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Implications of Brexit for Fishing Opportunities in Wales

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[1] In October 2017 the PPIW became part of the Wales Centre for Public Policy. The Centre builds on the success of PPIW and will continue the Institute's work of meeting Welsh Government Ministers' evidence needs, alongside a new mission to support public services to access, generate, evaluate and apply evidence about what works to address key economic and social challenges. This assignment was commissioned for the final PPIW work programme.

Contents

Summary

- This report explores the potential implications for fisheries policy in Wales of the planned exit of the United Kingdom from the European Union ('Brexit') and the EU's Common Fisheries Policy.
- Brexit has the potential to significantly change the context of fisheries management in the UK. The three main axes for that change are access to waters, sharing of fishing quotas, and tariff and non-tariff trade barriers. Devolution is also significant and could see power over some fishing responsibilities move from European institutions to the Welsh Assembly.
- There is a great deal of uncertainty regarding the outcomes of Brexit; nonetheless analysis of fleet economic performance under six Brexit scenarios reveals that while the Welsh fishing fleet as a whole could gain, there are large divisions in the industry, with most vessels, fishers, and ports likely to be 'net losers' from Brexit. A smaller number of vessels face potential gains including 'flagships' that land most of their catch in Spain and Ireland.
- These results are explained by the following:
    - Quota: Most of the Welsh fleet targets shellfish species that are not managed through quota limits. Without quota holdings and changes to fishing methods, these vessels would not benefit from any increases to quota post-Brexit.
    - Access to waters: The Welsh fleet comprises mainly small-scale vessels that would not benefit from exclusive access to an extended fishing area.
    - Barriers to trade: Most seafood produced by the Welsh fleet is exported to EU countries or through EU trade agreements. Potential tariff and non-tariff barriers could significantly impact market access and competitiveness.
- The structure of the Welsh fleet is unique and there is a real risk of it being 'left behind' by the demands of larger fishing interests in the UK-EU negotiations. In the short-term, in order to 'do no harm' to the Welsh fishing industry, it may be prudent for the Welsh Government to press for the continuation of current arrangements for total catch limits, quota divisions between countries, quota sharing within the UK, as well as for the continuation of frictionless trade.
- Looking forward, we estimate that fishing opportunities relating to Welsh waters post-Brexit could be much larger than Wales' current share. However, as any increases would accrue to existing UK quota holders, the Welsh fleet requires a different arrangement of quota sharing within the UK to get its fair share. Taking advantage of new quota would require targeted changes in the management of fishing opportunities, supported by further research, so that the benefits are felt in Welsh ports and wider society from what is, ultimately, a public resource.

Glossary

Effort: a combination of the time at sea and engine power of a fishing vessel. A reduction in fishing effort (effort control) can be achieved by limiting the time spent on fishing (days at sea).

European Economic Area (EEA): unites the European Union Member States and the three EEA Economic Free Trade Area (EFTA) States (Iceland, Liechtenstein, and Norway) into an Internal Market governed by the same basic rules. There are agreed tariff rates for members of the EEA.

Exclusive economic zone (EEZ): the area from a state's coast to 200 NM (or the midpoint to another state's coast) where a state has special rights regarding the exploration and use of marine resources, as prescribed by the United Nations Convention on the Law of the Sea.

Fishing mortality: the rate at which fish are taken out of the sea by fishing activity.

Fishing mortality maximum sustainable yield (FMSY): the level of fishing mortality compatible with producing the maximum sustainable yield.

Fishing opportunities: the access rights granted to companies, individual fishers and members of the public that allow them to fish commercially. These may be in terms of tonnage of fish, days fishing, and may relate to specific areas and gear types.

Fixed quota allocations (FQAs): the UK's quota-share system, in place since 1999, whereby fishers receive a fixed share of the national quota every year. FQAs are unitless values attached to fishing licences representing the share of quota they are eligible to.

Fleet segment: a grouping of vessels of similar length and gear type.

Gear: the equipment on board (or adapted to) a vessel to enable it to catch a certain species.

International Council for the Exploration of the Sea (ICES): provides scientific support services for the EU and other governments.

ICES rectangles: an area of '30 min latitude by 1 degree longitude in size, which is approximately 30 nautical miles by 30 nautical miles.

Individual transferable quota (ITQs): a quota system whereby long-term shares allocated to fishers can be commercially traded.

Landing obligation: is the requirement under the reformed Common Fisheries Policy, being phased in from 2015 to 2019 to land all catches of species managed under the TACs and quota regulation, and count these against quota holdings. Also referred to as the 'discard ban'.

Landings: fish brought to shore for commercial sale.

London Convention: signed in 1964 between before the UK, Belgium, France, Germany, Ireland and the Netherlands joined the EU, the convention granted access to UK inshore waters (6–12 nautical miles) based on historical fishing patterns.

Maximum economic yield (MEY): a framework for setting total fishing limits based on the amount of fishing pressure that maximises economic value (revenues minus costs) instead of tonnage of fish.

Maximum sustainable yield (MSY): a framework for setting total fishing limits where the level of fishing that could theoretically produce the largest continuous average harvest under existing environmental conditions.

Pretty good yield (PGY): a framework for setting total fishing limits where MSY is treated as a range, with some species fished over or under their MSY point value, depending on technical and biological interactions.

Producer Organisations (POs): officially-recognised bodies that manage the fishing opportunities of their members, align supply with demand, and create added value for landed catch.

Relative stability: the system of allocating fishing opportunities to EU Member States based on their historic fishing activity, adjusted to account for the loss of fishing opportunities in third countries' EEZs and areas dependent on fishing. These stock shares, based on a reference period of 1973-1978, have remained fixed.

Scientific, Technical and Economic Committee for Fisheries of the European Commission (STECF): official scientific advisers to the European Commission.

World Trade Organisation (WTO): a 162-country international organisation to promote international commerce. The WTO's Most Favoured Nation (MFN) tariffs are what countries apply to imports from other members of the WTO, unless the country is part of a preferential trade agreement, when lower or zero tariffs can be applied.

Zonal attachment: the average division of biomass of a stock within each country's waters.

Introduction

The exit of the United Kingdom from the European Union (EU) ('Brexit') and the subsequent changes to legislation could have profound implications for how fisheries are managed in Wales. The management of EU fisheries is predominantly an EU competency, with some notable policy areas (e.g. vessel licensing, permit schemes and internal quota allocation) remaining in the hands of Member States and which serve as exceptions to the rule.

The scale of the potential changes to be addressed is made more challenging by the ambiguities of the Brexit process. In this uncertain policy landscape, the need for research insight is imperative and for this reason the Cabinet Secretary for Environment and Rural Affairs asked the PPIW to explore the implications of Brexit for fisheries policy in Wales.

In its white paper 'Securing Wales' Future', the Welsh Government observes the need for Wales to create its own "dynamic and forward looking" Welsh fisheries policy following Brexit "to safeguard the future prosperity of Wales' fishing industry and coastal communities" (Welsh Government, 2017b). The UK Government, in consultation with the devolved administrations, plans to draw up a Fisheries Bill of its own to replace the EU's Common Fisheries Policy (CFP).

While management of fisheries is devolved to the National Assembly for Wales and the Welsh Government, it has operated according to the CFP, the framework regulating the fishing industry, since the UK joined the European Economic Community (EEC) in 1973. This means that fisheries policy decisions are taken jointly by Member States at the EU level (by the Council of the European Union, Agrifish). Devolved governments play a role in policy-making as part of UK delegations to the EU and also design policy in relation to domestic fisheries (e.g. shellfish), but have primarily been engaged in the administration and enforcement of the CFP. Once the UK leaves the EU the CFP will cease to apply to UK nations (subject to any provisions within the EU Withdrawal Bill) and negotiations around the terms of UK exit from the EU may present new opportunities for changes to fisheries policy and management in Wales and across the UK.

Currently, the CFP stipulates the Total Allowable Catch (TAC) of fish in the seas around the EU, and the quota of species allocated to each member state in particular zones of the seas surrounding member states. Ninety percent of the Welsh fishing fleet is made up of small vessels (under 10 metres), but together they are allocated less than 1% of the total UK fishing quota, and only around 0.02% of EU fishing quota overall. 'A fairer rebalancing of fishing quota' is a stated priority of fisheries stakeholders both in Wales and across the UK, with reference to EU and other countries fishing in Welsh and UK waters. Stakeholders in Wales are

interested in how to grow and add value to the fishing industry in Wales, however, what a fairer redistribution of quota means in practice has yet to be established.

Fisheries in Wales must operate in-line with Welsh legislation, notably the Environment Act (2016) and the Wellbeing of Future Generations Act (2015), as well as broader international regulation. Ensuring that developments in fisheries management align with the first Welsh National Marine Plan (currently out for consultation) and contribute to increased resilience of the sector to face long-term sustainability challenges is also a priority. This report therefore explores the possibility of increasing Welsh fishing opportunities, the evidence around alternative fisheries management systems and practices, and the implications of both these on associated industries, coastal communities, Welsh Government and sustainable marine management.

This report outlines the potential impact of Brexit on fisheries (section one) and estimates the economic impact for the Welsh fleet and fishing ports (section two). With this context, the focus is narrowed to the issue of fishing opportunities in Wales, analysing post-Brexit policy options (section three) and it concludes with comments on how fishing opportunities can be utilised to ensure that Welsh fisheries can benefit from the Brexit process.

Section One: The potential impact of Brexit on fisheries

The potential impact of Brexit on Welsh fisheries is broad, deep, and complex. For fisheries management, Brexit is inherently intertwined with devolution issues. Whereas many industries are closely monitoring aspects relating to the four freedoms of the European Union (freedom in the movement of goods, services, capital, and people), and these are present for the fishing industry as well, the issue of how the UK may claim its rights and responsibilities over fisheries resources in its Exclusive Economic Zone (EEZ)[2] outside of the EU is one of the key issues for UK and Welsh fisheries post-Brexit. This issue requires some historical context; indeed, much of the history of EU fisheries policy is bound up in the history of Exclusive Economic Zones.

The historical development of Exclusive Economic Zones

On 1 January 1973, at the time of UK accession to the European Economic Community (EEC), the precursor to the EU, coastal states had exclusive access to waters within 12 nautical miles (NM) from their coastline. Whereas some countries like Peru, Chile and Iceland had begun to expand their claims around this time, the UK accepted as a condition for its accession that waters of the EEC would be shared (Regulation 2141/70). This condition, put into force just six hours after negotiations with the accession countries (UK, Ireland, Denmark, and Norway) began, was seen as a basic deal between those having the resources and those having the markets (Peñas Lado, 2016).

'Taking back control' and similar pledges made during and after the Brexit campaign are thus complicated by this historical development, as the UK has only ever exercised sovereign control over 12 NM from its coastline. Still, for at least three decades there has been a feeling of unfairness within the UK fishing fleet regarding the combined equal access to waters and the division of fishing quota within this zone, especially as other coastal nations like Iceland and Norway have exercised their own EEZ.

The understanding that the UK will claim its rights and responsibilities over fisheries resources in its EEZ of 200 NM, at least as an initial negotiating position, could have profound effects on the UK fishing industry. In particular, the distinction between UK and EU EEZs would create a maritime border of some form and require access to those fishing waters would need to be re-

[2] The area from a state's coast to 200 NM (or the midpoint to another state's coast) where a state has special rights regarding the exploration and use of marine resources, as prescribed by the United Nations Convention on the Law of the Sea.

determined, and may also weigh in to discussion on how quota[3] should be divided between the UK and EU for shared fish stocks that straddle or migrate across the EEZ boundary. It is the position of the UK Government (Langston, 2016) – although fiercely denied by EU policymakers (Boffey, 2017) – that fishing quota will change from the EU system based on historical catches (termed 'relative stability'[4]) to a system based on the average division of the biomass of a stock within each country's respective EEZ (termed 'zonal attachment').

