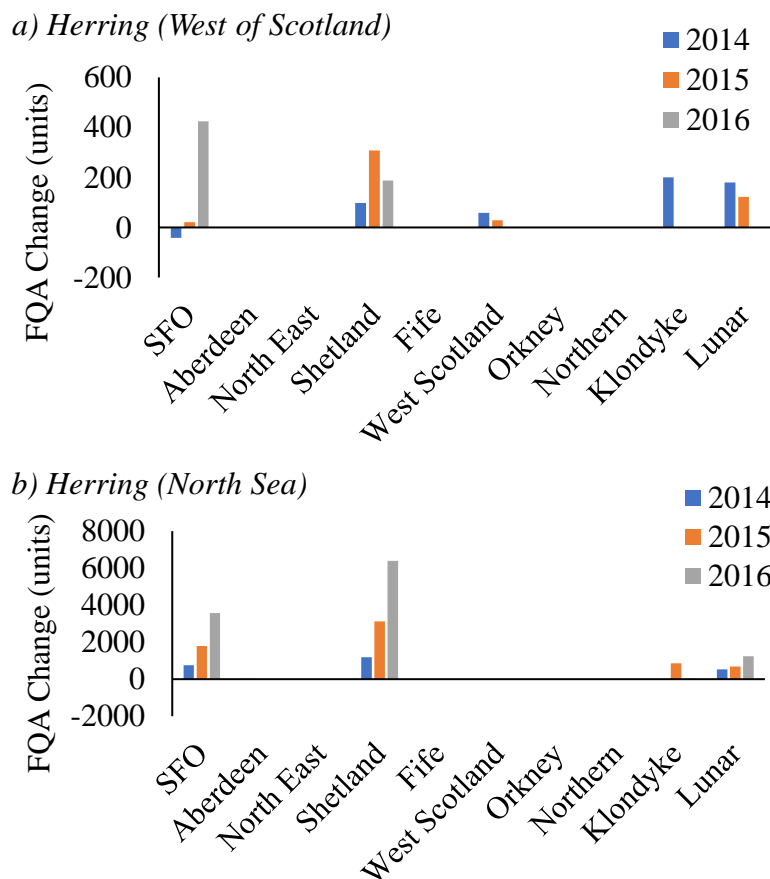


Figure 3: Illustrating the accumulation of Herring FQA units in the a) North Sea and b) West of Scotland, ‘swapped in’ for use in the European ‘maatje’ market (2014-2016)²⁰

¹⁹ Also known as traps or pots, creels target crabs and lobster.

²⁰ Source UK Quota-Use Statistics: <https://www.gov.uk/government/statistical-data-sets/quota-use-statistics> (Accessed November 2020)

ii) Whitefish Quota Leasing

Acknowledging that destination markets for derived catch evidently influence the dynamics of quota use, it is also possible to examine the implications of formal quota releasing mechanisms. These include the ‘banked’ quota (held from previous years), the ‘fully documented fisheries’ and cod camera schemes. All release additional quota, resulting in an annual flooding of the quota market, frequently too late in the season for efficient use. For example, North Sea (Area IV) cod quota lease prices, reportedly declined annually from £ 1650 to £ 900 per tonne between 2014 and 2015 (North East PMP, 2014; North East PMP, 2015) following the release of official additional schemed quota. Use data for the North Sea²¹ (Fig. 4) confirms that four of Scotland’s POs (SFO, Aberdeen, North East, and Shetland) attained significant additional amounts of cod quota between 2014 and 2016. Consulting wider sectoral data for Area IV (North Sea) offers insight, in that three UK POs outside Scotland²² and the government controlled ‘under 10m pool’ used less than their cod quota allowances during each of these years. These POs outside Scotland, and formal acquisition mechanisms, are both considered sources of additional cod quota.

European decisions to increase stock TAC levels may simply saturate quota markets. For example, a 78% increase in haddock TAC in 2016, caused the maximum price attainable for leasing quota to fall from £ 400 per tonne (in 2015), to £ 100 per tonne in 2016 (SFO PMP, 2016). As Fig. 4 shows, the SFO and North East POs acquired significant amounts of additional quota during this period, more than was floated (unused) by Scotland’s POs collectively. UK quota use data reveals potential sources were the Cornish PO (1286 units) and the Anglo-North Irish Fish PO (ANIFPO; 459 units)²³.