While much of the policy discussion over the potential transition to zonal attachment as the primary principle of dividing shared fisheries between countries has focused on EU-UK relations, this could potentially extend to dividing shared fish stocks among the devolved administrations (an issue explored in section three of this report).

Brexit consequences

For fisheries, the three most significant changes relate to sharing quota, access to waters, and trade. There are also likely indirect impacts from these and other changes that could, in turn, also impact fleet economic performance. The following table summarises the potential effects.

Table 1: Brexit consequences and their potential effects on the Welsh fishing industry

Potential Brexit consequence	Factors that directly affect the Welsh fishing industry	Factors that indirectly affect the Welsh fishing industry
Ending the four freedoms	• Imposition of tariffs • Imposition of 'Non-tariff barriers' • Reductions in EU labour • Restrictions to the establishment of EU businesses	• Depreciation of sterling • Changes to consumer spending on fish products • Changes to investment by fishing companies and businesses
Changes to the UK Exclusive Economic Zone	• Extent of and access to UK waters • Quota shares	• Overfishing
Regulatory change	• New or amended UK fishing policies and regulations	• Ecosystem impacts

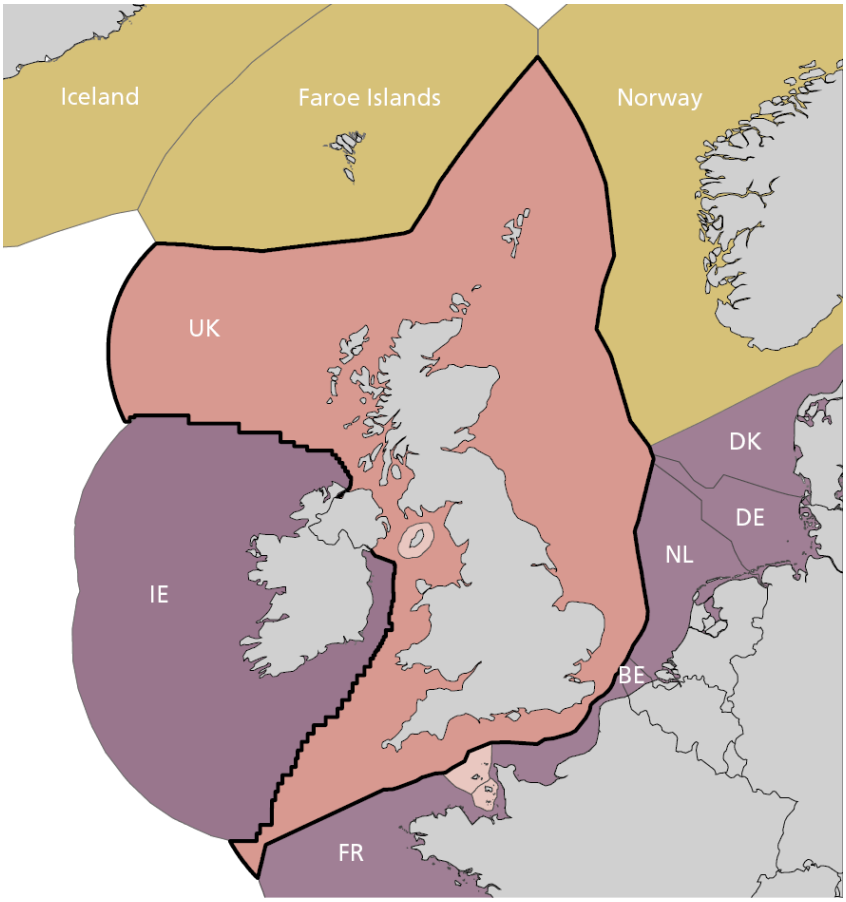
Source: Adapted from Carpenter (2017a)

[3] Quantity limits for commercial species such as haddock, sole, and mackerel.
[4] The system of allocating fishing opportunities to EU Member States based on their historic fishing activity. These stock shares, based on a reference period of 1973-1978, have remained fixed.

Potential changes to access to waters

The UK is expected to establish control over fisheries in its EEZ post-Brexit to determine which fishing vessels can access UK waters. This is common practice and many coastal states have declared an EEZ to exclude foreign activity, including fishing, such as when Iceland excluded UK fishing vessels from its EEZ during the 1970s. This declaration would likely be met with reciprocal exclusion in EU waters for UK fishing vessels, including Welsh vessels, which do fish in the waters of other EU Member States and land in EU ports due to closer proximity, higher prices, and/or supply chain factors – although some of the most abundant waters are in the UK EEZ.

Figure 1: The UK 200 NM Exclusive Economic Zone



Source: House of Lords (2017)

Potential changes to quota sharing

One of the potential impacts in post-Brexit fisheries with significant implications for economic performance, and one that has received a great deal of attention in the media, is how quotas for fish stocks will be shared post-Brexit. In the early days of the Brexit vote, the UK Minister of State for Agriculture, Fisheries and Food, promised “hundreds of thousands of tonnes” of

additional quota post-Brexit (Swinford & Chazan, 2016). Several studies have also calculated a significant increase in landings[5] if the UK were to claim its share of fishing quota based on zonal attachment, where quota shares are determined by the share of the biological stock inside the EEZ rather that what is granted through the EU system of 'relative stability' based largely on historical catches (Napier, 2017; HM Government, 2017; Fishing for Leave, 2017; Goulding & Szalaj, 2017). Much like access to waters, however, things are not as simple as they may seem, and much like the history of EEZs and 'British waters', it is important to understand the history of quota shares and how the current situation came to be.

In the late 1970s, as there was a growing appreciation both within the EEC and internationally that fish stocks were not infinite and fishing pressure could not keep expanding, the EEC was in discussions about how to introduce a limit on the amount of fishing pressure and how it should be shared between the EEC members, including the UK.

Over six years (1973-1978), the EEC members negotiated the relative stability shares with the aim of providing a stable and predictable proportion of the quota of each species to each Member State. The relative stability key was established on the basis of historical reported landings over a five-year reference period (1973–1978), and was subject to intense political negotiation. The agreed shares also accounted for the needs of coastal areas heavily dependent on fisheries and lost fishing opportunities arising from the declaration of 200 NM exclusive fishing zones by third countries (non-EU countries). It has been updated over the years to accommodate the accession of new Member States to the EU. While this was agreed at the time by all EU Members, many UK fishers feel the UK lost out relative to the proportion of fish stocks that are present in UK waters. The concept of zonal attachment has grown in prominence and is currently used for negotiating quota shares with third countries like Norway. The UK position on post-Brexit quota shares is that they should align with zonal attachment rather than relative stability or historical catches (Eustice, 2016).

There are certain fish stocks that are found within the UK EEZ that the UK fleet does not target. UK vessels are not adapted to harvest these species and little or no market exists for these species in the UK (e.g. sandeel and Norway pout). As such, there may be a middle scenario where zonal attachment is invoked by the UK as a starting position, but quota shares are renegotiated based on the priority stocks for each side. An indication of what these priority stocks are can be found in the stocks that the UK gains in quota swaps[6] every year between the UK and other EU Member States.

[5] Fish brought to shore for commercial sale.

[6] Fishing quota can be exchanged between EU Member States (e.g. 1 tonne of cod in area X for 2 tonnes of haddock in area Y), but not bought or sold.

Potential changes to EU tariff and non-tariff barriers

In the UK, the majority of fish caught is exported and the majority of fish consumed is imported (Seafish, 2016). In fact, given the volume of sales, the EU market for fish is of higher importance to UK fishers than the domestic UK market (Carpenter, 2017a). When it comes to seafood – the most traded food commodity globally (Terazono, 2016) – the importance of trade cannot be overstated.

The possibility of EU tariffs post-Brexit restricting trade flows and/or cutting prices of UK exports concerns many in the UK fishing industry. Fish processors and wholesalers, the parts of the supply chain closer to the final market, are lobbying for the free flow of seafood products (together with access to EU labour) as one of their key Brexit demands (House of Lords Brexit Committee, 2016). The same is true for aquaculture producers (Scottish Salmon Producer Organisation, 2017; Belfast Telegraph, 2017).

For some in the UK fishing industry, non-tariff barriers to trade pose as great a threat as tariffs themselves. These 'barriers to trade' outside of import or export duty include import quotas, food safety and traceability requirements, local content requirements (e.g. size, presentation, catch methods), subsidies and industry bailouts, rules of origin, customs delays and inspections, licensing, packaging and labelling requirements (Carpenter, 2017a).

As a perishable good, the quality of fish products quickly deteriorates with age. The prices that fish exporters receive are therefore highly vulnerable to non-tariff barriers that generate additional inspections and border delays. Some interests within the EU may act to intentionally create delays for the importation of UK fish products to the EU.

Quota setting

It is possible, especially as the EU seeks to maximise the quota it can allocate to its own fleet, that agreements over the division of quota will break down and result in the UK and the EU setting their own respective shares of a finite, shared resource. If these shares sum to more than 100%, and quotas is fully utilised, then systematic overfishing will take place.

The history of quota setting negotiations with countries outside of the EU that share fish stocks (the 'third countries' of Iceland, Faroe Islands and Norway) only adds to the concern. While quota decisions set by the EU frequently exceed scientific advice on sustainable limits, quota negotiations with third countries over shared stocks depart even further from scientific advice desire (Carpenter, 2017a) – a result that fits with theories of decision-making. Outside the EU framework there is always the threat of a third country simply leaving the negotiating table and

fishing as much as they desire, so higher fishing limits serve as an effective compromise for all parties but at the expense of the health of fish stocks (Carpenter, 2017a).

Political realities

The decisions made on access to waters, quota sharing, tariff and non-tariff barriers, and other issues relating to Brexit and fisheries will not be made in a vacuum but will be influenced by a number of political realities that should be recognised.

The most obvious, but also the most unpredictable political reality is that the UK will face trade-offs between its demands in Brexit negotiations. Where fishing will fit in these negotiations is unclear. The UK fishing industry is not a particularly large economic sector in the UK (0.5% of GDP) (House of Lords, 2017), although neither is it a large sector for the rest of the EU (as a whole). It is not immediately clear which side will be prioritising fisheries to a great degree.

There has been some debate over which side of the negotiation 'needs' the other side more. While the UK runs a trade deficit with the rest of the EU for all goods and services (ONS, 2017), this is a rather limited concept of 'need'. The UK relies on the EU market for 41% of its exports, whereas the EU relies on the UK market for only 17% (or 8% if you include intra-EU trade) of its exports (ONS, 2017; European Commission Trade Export Helpdesk, 2017). As a share of the overall economy, the UK relies on exports to the EU for 12% of its GDP, whereas the EU relies on exports to the UK for 3% of its GDP (ONS, 2017; Eurostat, 2017). As The Economist explained the numbers game: "As many a supplier to a big supermarket knows, if one customer has half your business, they have a lot of power over you" (Buttonwood, 2016). That market power increases with economic size is one of the key reasons to form a trading bloc.

There are also trade-offs between issues within the scope of fisheries negotiations. If the UK seeks to claim its EEZ and larger quota shares, it can reasonably be expected that the EU will seek to gain something in return. As the National Federation of Fishermen's Organisations (NFFO) wrote after the referendum result:

> "We can certainly seek to renegotiate quota shares as well as access arrangements, but it is realistic to expect that there will be a price of some sort. Who will pay that price is a critical question". (National Federation of Fishermen's Organisations, 2016).