Monkfish, or ‘anglerfish’ as they are named under EU regulation, also benefit from a formal ‘transfer allowance’, which means that FQA units for the North Sea stock can be transferred to the West of Scotland, by any PO as they see fit, during a given year. Further leasing in of monkfish quota, beyond formal banking, is documented in the ‘production and marketing plans’ and evidenced from quota-use records. The SFO, North East, and Northern POs all acquired quota between 2014 and 2016 (Fig. 4). All reference a UK wide overfishing of monkfish, which occurred in 2015, despite a 20% increase in the UK monkfish TAC. This was reportedly driven by ‘*an abundance of fish on the grounds*’ (SFO, PMP 2016). Poor European TAC decision making for monkfish, is reportedly based upon inadequate data for stocks. This is attributed to: i) a lack of historical fisheries information concerning bycatch and discards; ii) the challenges of two monkfish species (*Lophius piscatorius* and *L.budegassa*) being profiled under a single TAC; and iii) active monk fisheries not reaching TAC targets between 2011 and 2014, as fish were simply not available to catch. Monkfish were therefore captured in abundance in 2015 for the first time in five years and European markets for Scottish exports (Spain and France) responded positively. The corresponding lease price for quota soared to a ‘record high’ of £ 2200 in 2015 (SFO PMP, 2016).

²¹ UK Quota-Use Statistics: <https://www.gov.uk/government/statistical-data-sets/quota-use-statistics>.

²² The POs external to Scotland are Anglo-North Irish Fish PO (ANIFPO), North Sea PO, the FPO Ltd

²³ UK Quota-Use Statistics: <https://www.gov.uk/government/statistical-data-sets/quota-use-statistics>

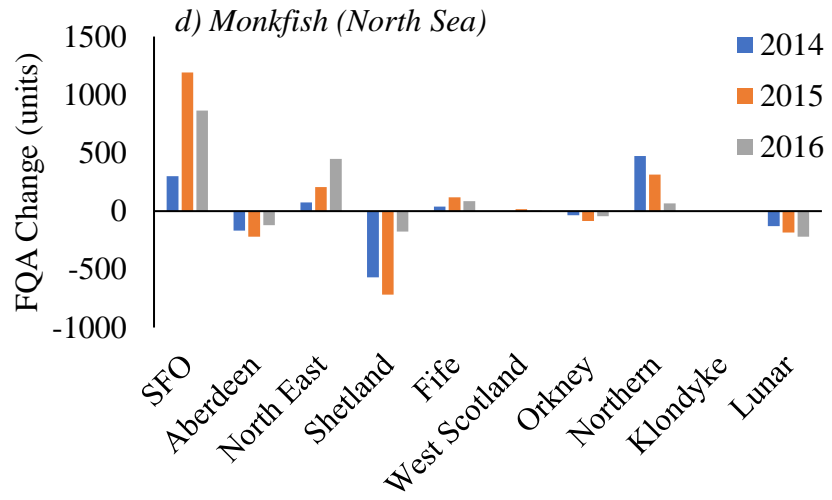
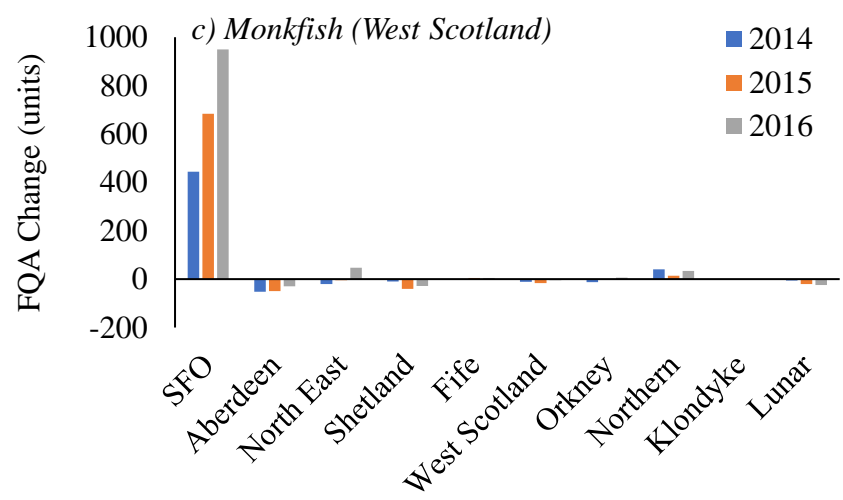
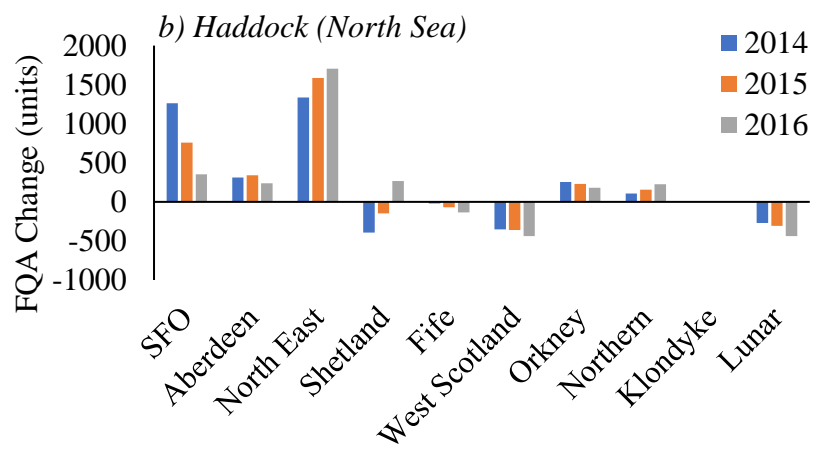
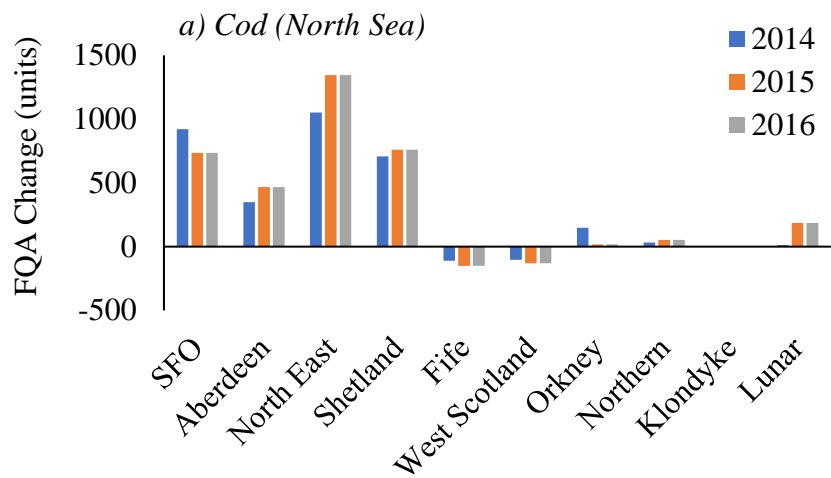


Figure 4: Unit changes in FQAs used by Scotland’s ten POs (between 2014 and 2016) for: a) North-Sea Cod; b) North Sea Haddock; c) West of Scotland Monkfish and d) North Sea Monkfish. Where positive values indicate quota unit ‘accumulation’ through leasing or barter while negative values signify quota ‘given up’ through similar mechanisms (*Source: UK Quota-Use Statistics:*

<https://www.gov.uk/government/statistical-data-sets/quota-use-statistics>)

7. Discussion

This study identifies some of the complexities characterising the temporary dispensing of rights, to annually access fish stocks around Scotland and the wider UK. Here, the language of rights translates into access to quota units, the majority of which are privileged to Producer Organisations, including ten in Scotland and a further thirteen groups located across England, Wales, Northern Ireland, and the Crown Dependencies. This analysis was designed to first gather evidence and establish the extent to which informal quota transactions have been a key characteristic of UK fisheries and second, discern attributes shaping any observable quota transaction system. Drawing upon similar studies, the broader objective behind the study, was to understand the efficiencies of an existing UK quota market. In summarising, this discussion will focus upon equitabilities among Scottish POs, in terms of opportunities to access and accrue economic rent from fishing through the current quota system.