In considering how these trade-offs between demands for fisheries will be settled, it is important to recognise that priorities for the Brexit negotiations vary by stakeholder. Already it is clear that different stakeholders vary in terms of priorities for Brexit, particularly seafood

processors and anglers when compared to the catching sector (Stewart, 2017). Even within the catching sector there are diverging views on the importance of tariffs, as some fleet segments are more export-oriented than others, just as some fleet segments or areas may fish in EU waters or employ EU labour on board or in their supply chains (Stewart, 2017).
These diverging priorities are complicated by the fact that, like nearly all industries and organisational forms, there are imbalances of power. In the fishing industry this problem is particularly acute due to the dispersed and unorganised nature the small-scale fishing fleet in contrast to the well-organised and powerful lobby of the large-scale fleet. Some stakeholder priorities have a greater voice and more political weight than others.

Another reality is that the UK will be constrained in what it can achieve in terms of quota gains by the need to deliver sustainable outcomes. Indeed, producing 'sustainable fisheries' is the only priority that was universally rated with the highest importance across fishery stakeholders analysed in a University of York study (Stewart & O'Leary, 2017) and yet public opinion surveys have revealed that the UK public is sceptical of claims that Brexit will lead to better management of fisheries and the marine environment (Oceana, 2017). As mobile fish stocks are inherently shared, negotiations will need to be carefully handled to avoid adversarial relationships that could lead to unsustainable outcomes.

Lastly, how fisheries management is shared between Westminster and the devolved administrations adds to the complexity of post-Brexit fishery management. Already there have been suggestions to change the sharing arrangements of quota (Ekins, 2017), although a shifting of Arctic cod quota last year from England to Scotland proved controversial, as have initial proposals in Scotland to direct more of their own landings to Scottish ports (Fishing News, 2016). Fishing opportunities and issues related to Wales as a devolved nation are explored in more detail in sections three and four of this report.

Section Two: The economic impact of Brexit for the Welsh fleet and fishing ports

Although the details of UK fisheries management post-Brexit are just beginning to emerge, many reports have already gone a long way towards identifying the key risks and opportunities for the UK fishing industry. The most comprehensive of these reports is the House of Lords European Union Committee report on fisheries (House of Lords, 2017).

In terms of measurement, most of the research that has been completed has been to calculate the share of catches in the UK EEZ. Table A in the appendix looks at five studies that have attempted this. The studies use different assumptions and the results range from a potential 48-99% increase in landed value for the UK (Carpenter, 2017a).

This is just one aspect of economic impact however, and Brexit may not result in this. Carpenter (2017a) outlines six potential Brexit scenarios, some using zonal attachment, some not, but all based on some combination of outcomes across access, quota, tariffs, and quota-setting.

Table 2: Brexit scenarios used in Carpenter (2017a)

Scenario	Access	Quota	Tariffs	Quota-setting
Status quo (No Brexit)	Status quo	Status quo	Status quo	Status quo
Hard Brexit	None	Zonal attachment	WTO	Unilateral
Soft Brexit	Partial	Renegotiation	EEA	Negotiated as third country
Fisheries First Brexit	None	Zonal attachment	Status quo	Negotiated as third country
Fisheries Last Brexit	Status quo	Status quo	WTO	Negotiated as third country
No Deal Brexit	Partial	Zonal attachment	WTO + delay	Unilateral

Source: Adapted from Carpenter (2017a)

The importance of economic analysis

The changes in the value of UK fisheries from Table 2 refer to zonal attachment without other changes ('Fisheries First Brexit'). In Carpenter (2017a), incorporating changes to tariffs and quota-setting, for example under 'Hard Brexit', results in the change in earnings falling from 49% to 37%.

Economic analysis should not just look at the benefits of an action (an increase in earning) but also the costs (an increase in expenses). For many considerations, profit or gross value added (GVA) is more relevant than landed value or earnings.

The importance of fleet segment analysis

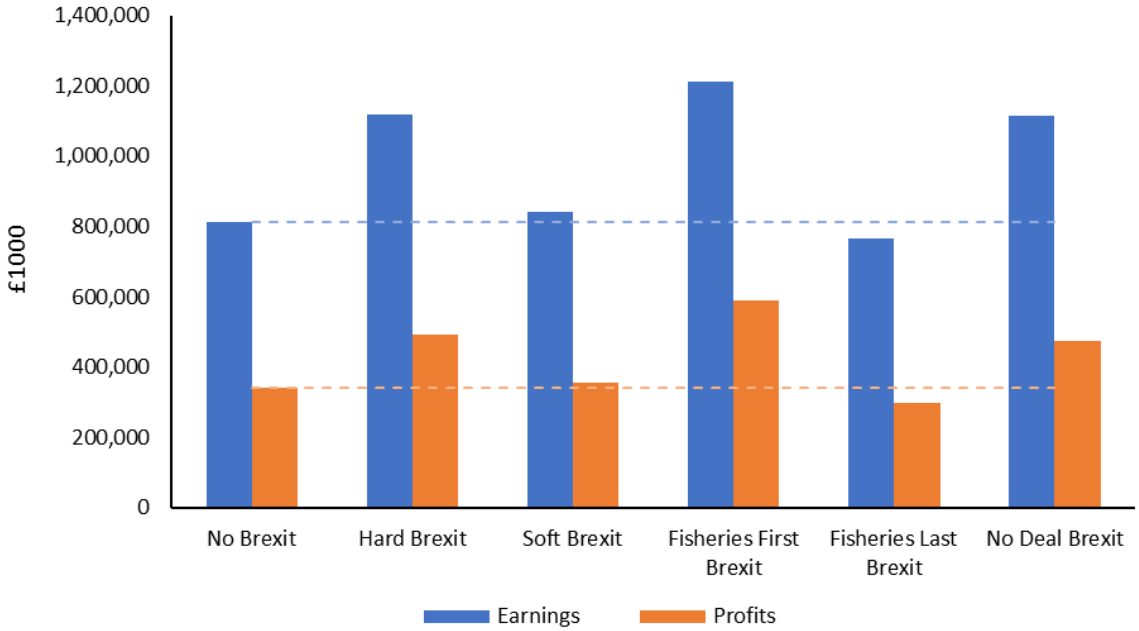
Going further still, analysis reported at the level of UK fisheries as a whole misses the complexity and variability of the industry across different regions of the UK. There is significant variance between the UK fleet segments, not just in size, but also in economic performance. The profit margin for the UK fleet as a whole is 17%, but some fleets, particularly the small-scale (under 10m) fleets, are considerably more vulnerable. Average profit margins for the large-scale fleet is 19% compared to 0% for the small-scale fleet. In fact, some segments are even running at a loss – reflecting that fact that for some fishers, fishing is as much of a leisure interest as a commercial one. Small-scale fishers in particular are not profit maximising actors (Salas, 2007; Cambiè, 2015). Also, fishers are continuously exiting the industry, as shown by declining numbers of fishers and vessels, which include those fishers with negative profit margins (STECF, 2017).

Results from Carpenter (2017a)

One study on the economic impact of Brexit for the UK fishing industry has been produced, with important implications for Welsh fisheries. Carpenter (2017a) analyses six different Brexit scenarios based on their expected changes in access to waters, quota sharing, tariff and non-tariff barriers, and impact on overfishing. This analysis was conducted for UK fleet segments and the results reported here refer to the UK as a whole.

Figure 2 below illustrates that compared to the 'No Brexit' scenario, a 'Hard Brexit', 'Fisheries First Brexit' and 'No Deal Brexit' increase landings, earnings and profits, the 'Soft Brexit' scenario has a small increase, and the 'Fisheries Last Brexit' scenario has a small decrease in earnings and profit. The difference between Hard and Soft Brexit is more varied at the fleet segment level, with some net winners and some net losers under both scenarios.

Figure 2: Total UK fleet earnings and profits under six scenarios



Source: Carpenter (2017a)

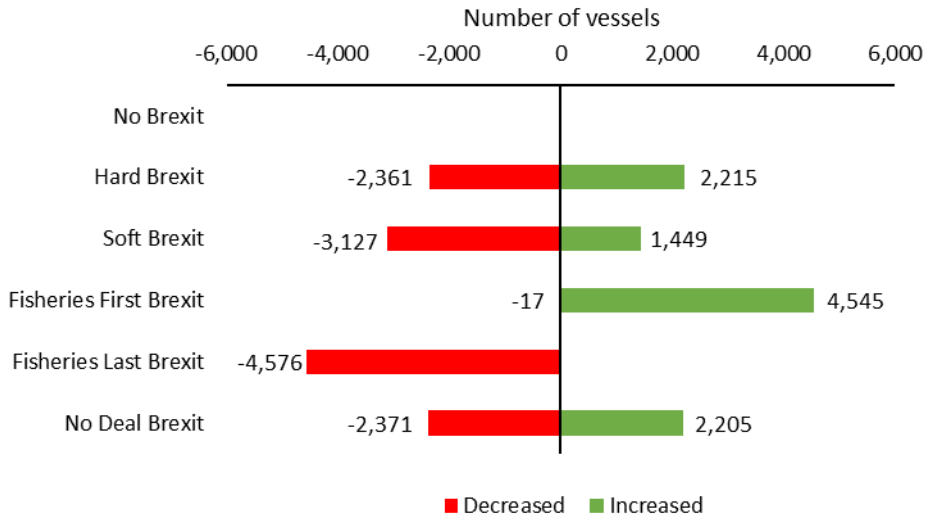
At the fleet segment level, some important trends also emerge. Some fishing gears[7], notably dredgers and pots & traps, have reduced landings, earnings, and profits across the major scenarios, with the exception of Fisheries First Brexit. This is due to the species composition of these gear types: shellfish are not managed under quota and therefore see no quota increase, but they are exported to the EU market in large volumes.

Figure 3 illustrates the positive (green) or negative (red) change in net profit across the six Brexit scenarios by number of vessels. The bars indicate the number of vessels and therefore illustrate the probably of a vessel or fisher yielding higher profits (and potentially wages). This figure combines all fleet segments together, which vary significantly in the number of vessels they contain.

By number of vessels, only the Fisheries First scenario benefits the majority of vessels, although the division is very close in many scenarios with nearly half the vessels doing better and half the vessels doing worse. By number of FTE fishers, the results show more positive results for Hard Brexit, Soft Brexit, and No Deal Brexit scenarios.

[7] The equipment on board (or adapted to) a vessel to enable it to catch a certain species.

Figure 3: Number of UK vessels with increased/decreased profits under six Brexit scenarios



Other considerations

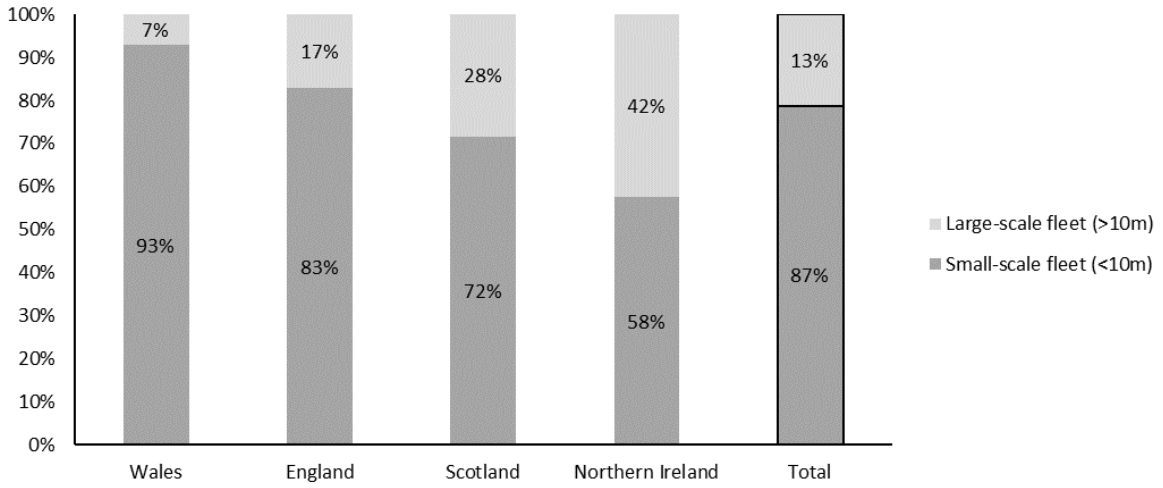
Carpenter (2017a) conducts three sensitivity analyses for quota uptake (as the UK fleet does not have sufficient vessels, the right gear, or viable supply chains for many of the estimated quota increases under zonal attachment), overfishing (as scientific advice on sustainable fishing may be undermined by competing national interests), and currency depreciation (as the value of sterling remains lower since the vote for Brexit).