7.1. Methodological reflections

Before commencing, a reflection on the devised methodology can provide insight into the limitations of this analysis. The dataset focuses only on one geographic region (Scotland) which is a devolved element of a wider national UK economy. While this has been necessary given limitations surrounding the core data set ('production and marketing plans') the study does not capture broader fluidity of quota unit movement among all UK Producer Organisations (POs), because the UK Fixed Quota Allocation (FQA) database lacks transactional information. Attempts to interpret quota movement, therefore result in a piecing together of information from a various-sources, and while providing insight, this presents an unstandardised narrative of the quota market. This can be illustrated simply, by the terminology used. For example, while POs discuss quota 'brought in' or 'loaned out' in equivalent catch tonnes; government quota statistics describe the number of FQA units used by each PO without any discussion of equivalent catch tonnes. With these caveats in mind, the discussion will focus upon key findings.

7.2. A pervasive UK quota market

The quota market was clearly a pervasive feature of UK fishing, between 2014 and 2017 across the pelagic, whitefish and shellfish sectors, as outlined in this analysis of PO 'production and marketing plans'. Examining the drivers for temporarily leasing quota, it emerges that prices, are driven as much by events in the marketplace (e.g., trade sanctions) as they are by the events in the water, which drive the stock assessment models and subsequent TAC limits. A recently released Fisheries Discussion Paper [35] identifies the systemic problems incurred by unequal initiation distribution of quota among members of Scotland's sea fishing fleet and a lack of limits to the amounts of FQA units which can be bartered or leased domestically. This recent government paper therefore reinforces that earlier challenges have not simply disappeared in the last three years.

Furthermore, the regulatory environment surrounding fishing in Europe has become increasingly complex since 2017 with expansion of both the landing obligation (or discards ban) and 'minimum conservation size' rules being imposed. Some fishing gears are particularly susceptible to 'choking' – targeted fishing leading to untargeted capture ('bycatch') of other catch groups. 'Chokes' may be either low value fish or catch for which a fisher simply has no quota. With increased regulations, chokes cannot be discarded at sea but cannot be landed either, unless appropriate quota is sourced and secured. Access to quota is

therefore likely to become increasingly important because of the more regulated capture environment.

7.3. Quota market (In) efficiencies

The ‘grandfathering’ of FQAs as a mechanism for sharing out fishing rights in the UK has evidently led to a skewed distribution of opportunity in Scotland. This is now widely recognised [35]. Opportunity is described as particularly constrained for small vessels (‘10m and under’) who may only access limited quota through a government pool, unless they secure membership in a Producer Organisation (PO). However, access to opportunities is also limited among the POs themselves, as evidenced in the analysis presented here, by the variability in FQA units held. It is identified that the average quota holding per registered entity inside a PO, varies significantly among the ten PO groups in Scotland.

Three POs boast average FQA holdings of between 26,000 and 169,000 units. For the other seven registered POs, each registered entity within their membership holds an average FQA allowance of between 2,000 and 7,500 units. This indicates a significant concentration of opportunity and rights among the POs, which skews any resultant distribution of profits from fishing. At the national level, this suggests that three POs dominate the Scottish industry membership. In an efficient market, a degree of consolidation is expected, for example, where profit is aligned with a specific type of quota [24]. This is evident in Scotland’s pelagic industry, with the three main PO groups (Lunar, Shetland, Klondyke) describing the development of a quota bartering system, which curtailed against losses when global market access for specific catch products became constrained. These POs have been able to consolidate power within the pelagic sector, by ‘swapping’ (or bartering) horse mackerel, Atlanto-Scandia Herring, and whiting FQA units in return for herring and mackerel. The Scottish Fisherman’s Organisation (SFO) is also a potentially dominant actor in this quota bartering economy but represents a significant anomaly in terms of Scotland’s POs, accounting for 47% of all registered vessels. Furthermore, perhaps by virtue of membership size, the SFO has diversified across both pelagic and whitefish catch and while the membership narrative details whitefish leasing transactions explicitly, its association within the pelagic bartering system is less clear. While this study therefore proposes a pelagic monopolisation among POs in Scotland, between 2014 and 2017, it is recognised that the actors involved are not characteristically uniform. Rather, their membership, capacities, links with international export markets and with local processing operations, which enable vertical integration into the supply chain, varyingly influence their opportunity.