The results of these sensitivity analyses show that currency depreciation is unlikely to help economic performance, that much of the potential gains are eroded if UK fishers fail to take advantage of new and additional quota, and that overfishing – by depleting fish stocks and future fishing opportunities – can completely reverse the results.

Estimating Brexit impact for Welsh fisheries

From the results of Carpenter (2017a), the 0-10m pots and traps fleet, the largest fleet segment by number of vessels, is a net loser under all Brexit scenarios except for 'Fisheries First'. This is particularly concerning for Wales as compared to the other devolved administrations (and the UK as a whole), the Welsh fleet is particularly small-scale and particularly oriented towards shellfish (caught with pots and traps). Of the 451 vessels registered in Wales, 419 are small-scale (defined as under 10 metres in length) and 32 are large-scale (over 10 metres).

Figure 4: Large-scale and small-scale composition of the fleet by devolved administration (2016)

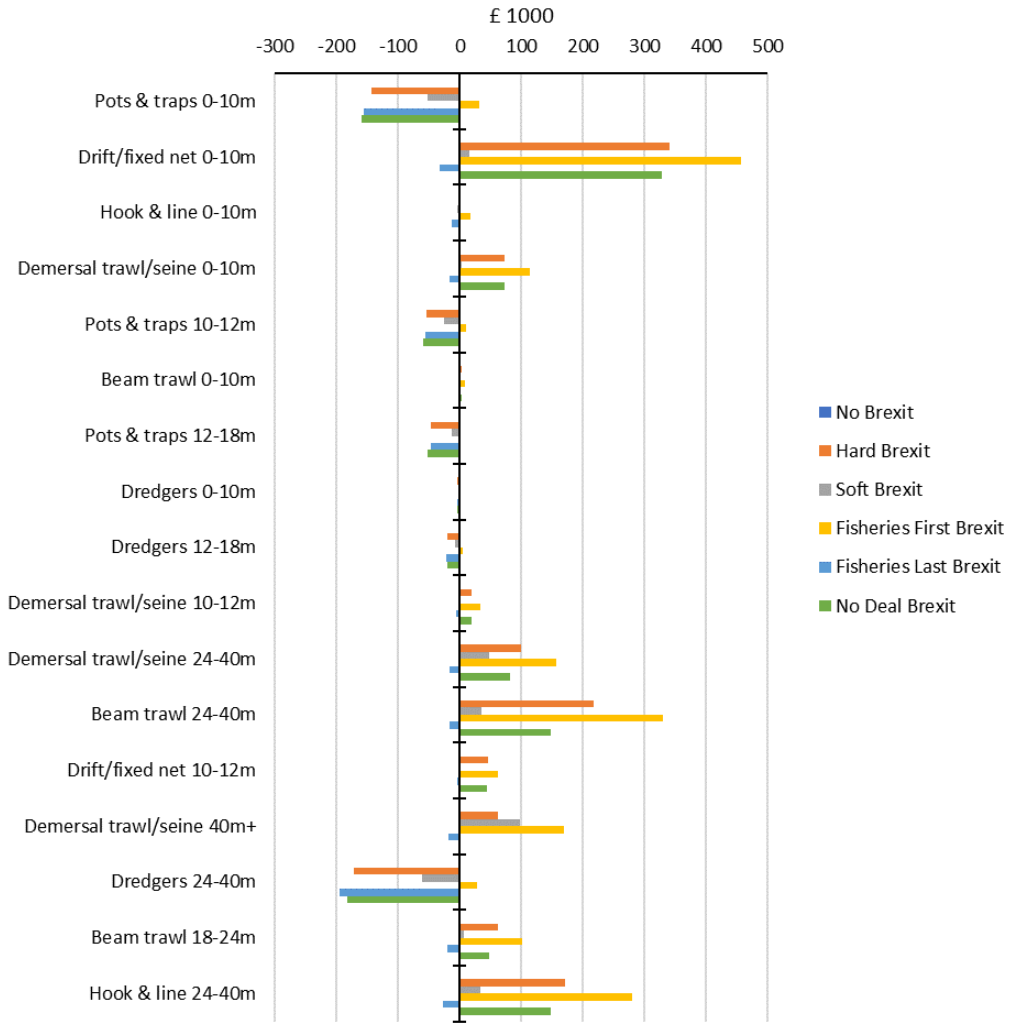


Source: MMO (2017)

The fleet-level economic data from the Scientific, Technical and Economic Committee for Fisheries of the European Commission (STECF) used in Carpenter (2017a) is not disaggregated to enable analysis for the Welsh fleet exclusively. However, the EU fleet register lists vessel length, gear and port of registration, so it is thus possible to apportion the results of Carpenter (2017a) to the Welsh fleet by determining the share of each fleet segment registered to Welsh ports. This approach assumes fairly homogenous vessels within a fleet segment (i.e. that the average Welsh vessel in each fleet segment is similar to other UK vessels within that segment).

The result of this apportioning of economic impact for Wales is similar to the results for the UK as a whole. While under most scenarios the total change in profit is positive, this is not true across all fleet segments, with pots & traps and dredgers worse off.

Figure 5: Change in profits by fleet segment under six Brexit scenarios for Welsh fleet segments

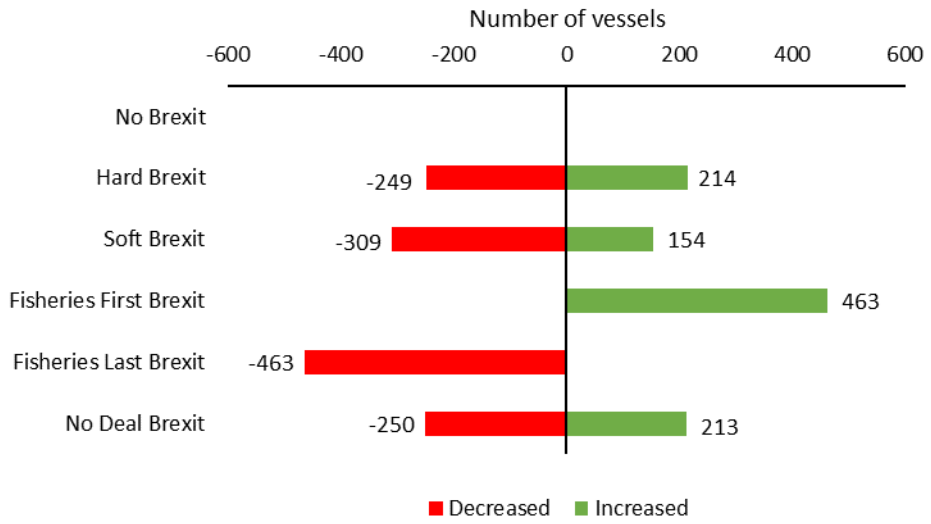


Source: Authors' calculations based on Carpenter (2017a)

As pots and traps under 10m is the largest fleet segment by number of vessels, it is also the case that despite overall gains, most Welsh vessels (and most fishers) are worse off post-Brexit under all scenarios except 'Fisheries First Brexit' (Figure 6).[8]

[8] There is a great deal of uncertainty associated with estimating the results for Wales based on the UK data. Landings data from the Marine Management Organisation (MMO) for Welsh vessels is recorded by different, but similar, fleet categories. In particular, based on the value of landings in the MMO data (i.e. calculating landings per vessel), the Welsh activity for the under 10m drift/fixed fleet segment may be overestimated.

Figure 6: Number of Welsh vessels with increased/decreased profits under six Brexit scenarios

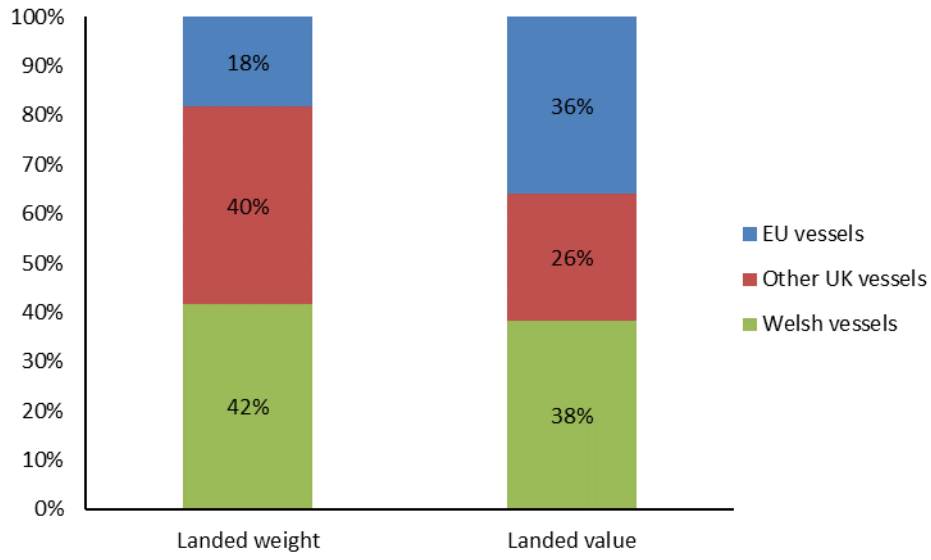


Economic impacts at the port level

In addition to identifying the Welsh fishing fleet separate to the UK fishing fleet, the MMO port landings data can also be used to estimate impact at the port level. Estimating impacts at this level is important due to the significance of fisheries as a place-based economic activity. Some ports rely on the economic activity that fish landings and industry expenditure.

As the value of landings into Wales is almost evenly split between EU vessels, other UK vessels, and Welsh vessels (Figure 7), focusing solely on the impact of Welsh vessels gives an incomplete picture.

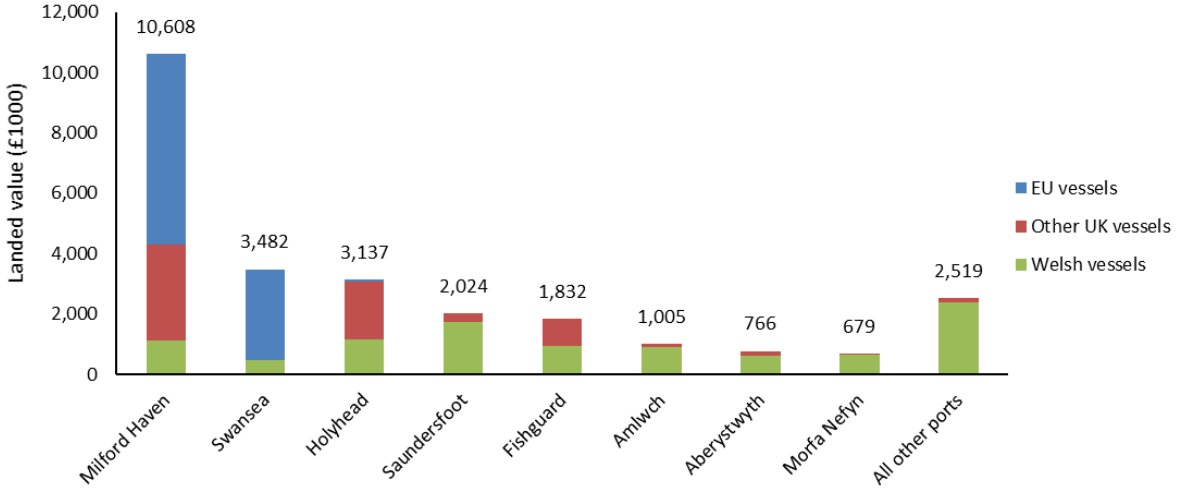
Figure 7: Composition of landings by vessel nationality (2016)



Source: MMO (2017)

While the value of landings from Welsh vessels are spread around the Welsh coast, the value of landings from other UK vessels is concentrated in the ports of Milford Haven, Holyhead, and Fishguard, while the value of landings from EU vessels is concentrated in Milford Haven and Swansea

Figure 8: Landed value by port and vessel nationality (2016)



Source: MMO (2017)

Categorising Welsh ports by main fleet segment shows that in almost every Welsh port the main fleet segment is worse off under most Brexit scenarios. Table C in the Appendix shows this for the 19 Welsh ports with landed value over £100,000. Note that the large beam trawlers landing into Milford Haven and Swansea are part of the Belgian fleet, not the UK fleet. How their pattern of landings could change post-Brexit is discussed in section three.

This danger to Welsh ports is recognised in many areas. Alec Don, chief executive of the Milford Haven Port Authority, has explained that "For us, the key issue is frictionless trade…Imposing processes leading to products being delayed at borders, unnecessarily and for the sake of creating some totemic control of your borders will undoubtedly cause problems" (George, 2017).

One appealing, although unlikely, option for ports at risk due to post-Brexit trade is to seek a special trading arrangement. Grimsby recently made headlines looking for a 'Brexit exemption' through the designation of 'Free Port' status where goods entering and leaving do not need to pay tariffs. Associated British Ports, which put together the Free Port proposal with Grimsby's fish processors, has also pointed to Port Talbot as a port that could benefit for this status (BBC Radio 4, 2017).

In summary, many Welsh ports are estimated be worse off post-Brexit based on changes in the economic performance of Welsh fleet segments. There are also concerns about the landings from Belgian vessels, to whom access may be restricted in the future.

Other parts of the fishery sector

The scope of this analysis is limited to the catching sector. However, there is a £17 million aquaculture industry in Wales (Seafish, 2016) that is forecast to expand rapidly (Welsh Government, 2016c). Aquaculture producers, including mussel producers in Wales, have warned about the prospect of tariffs and other disruptions to trade flows (New Economics Foundation, 2017; Scottish Salmon Producer Organisation, 2017; Belfast Telegraph, 2017). One concerning development is the addition of labelling requirements for UK fish products to enter the EU market, with the announcement that UK shellfish exports will require passports post-Brexit (The Grower, 2017). For aquaculture producers, there is very little economic upside from these potential Brexit changes.

For fish processors and wholesalers, these market restrictions are a significant concern, as is any slowdown in the flow of EU labour (Noble, Quintana, and Curtis, 2017; Stewart and O'Leary, 2017; MacDuff Shellfish, 2016; New England Seafood, 2016). The UK Seafood Industry Alliance (SIA), which represents seafood processers and traders, explained in their evidence to the House of Lords committee that, "a future relationship with the EU must maintain existing market access and our ability to import zero or reduced tariff supplies from both EU and non-EU countries (Seafood Industry Alliance, 2016)." Fish processing is relatively minor in Wales, with 10 'major' fish processing sites and 51 FTE jobs (Noble, Quintana, and Curtis, 2017) and a growing small-scale processing sector (CamNesa Limited, 2017).

While these other segments of the fishery and seafood sector are not explicitly analysed, their unique impacts are notable and may even have unpredictable knock-on effects in the catching sector.

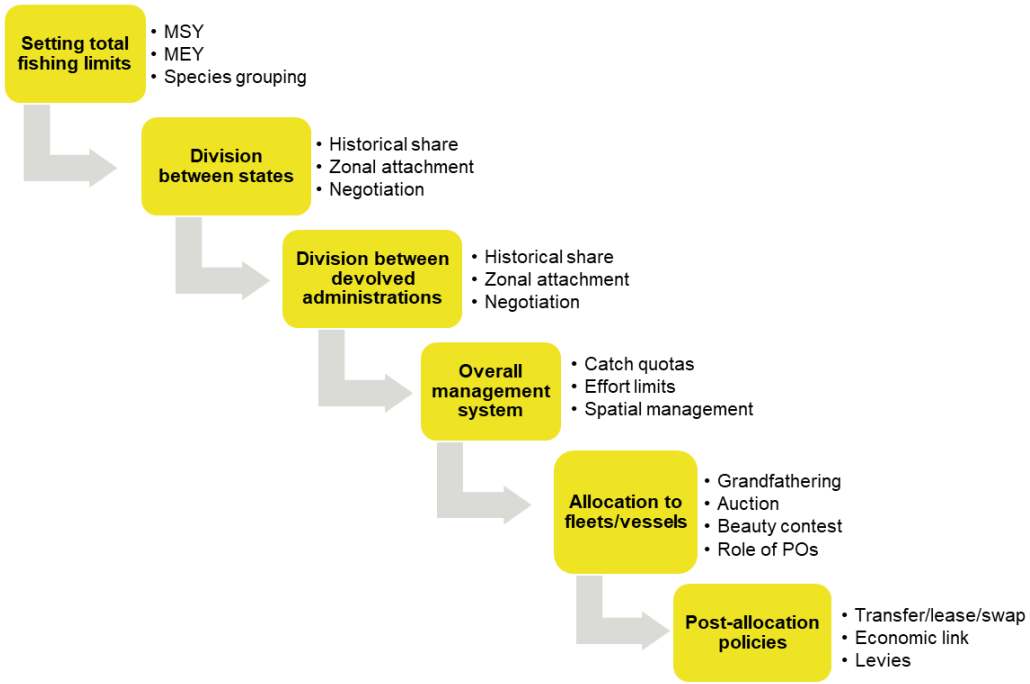
Section Three: Policy options for fishing opportunities in Wales

Fisheries management is only one of many areas of public policy and governance in Wales, and not the only one that will be significantly impacted by Brexit. In practice, it is difficult to separate the impacts of different policy areas, but the scope of this analysis will focus on fisheries management in an isolated context from wider Brexit factors, as these are outside of the direct control of fisheries management.

Fisheries management, like other policy areas, can be analysed in terms of institutions, processes and policies. This report will focus specifically on policy, although where relevant, institutions and processes will be brought into the analysis if a policy change would require major reform in these areas.

Within the policy space, this report will focus on fishing opportunities: how they are set, how they are allocated, and how they operate[9]. The remainder of the report details the six levels of decision-making regarding fishing opportunities and the policy options at each level that the Welsh Government may consider reforming as part of a post-Brexit fisheries management strategy for Wales.

Figure 9: Policy options for the management of fishing opportunities



[9] Other policy areas within fisheries management that this report doesn not explicitly cover include conservation and technical measures; science and data collection; markets; grants and subsidies; and enforcement and Control.

Level One: Setting total fishing limits

Before fishing opportunities are allocated to holders of fishing licenses or shared among countries, an overall limit on the available opportunities must be set. This typically occurs through the setting of a maximum level of acceptable fishing mortality (the proportion caught and removed through fishing) for a particular fish stock that would not jeopardise the health of the fish population.[10]

The Welsh Government could seek to negotiate for a change in how these total fishing limits are determined. In the absence of any changes, it is assumed that the current EU framework of maximum sustainable yield (MSY) – the level of fishing that could theoretically produce the largest average harvest indefinitely – will be replicated in UK law. How these fishing opportunities are shared between countries and allocated between fishing vessels, as well as the type of fishing opportunity and its features, are explored in subsequent 'levels' of this section.[11]

Why MSY?

Without fisheries management, unrestricted fishing will deplete the biomass of fish stocks such that fewer fish are spawned and catches eventually fall, even as fishing pressure intensifies. Under an MSY framework, fishing effort is curtailed through quota, licences, or other limitations, so that fish populations recover and produce greater available harvests.

Managing fisheries to produce the maximum sustainable yield is associated with sizable economic benefits (Table D in the Appendix). As with other renewable resources, sustainable management can increase economic yields, rather than being faced with a trade-off between the environment and the economy.

For Wales, the benefits of reaching MSY are estimated as £3 million per annum, significantly smaller than its proportional share of UK fisheries (total UK benefits of £251 million per annum). This relates to the fact that MSY estimates are based on stock assessments that are available for most species managed under quota, but not for the species of shellfish (because of how they spawn) and several other prominent species in Welsh fisheries. In fact, the

[10] This rate of fishing mortality (e.g. a rate of 0.1) is then converted into fishing opportunities (e.g. 100 tonnes, 100 pots, a season of February to March, or 100 days at sea) to be allocated.

[11] The MSY framework is a common approach to fisheries management and is used – with some adaptations – in most developed nations with significant fisheries (US, Canada, Iceland, Norway). The UK is a signatory to various international commitments to MSY, including the United Nations Convention on the Law of the Sea (UNCLOS) and commitments at the World Summit on Sustainable Development. The UK Fisheries Minister has confirmed that he intends for MSY to remain as the overarching framework for fishing opportunities post-Brexit (Eustice, 2016). Indeed, the UK Government was one of the driving political forces behind the adoption of MSY in EU's Common Fisheries Policy.

increase in future catches from rebuilding populations to MSY levels may be greater for scallops and other shellfish fisheries – recent studies indicate that scallops in the Irish and Celtic Seas are overexploited (Curtis, Holden, Quintana and Motova, 2017; Marine Stewardship Council). Conducting stock assessments for all Welsh fisheries would put Wales in a better position to realise these gains, but the focus of this report is specifically on quota fishing opportunities.

Mixed fishery issues

Fisheries management, especially in setting total fishing limits, tends to use a single-species approach. This is largely due to the level of biological information historically available (although this is rapidly changing) and the need for decisions to be made in short (generally 12-month) timeframes.

Many fisheries are not single-species, however. Instead, virtually all demersal (fish that live and feed on or near the bottom of aquatic bodies) fisheries harvest multiple species simultaneously and the selectivity of current fishing methods and equipment limit the ability to target individual species alone. This presents a challenge to MSY management as either discarding of fish will take place once a quota has been exhausted but (unintentional) catching continues (pushing mortality above the MSY limit), or, if discarding is banned (as is being phased in under the Landings Obligation of the CFP[12]), there is the risk that these previously discarded species 'choke' the fishery by ending the ability to fish in a mixed fishery once that most limited quota is exhausted. A great deal of fishing research and policy focus is currently being spent on this issue internationally.

Multispecies and ecosystem-based approach

There are also complications to the MSY framework at the biological level that extend from the fact that fish species interact with one another. One of most obvious and important forms of interaction is in predator-prey relationships. This issue does not present an existential threat to fisheries like mixed fisheries, but it does make estimating MSY in fisheries more difficult (Guillen et al., 2013). A fish stock may not be able to reach its own single-species optimal yield if it is prey for another species. Smith et al. (2011) for example suggest harvesting forage species (those lower down the food chain) at sometimes half of MSY so that (more valuable) predator species are less affected. Fisheries models are thus increasing in complexity and now focus not just on ecosystem interactions, but fully integrated ecological-economic

[12] The Landing Obligation or 'discard ban' is the requirement under the reformed Common Fisheries Policy, being phased in from 2015 to 2019 to land all catches and count these against quota holdings.

feedback loops (Nielsen et al., 2017). The International Council for the Exploration of the Seas (ICES), which provides scientific support services for the EU and other governments, already provides multispecies advice for some fisheries. This advice accounts for known interactions such as cod and capelin in the Barents Sea (ICES, 2013).