It is also recognised that consolidation can be indicative of market inefficiencies, particularly when a loss of opportunity can be specifically identified in rural, remote, or marginalised geographic locations [28]. The dynamics of Scotland’s quota market suggest that consolidation to a point of inefficiency may be a real and tangible problem. Evidence supporting this includes an apparent lack of pelagic quota for six PO groups, a retraction in numbers of small vessels registered with Scotland’s POs since 2016 and the challenges marginal POs face to meet the prices of acquiring quota, in support of their members and processing partners. Ultimately, fish quota is a valuable commodity. As evidenced in Scotland, for any POs operating under high costs, the temporary leasing out of quota can be financially beneficial; conversely, for those with lower running costs or market access opportunities, bringing in quota may generate profit [45]. For both North Sea haddock and monkfish stocks, Scottish actors may be involved in the ‘making’ of quota unit lease prices, and a degree of market power inside the Scottish lease economy is likely. However, findings

from this study also indicate that most of Scotland's POs are marginal actors and 'price takers' in quota leasing arrangements. For whitefish, marginal POs including those in the North and North East are dependent upon leasing in cod and haddock quota to fulfil the expectations of their local processing industry. Other marginal groups (West Scotland) describe out-sourcing pelagic herring overseas (in Ireland and the Netherlands) being unable to afford the quota prices on the Scottish market. Ultimately the price of quota is associated with market prices for end products and here it is also evident that high costs are associated with establishing new overseas trading partnership, particularly in Asia. Those inside the pelagic monopoly, with capacity to invest in new overseas trading relationships, clearly benefitted earliest when Nigerian and Russian- Ukrainian markets collapsed, with significant costs attached. For those outside the monopoly group, such investments seem unachievable given the current status-quo.

8. Conclusion

This study identifies that, the fish quota market in Scotland and dynamics surrounding this, are integrated into and not separate from the wider UK. The market in which quota units are temporarily leased and bartered emerges as a self-created, self-regulating system, largely driven by industry actors, which can be likened to 'economic deregulation' in which the industry is '*left to bring about its own*' efficiency and rent maximisation [13]. As the UK realigns its interests as a European Coastal State, Scotland's fisheries stakeholders are requesting that domestic challenges surrounding dis-organisation of the quota market are confronted [35]. This is particularly important in rural areas, where fishing remains of significant economic and cultural importance. There is evidence of progress in this regard south of the border in Cornwall, where the Duchy Fish Quota Company are now actively buying Cornish quota to provide affordable leasing arrangements for fishing communities²⁴. Such a strategy might be applicable in marginal PO areas across Scotland.

Given that current guidelines for the fishing industry only request quota market transaction details involving the government '10m and under' quota pool, and POs liaising with non-UK actors, the systematic collection and storing of data, concerning domestic FQA unit swaps and loans among POs, does not appear to have been prioritised. Neither has the equitability of access to knowledge surrounding real time quota unit value, among those who have been gifted the right to access fish. These shortfalls present opportunities for future research.

8.1. Future research

This study identifies that further information is required to adequately understand efficiencies of the UK quota market. Available data for the UK leaves many 'unknowns', for example where lease prices are not discussed for certain catch groups (e.g., Nephrops, Plaice, Mackerel) or where the distinction between quota unit accumulation through bartering or leasing, is unclear. Every attempt has been made to address these problems by drawing upon supplementary government statistics, however neither the FAQ database nor the available 'quota use' data specifically contextualises quota transactions. Further, there is a lack of information concerning PO production (capital and running) costs and profits. This restricts detailed analysis of market performance efficiency, as organisational 'turnover' data defines the value of annual catch sales which is not representative of profit. Future scenario

²⁴ <http://www.duchyfishquota.co.uk/>

modelling, or ‘alternative dynamic stories’ of management [46] have been used to explore decision making in European fisheries [47,48]. It is therefore recommended that participatory approaches are now adopted, to further investigate opportunities for quota market reform in the wider UK, for example by understanding challenges to developing a digital quota trading marketplace.

CRedit

Authorship contribution statement: Helen Cross: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data curation, Writing - original draft, Writing - review & editing, Visualization, Project administration, Funding acquisition.

Acknowledgements

This study does not represent the interests of any members of Scotland’s Fishing Industry and was made possible through an internally funded post-doctoral research position. Sincere thanks, are extended to colleagues at Heriot-Watt University and two anonymous reviewers for their written insights.

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