An ecosystem-based approach would entail more than species interactions, but would also take into account for example sensitive habitat and temporal closures for example. Gibbs and Thebaud, (2012) provide a framework which expands the quota management framework beyond the narrow definition of a set of commercially important target species to a wider set of fisheries management tools. Incentive based approaches such as taxing fisheries that fish in key ecological habitat could be considered.

Policy option 1.1: Continue with a MSY framework

The explicit objective of MSY is to maximise the quantity of fish that can be harvested from the ecosystem. It is difficult to see why the quantity of fish is the prime objective of many stakeholder groups, with the lone exception of perhaps fish processors who require large, sustained catches as inputs to production. Conservationists advocate for large and diverse fish stocks (as well as healthy ecosystems), as do other user groups such as recreational fishers. Economists advocate high value and resource rent, while managers and political decision-makers seek employment, particularly in vulnerable coastal communities. The appeal of MSY is likely that it is correlated with the many objectives of diverse groups. Coming from a position of unsustainable overfishing, lowering fishing pressure to MSY will contribute to restoring the main target species to reasonable levels and will thus satisfy many of the mentioned interests of stakeholder groups.

Policy option 1.2: Take a more precautionary approach to MSY

In the MSY framework, the level of fishing mortality that is associated with MSY (FMSY) is a limit on fishing pressure, rather than a target. In practice, this means that ICES scientific advice to limit catches of a stock to 10,000 tonnes is not to be interpreted as a request to fish exactly that amount, it simply defines the maximum fishing limit that would still be consistent with MSY, above which the fishery would be unsustainable. In this sense, the question of what level of fishing would be optimal is still open.

In the lead-up to the reform of the CFP in 2012, some environmental non-governmental organisations (NGOs) made it clear that the target level of fishing mortality should still be lower than the level MSY permits. BirdLife wrote in their Position on the Green Paper on Reform of the Common Fisheries Policy that:

> “MSY should only be an intermediate step towards achieving sustainability and a more precautionary reference point. MSY should therefore be regarded as a direction of travel and a limit to be avoided rather than a target.” (BirdLife, 2009).

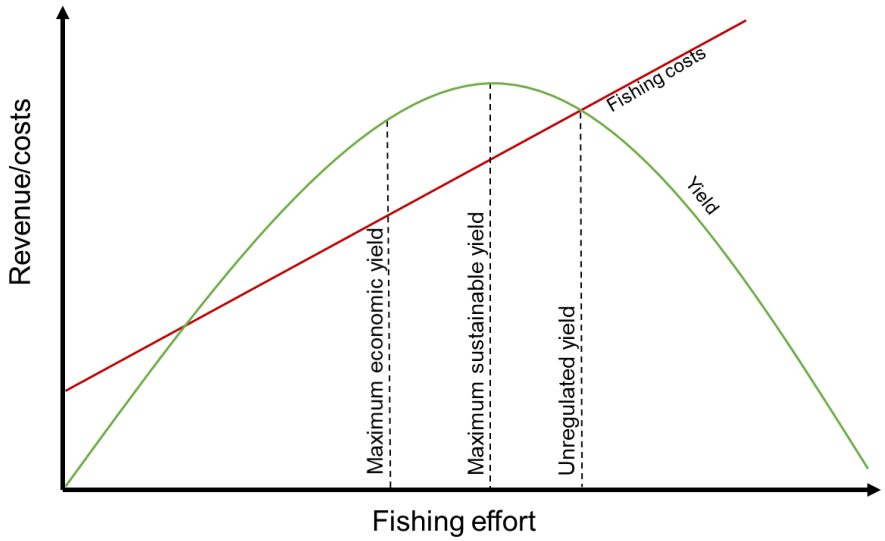
Wales could push for such a precautionary reference point, defined by a buffer around MSY, set at 90% of MSY for example. A more precautionary approach would also align with some of the relevant legislation in Wales on the sustainable management of natural resources. The Environment (Wales) Act 2016 specifies not only that natural resources are used in a way and at a rate to support sustainability, but also to “enhance the resilience of ecosystems and the benefits they provide”. The Well-being of Future Generations (Wales) Act 2015 makes a similar commitment to becoming a resilient Wales:

> "A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).” (Welsh Government, 2015).

Policy option 1.3: Use maximum economic yield (MEY) as an alternative framework

An alternative framework to MSY is to use maximum economic yield (MEY) – the amount of fishing pressure that maximises economic value (revenues minus costs) instead of tonnage. Generally, although not always, MEY is associated with lower fishing pressure than MSY and higher biomass. This framework for setting fishing limits is used in Australia.

Figure 10: Fishing reference points



Economic yield is maximised at this lower level of fishing pressure as lower fishing mortality increases the size of fish stocks closer to their unfished state. With a larger biomass, it takes less time and operational costs to harvest a given level of catch.

In Figure 10, the MEY level of fishing effort is where the distance between fishing revenues (green) and fishing costs (red) is the greatest. This maximised profit is rent from the fisheries. Maximum sustainable yield permits fishing effort to continue past this to the peak of the green curve (here assuming maximum quantity equals maximum revenue) and the default state of an unregulated fishery is where fishing costs equal fishing revenue and profits fall to zero.

It has been argued that from an economic perspective across the whole value chain, MSY=MEY as the greater level of landings at MSY generate higher economic returns for the processing and retail sectors (Christensen, 2009), although this depends on what happens with the resources saved from reduced fishing effort under MEY. It is also possible for MEY to rise above MSY, leading to some proposals of "ecologically-constrained maximum economic yield" (Voss et al., 2017).

Estimating MEY can prove more difficult in practice than in theory. Every price movement is associated with a different yield curve and adjusted optimal level of harvest (Dichmont et al., 2009). In the Welsh policy context, it is not clear that maximising economic yield – usually in the form of profits to vessel owners – is a key objective, especially if that comes at the expense of reducing effort and employment.

Policy option 1.4: Use 'pretty good yield' (PGY) as an alternative framework

As explained, issues relating to technical interactions in mixed fisheries and biological interactions in multispecies fisheries challenge the MSY framework and make it nearly impossible to fish all species at their MSY level simultaneously (although all species can be fished below their MSY point simultaneously). In recognition of this, proposals have been made advocating the idea of 'pretty good yield' (PGY), where MSY is treated as a range, with some species fished over or under their MSY point value, depending on technical and biological interactions (Hilborn, 2010; Rindorf et al., 2017). This range can be widened or narrowed depending on the level of risk that is acceptable. The theoretical backing to the idea is that a broad range of fishing mortalities can result in yield close to MSY (i.e. flat-topped yield curves). PGY, or at least the use of MSY ranges, is now being incorporated into the EU's long-term management plans, with some results for when the upper range can be used (although early signs are assessing these conditions can be difficult) (Carpenter, 2016).

At its core, the PGY framework is a risk-reward trade-off that sacrifices a risk of overfishing for the possibility of higher yields. Various analyses have concluded that fishing in the lower end

of the PGY range is preferable to optimise this balance (Thorpe et al, 2017; STECF, 2015), as does the ICES advice on MSY ranges (ICES, 2015).

Similarities in reference points

MSY, as well as the three alternatives considered (precautionary reference point, MEY, PGY), tend to assume that each species should reach as close to the desired target as possible. An adaptation of the MSY (or alternative) framework would be to introduce some flexibility between species. One way to do this is to group fishing opportunities for multiple species together. This is a direct response to the issue of discarding and the mixed species composition that is associated with various fisheries. Already this is present in Welsh fisheries through the quota for species of rays, but theoretically it could be extended to group other species. Another approach is used in Iceland where there is a market where species can be transferred, up to 20% of catch (Woods et al., 2015). These species flexibilities are often presented as a way around the discard ban, but a new framework should be based in science rather than policy avoidance.

Discussion

At the level of setting total fishing limits, there are several alternative frameworks that could be used post-Brexit as an alternative to MSY. The analysis in this section suggests that while different objectives and ideologies lie behind these frameworks, in practice they may end up looking very similar in that most of the alternatives either explicitly or implicitly make the case for lowering fishing mortality below MSY.

Currently the EU is heading in the right direction, but too slowly (STECF, 2017) if it is to make its commitment in the CFP for all commercial fish stocks to be harvested in accordance with MSY by 2020. This is also the case for fish stocks targeted by the Welsh fishing fleet (Cefas, 2017). Furthermore, Brexit presents a risk to achieving MSY even if the EU and UK keep MSY as their objective, as each side may still pursue a ‘fair share’ of fish stocks that when combined exceeds the scientifically advised allowable catch. Given these findings and the risks and complications of framework divergence, a change to the MSY framework for setting total allowable catches may do more harm than it is worth.

Level Two: Division of fishing opportunities between states

As described in Section One, fishing opportunities are currently divided between EU Member States based on 'relative stability'. This snapshot was calculated based on three components:

1. recorded catches from 1973-1978
2. losses of fishing opportunities in third countries as a consequence of EEZs
3. special needs of coastal communities with a high dependency on fishing

The UK was a beneficiary under the latter two conditions, with extra quota granted in recognition for losing access to Icelandic waters, and the creation of the 'Hague Preferences' for the UK and Ireland to guarantee a quota floor (in quantity) for certain stocks that override the percentage shares based on historical catches.

Policy option 2.1: Continue based on historical share

One option post-Brexit would be to keep the division of fishing opportunities founded on relative stability, despite the fact that the UK and Wales would likely be a net winner from any change to how fishing opportunities are divided with the EU. As quota fisheries are not a large fishery for Wales, it is possible that this is the best policy option if quota and fish tariffs are presented as a trade-off. EU leaders, including the EU's fisheries committee, have stated that joining up these issues is their position for Brexit negotiations (Carpenter, 2017a). A trade-off between quotas/access to waters and access to the EU market has also characterised the EU's fisheries relationship with other third countries like Norway and Greenland (Carpenter, 2017a).

Policy option 2.2: Zonal attachment

The division of fishing opportunities between the EU and some third countries (Norway, Iceland, Faroe Islands) is based on zonal attachment – the average division of biomass of a stock within each countries' waters (Dankel et al., 2015). Several recent publications have analysed how landings might be affected by a shift to zonal attachment for the division of fishing opportunities between the EU and the UK (Napier, 2017; HM Government, 2017; Fishing for Leave, 2017; Goulding & Szalaj, 2017; Carpenter, 2017a), based on the reported location of catches. These studies are summarised in Table A in the Appendix.

Using calculations from Fishing for Leave (the only study that calculates zonal attachment at the quota level) to estimate how the amount of Welsh quota would change if zonal attachment were used, there is an increase of 1,469 tonnes (an increase of 170%), which comes mostly from monkfish, megrim, skates and rays, and hake. These results are detailed in Table E in the Appendix.

The Fishing for Leave figures, like the other studies, assume that landings by area are an accurate reflection of biomass in the same area. This may not hold true however as there are many drivers that influence locations where fishing takes place (e.g. proximity to home port, proximity to market, weather, size of fish) and not just available biomass. Unfortunately, the only study of biomass by EEZ that exists (University of Aberdeen, 2017) only covers stocks relevant to Scotland.

Policy option 2.3: Negotiation over priority species

A third potential approach to dividing fishing opportunities between the EU and the UK is to draw out the relative preferences for each quota species for the UK and the rest of the EU. Under EU law, after quota is distributed to Member States based on relative stability, Member States may 'swap' quota with each other. These quota swaps have become a critical feature of fisheries management in the EU as Member States seek to better align their quota portfolio with the needs and requests of their fishing fleet. The UK share of quota before and after quota swaps is indicated for the largest quota changes in Figure A in the Appendix.

Most of the quota with a Welsh interest appear to be outward swaps, including some of the key species with quota increases under zonal attachment (e.g. skates and rays, pollack, whiting). More detail is available in Table F in the Appendix.

Pursuing a renegotiation of relative stability based on the principle that some stocks are of greater interest than others for the UK carries some risk, as it appears that quota swaps have tended to result in reductions for many species. Notable exceptions are monkfish and megrim in Area VII – the two largest quota allocations for Wales.

Discussion

A shift in the division of fishing opportunities to be based on zonal attachment would be a clear benefit to the Welsh fishing fleet. Whereas in 2016, Wales was allocated 867 tonnes of quota, calculations suggest a change to zonal attachment may yield 2,336 tonnes – an increase of 170% — with large increases for angler, megrim, skates and rays and hake. This is a greater percentage increase than the UK as a whole. Whether this increase aligns with the zonal attachment for Welsh waters is explored in the next level.

From the information on quota swaps, it appears that many species with a Welsh interest are used as swaps out, including quota with some of the largest increases under zonal attachment. A renegotiation thus runs of risk out continuing to give a low priority to these quota species. Whilst in-year quota swaps with EU Member States will not be possible once the UK leaves the CFP, a bilateral agreement between the UK and EU may still include annual quota swaps

of interest to both parties, and therefore the Welsh Government should seek to ensure that quota species of interest to Wales are retained within the UK.

Level Three: Division of fishing opportunities between devolved administrations

The four UK nations (England, Scotland, Northern Ireland and Wales) are unusual in that, compared to other jurisdictions where fisheries are a central government responsibility, within the UK itself, fisheries are a devolved matter. The administrations in Wales, Scotland and Northern Ireland are legally responsible for their adjacent EEZs.

There is a concordat on quota distribution between the four nations' administrations (UK Government, 2012) giving greater control over the management of the commercial fishing fleets, within a UK-wide quota and effort management and licensing system. Currently quota management is harmonised, adopting similar rules, although the process may change.

The Concordat involves an agreement to allocate amounts of quota to each administration, but these 'shares' are not a permanent split. Allocation for vessels with Fixed Quota Allocations (FQAs) are calculated each year for the fishing year ahead. Each UK administration then allocates this quota among their fishing industry: Producer Organisations (POs)[13], the Under 10m pool, and non-sector vessels. In the case of POs, once allocated, this quota is under PO control for the purposes of use, leasing and swaps. FQAs do not provide any right to a share of UK quota, but rather a general expectation of receiving a share of UK annual quotas (UK Government, 2012).

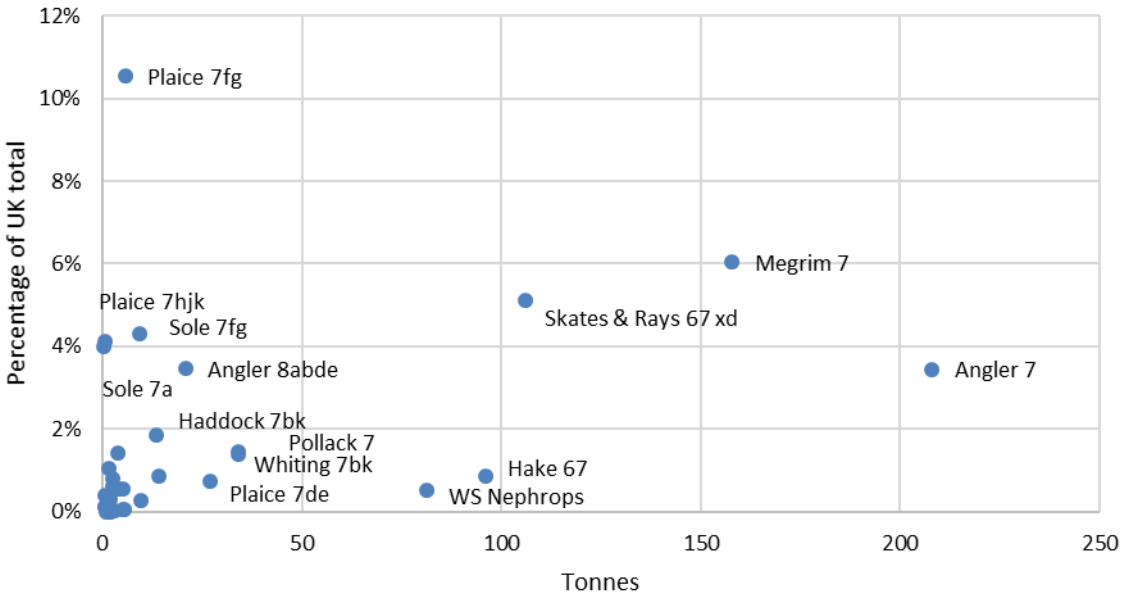
The chronology for how this system developed is important. With the advent of EU fishing quota, the UK Government made the decision not to be involved in the day-to-day management and instead encouraged the development of POs. These organisations, which are predominantly about fish marketing, became quota brokers. Larger vessels were able to join POs and, based on their track record, were able to take their share of the quota pool with them. The non-sector (larger vessels not in producer organisations) and the under 10m vessels (that are not able to travel far and a very weather dependent) were left with whatever remained in the quota pool. As increasing numbers of non-sector vessels joined producer organisations, fewer and fewer amounts of quota was left for the under 10m vessels. Under 10m vessels were not required to log their catch, they had no track record. The sampling methods that were used to estimate the under 10m share have been heavily criticised as disadvantaging the under 10m fleet (Carpenter & Kleinjans, 2017).

[13] Officially-recognised bodies that manage the fishing opportunities of their members, align supply with demand, and create added value for landed catch.

Policy option 3.1: Historical share

The use of historical share for devolved administrations is a risk to Wales, which has received a disproportionately small share of the UK total over recent decades. Given the small size of the Welsh industry, the dominance of under 10m vessels left out of the FQAs, and the importance of shellfish and non-quota species such as bass, Wales has been disadvantaged versus Scotland and England. Using the same method of allocation would continue this practice and the resulting lack of investment, processing, and ability to exploit new fisheries. A change in EU/UK division of quota (see Table E in the Appendix from level two), while keeping existing FQAs would result in significant increases in relative terms (percentage change) though not absolute (tonnes).

Figure 11: Welsh quota share (2016)



Source: Authors' calculations based on MMO (2017)

Policy option 3.2: Zonal attachment

Under policy option 2.2 (zonal attachment between countries) it was assumed that the UK would receive a division of quota based on the share of stocks in UK waters (estimated by landings by EEZ). The Welsh Government would then continue to receive the same percentage share of the UK quota (based on current FQA holdings). But just as there is a push to change the division of fishing opportunities between the EU and the UK to reflect zonal attachment in these waters, there could be a similar case to change the division of fishing opportunities between the UK and Wales (and other devolved administrations) based on this principle.

This could take two forms. The first would be to divide the gains (and losses) from EU quota based on zonal attachment in the EEZs of the devolved administrations. This means that current EU fishing of stocks in Welsh waters would accrue as quota to Wales, rather than distributed through FQAs.

Using data on landings of quota species by ICES rectangle[14] in the Welsh EEZ indicates what this change may look like (Table G in the Appendix). It is clear from these calculations Wales could gain a significant increase in quota. While there are gains in whitefish (haddock, whiting and hake from Ireland and France) and Nephrops (from Ireland), by far the largest increase comes from herring in one particular ICES rectangle that straddles both Welsh and Irish waters (31E3). If this division of quota is pursued it is important to verify that the landings (or, ideally, the biomass of the stock) is occurring on the Welsh side of that ICES rectangle.

Quota gained through zonal attachment from current EU fishing would lead to larger increases in Wales if allocated to devolved administrations based on zonal attachment (407% UK increase) compared to existing FQA holdings (170%).

A second, related policy option utilising the Welsh EEZ is to divide current UK quota based on EEZs instead of FQAs. This form of intra-UK zonal attachment would be the full extension of zonal attachment if this is indeed the new principle of how shared stocks should be divided across EEZs. Again, landings by ICES rectangle can be used to estimate this change, here as calculated by the MMO as part of their annual sea fisheries report (MMO, 2017). Table 3 reveals the amount of quota species caught by Welsh vessels in the EEZs of other devolved administrations, as well as the amount of fishing by other UK vessels in the Welsh EEZ. While Welsh vessels land extremely small amounts of fish from Scottish and Northern Ireland waters, these fleets land significant quantities from the Welsh EEZ. An intra-UK zonal attachment would lead to an increase of 257%.

Table 3: UK landings of quota species in the Welsh EEZ and Welsh landings in the UK EEZ (tonnes)

Nationality	Welsh vessels, other UK EEZ	Welsh EEZ, other UK vessels	Difference
Scotland	3.00	57.40	54.40
England	111.15	165.24	54.09
Guernsey	3.33	0.00	-3.33
Jersey	0.00	0.00	0.00
Northern Ireland	0.02	1,652.62	1,652.60
Isle of Man	0.06	0.00	-0.06
Total	117.56	1,875.27	1,757.70

[14] An area of '30 min latitude by 1 degree longitude' in size, which is approximately 30 NM by 30 NM.

Current quota landings	683.59
Percentage change	257%

Source: Authors' calculations based on MMO (2017)

These potential fishing opportunities (based on current UK fishing activity) are separate to the fishing opportunities resulting from the UK receiving quota based on zonal attachment in EU negotiations (based on current EU fishing activity). The largest increases from an intra-UK zonal attachment come from herring, Nephrops and haddock for which is there not currently a developed fishery in Wales (Table H in the Appendix).

Policy option 3.3: Negotiation over prioritised species

Similar to a potential change in the division of quota between countries and the possibility to revisit and renegotiate relative stability, there is also the possibility for the Welsh Government to pursue a division of fishing opportunities between devolved administrations based on the species that would yield the greatest benefits for the Welsh fleet. Based on the findings from the zonal attachment calculations for the Welsh EEZ, there is a clear risk that quota gains cannot be practically utilised by the existing Welsh fleet, at least not without significant and long-term investments.

Further research would be required to identify the species or baskets of quota that could realistically develop new quota fisheries in Wales. Currently quota uptake is already low for several species, indicating that quota gains from Brexit may not be utilised, but it may also be the case that there are tipping points where additional quota would actually increase quota uptake. The following section discusses how to approach the issue of where (or if) these tipping points occur.

Discussion

It is clear from the above options that Wales could stand to gain a significant quantity of quota if the Welsh EEZ is used to inform the division of gains in EU quota amongst the UK nations, or extending this further to the division of quota by UK vessels as well. This is complicated by the fact that much of this quota could not effectively be used by the Welsh fleet at present. Further still, Wales is particularly affected by any disruption to EU fishing activity as foreign landings represent about a third of current landings and most of the landings to the two largest ports of Milford Haven and Swansea (see Figure 8).

As a starting point, it is important to be cautious in this space and 'do no harm'. The possibility for key Welsh quota to decrease, or for landings to key Welsh ports to decrease, would have a clear and damaging impact. If historic share is perceived as inadequate (given complaints

about the original allocation of FQAs) and if zonal attachment is perceived as too detached (as industry specialism has not strictly followed EEZs), there may be the potential for a middle way of negotiating a change in shares for Wales that is somewhere in between the two.

This could be done by treating any increases in quota differently from standard FQAs. Priorities for these quota gains could be used to compensate any fleets that have lost quota through the change in shares, to protect vulnerable fleets, and to distribute according to need. There are some similarities here to the approach taken for quota uplifts under the Landing Obligation.

The division of fishing opportunities between devolved administrations as a choice between historical shares (through FQAs), zonal attachment, or a negotiation over prioritised species mirrors the division of fishing opportunities between states discussed in level three.

Figure 12: Illustration of options for dividing quota from total TAC to devolved administrations

Further research is required if substantial quota gains are going to be utilised by the Welsh fishing fleet and/or new fisheries developed. In particular, the following issues should be explored:

- vessel and fleet capacity, including latent capacity;
- scope/need to issue new licences versus the need for a cap;
- current gear usage and potential for adaptation to alternative target species or fisheries (e.g. Nephrops trawl);
- port and other land-side infrastructure and transport connections (although potentially some freeing up if Belgian landings are lost in Milford Haven and Swansea);
- potential for development of a live auction (none currently exists in Wales);
- ability to attract new fishers;
- developing supply chains and value-added processing (potentially linking to existing aquaculture routes);
- market opportunities (e.g. market demand, product development, branding).

Further research is also required to calculate the zonal attachment figures from stock biomass surveys rather than landings data alone.

Level four: Overall management system

The predominant form of fishing opportunities for mobile fish stocks in the North-East Atlantic, and indeed most of the developed world, is through limits (quotas) on the amount of catch. This is currently the case for EU-level fisheries management, although Welsh fisheries are heavily focused on shellfish which are not under quota management. There is an opportunity to revisit this overall management system that is used for different types of fisheries.

Policy option 4.1: Catch quotas

Like the MSY framework, UK Fisheries Minister George Eustice has confirmed that catch quotas will continue as the predominant form of managing fishing opportunities post-Brexit (Eustice, 2016). This makes catch quotas the assumed policy choice, although there are current discussions and proposed trials for effort-based management (covered in the next subsection).

Along with shellfish, sea bass fisheries are not under quota management, partly due to conflict between France and the UK about how the amount of fishing opportunities would be shared between them. France would advocate using an earlier reference period, where their vessels fished the vast majority of the stock, whereas the UK would advocate a later reference period, after the UK fishery had developed. The selection of a reference period is further complicated by the fact that basing the decision on the proportions that each country has fished in recent years would in effect, 'reward' those countries and/or fleets most responsible for overfishing the stock to the critical level at which it now stands.

Catch quota has the advantage of providing a cumulative limit on the amount of catches and thus the mortality of a fish stock. This approach more directly targets the harm that is trying to be avoided, rather than limits on licences, days at sea, or other 'input' controls under effort management.

In consideration of the transition from effort management to catch quota, Carpenter & Kleinjans (2017) define a number of conditions that indicate the suitability of a stock to catch quota management:

- Species that can be targeted with limited bycatch (i.e. not mixed fisheries);
- Large or medium-scale fisheries;
- A high level of overfishing (i.e. an urgent policy change);
- Reliable landings data to ensure the limit is respected;
- Reliable scientific data for setting catch limits;
- Few ports and vessels involved for easier management and enforcement;

- A good length composition of stock (to protect against the incentive to discard small fish);
- Reliable catch records.

The major non-quota fisheries in Wales of whelks, scallops and sea bass all have mixed results when assessed against these suitability criteria. Whether the entire UK (or beyond) would also need to be under a catch quota system for it to be effective in Wales is one additional aspect for consideration.

Changes to current catch quota management, especially to deal with the challenges presented by the landing obligation are explored in policy option 6.1.

Policy option 4.2: Effort limits

In light of Brexit, some groups have proposed a move away from fisheries management based on catch quotas to effort management through restrictions on days-at-sea instead (Fishing for Leave, 2016). Days-at-sea is currently used for some scallop fisheries e.g. in South-West Scotland and Western Waters, effort has been used in recovery plans for both cod and sole (MMO, 2014). This proposal requires scientific assessment to understand what opportunities in terms of days could be realistically expected, and directed analysis could explore how industry fishing practices may change and if there are lessons to be learnt from days-at-sea management of scallop fishing (Welsh Government, 2016a). Days-at-sea has been presented as a solution to the issue of discarding, enabling vessels to land everything they catch within their permitted days.

Fishing for Leave has emphasised that their system would involve flexible catch compositions (Fishing for Leave, 2016). A more advanced version of a similar model is the use of 'real-time incentives' – a system that assigns credits to fishers to spend according to tariffs for certain species in a particular area and time (the more vulnerable the species/time/area the higher the tariff) (Kraak et al., 2014; Kraak et al., 2015). Under this model all catches are still landed and there is a penalty for vulnerable species (here as a tariff instead of time at sea) but with an added spatial aspect and ecosystem protection. The use of real-time incentives is currently being explored in a case study of the Celtic Sea (Pedreschi et al., 2017).

Policy option 4.3: Spatial management

Another form of managing fishing pressure is through spatial management, for example, restricting access for fishing, either permanently or seasonally, to protect spawning sites or nursery areas for example. The July 2017 announcement that the UK will withdraw from the

London Convention[15] opens up the possibility to more actively manage inshore waters (0-12 NM) post-Brexit.

Spatial management involves imposing restrictions on where vessels may fish. Restrictions are usually put in place to protect biologically sensitive or valuable areas, or to prevent gear conflict, where different fishing gears compete for access to fishing grounds. Marine protected areas (e.g. Skomer Marine Conservation Zone off Pembrokeshire), no take zones (currently none in Wales, although Lundy in the Bristol Channel is a no take zone) and fishery restricted areas (e.g. the Conwy estuary) can also be considered a form of spatial management.

Spatial restrictions are often based on the fishing gear type or vessel size and may also have a temporal component. Most EU Member States restrict their inshore areas (0-3/ or even 0-6 NM coastal zones) to only passive gears such as fixed nets or shellfish pots (Carpenter & Kleinjans, 2017).[16]

Examples from around the world show that spatial management works; it can be a basis for inclusive co-management and habitat mapping, where ground-truthing (testing the changes on the seabed through monitoring) could provide sufficient information for spatial management proposals (Bax, 1999; Hillborn, 2004; Castrejon, 2013). Further, a criteria-based approach to inshore spatial management has also been put forward to reduce or eliminate gear conflict between trawls and creels both fishing the same inshore grounds in the Scottish Nephrops fishery (Williams & Carpenter, 2016). This would mean weighing the wider impacts of employing different fishing gears against each other to determine who should get preferential access as a result of a higher contribution to Government objectives (e.g. around sustainability or coastal communities). There is a historic UK precedent in this, as prior to 1984 there was a three-mile limit where mobile fishing gear (trawling) was banned in Scotland (Scottish Government, 1984).

The inshore fisheries management arrangements of England, Scotland and Northern Ireland are outlined in Appendix B. In Wales, Welsh Inshore Fisheries Groups (IFGs) provide proposals to the Welsh Marine Fisheries Advisory Group (WMFAG) relating to fisheries management within the groups region of Wales. IFGs aim to assist the WMFAG to engage with those with an interest in fisheries and the marine environment within the IFG region and

[15] The London Convention was signed in 1964 between the UK, Belgium, France, Germany, Ireland and the Netherlands. The convention granted access to inshore waters (6–12 NM) based on historical fishing patterns, and these have been subsumed into the CFP. As there is a two-year notice period, the UK will officially leave the convention in July 2019.

[16] Technical regulations themselves (e.g. gear restrictions, net mesh sizes) are not considered a true fishing opportunity, although they share many characteristics with effort and spatial management in terms of determining what is permissible within a fishery. Spatial management is therefore considered a form of effort management.

feedback the views of the wider stakeholders within the IFG region (West Wales Shellfisherman's Association, WWFSA 2010). IFGs are currently suspended (since 2016) and stakeholder groups are invited to attend WMFAG meeting through nominated representatives, as the only strategic group working on fisheries in Wales.

Wider policy context

The Well-being of Future Generations (Wales) Act 2015 requires public bodies to pursue the economic, social, environmental and cultural well-being of Wales in a way that accords with the sustainable development principle. It also foresees a healthy and resilient environment and vibrant, cohesive communities. The Environment (Wales) Act 2016 aims to promote sustainable management of natural resources in Wales.

Welsh MPA recommendations (Welsh Government, 2017), include adopting an area based approach, clear MPA management objectives and an enforcement strategy for fisheries in MPAs. All of these recommendations are wholly in-line with a defined spatial management system. Future Welsh fisheries management arrangements should consider the Wales National Marine Plan (Welsh Government, 2016) and a Welsh MPA strategy (Welsh Government, 2017).

The use of spatial management has several advantages, in that it matches fishing activity to ecosystems, is easier to enforce than catch quotas and/or effort limits, and is compatible with wider environmental policies (e.g. MPA policy). Spatial management will therefore benefit from requirements for all vessels to install vessel monitoring systems (VMS) or inshore VMS (iVMS)[17] or another form of vessel monitoring. However, spatial management in itself cannot control the amount of fishing effort or fishing mortality, it requires good scientific understanding and data, it has the potential to cause unpredictable displacement impacts, and requires stakeholder buy-in.

Impact of Brexit

In July 2017 the UK Government gave its two-year notice of withdrawal from the London Convention, which established historical rights to some inshore waters (6-12 NM) for five EU Member States (France, Germany, Belgium, the Netherlands and Ireland). This withdrawal opens up the possibility to more actively manage inshore waters (0-12 NM) at a spatiotemporal level rather than solely through the quota system and technical measures. Leaving the London Convention allows for new rules on spatial access (i.e. spatial fishing

[17] Vessel monitoring system is a form of satellite tracking system using transmitters on board fishing vessels. iVMS uses mobile phone-based technology instead of satellite transmission, and is appropriate for smaller-scale, inshore vessels.

opportunities) to inshore waters that consider more than just historical track records (for both domestic and foreign vessels). Access to foreign vessels can then be made conditional. This is especially important as some inshore waters have come to be characterised by large foreign vessels competing for space with small inshore vessels for the same grounds. There is also the opportunity that outside of the London Convention, devolved fisheries managers and regulators could be empowered to enforce fishing regulations and inspect all vessels, regardless of national flag, within the 12 NM zone to 'level the playing field' (Carpenter & Kleinjans, 2017).

Discussion

To move some of these policy options forward, for example a days-at-sea system with flexible catch composition, it has been suggested that localised trials should be implemented to collect data and measure the impact (Ridley, 2017). While there is little opposition to more data and evidence there are two important considerations in trials of alternative management systems. The first issue is how comprehensive the trial needs to be to properly inform management. Anything less than a full year would miss important seasonal effects in the fishery, for example. More difficult is the issue of spatial coverage. A trial that proved successful/unsuccessful in one area may not offer the evidence base to form judgment for another. A trial may also attract participants that have fundamentally different characteristics from fishers as a whole. This is particularly concerning for controversial proposals, as changes to management regime have proven to be (NFFO, 2017; Carpenter, 2017c). At the very least, the appropriate scope for a trial and the metrics for success would need to be agreed by stakeholder groups well in advance of any trial taking place.

There is also the issue of opportunity cost. It is clear that an informative trial requires a significant amount of time and funding to administer – resources that could be spent on other policy options considered in this report. Given resource constraints, the priorities of fisheries stakeholders must be assessed. The only survey conducted of UK fishers on support for an alternative management was administered to members of Fishing for Leave, a Brexit campaign group (Carpenter, 2017a).

Separate to the issue of trial(s), it would also be necessary to explore with the UK Government whether Wales could implement its own management regime independent of the rest of the country.

Regarding spatial management, access to inshore Welsh waters could be made conditional (for foreign vessels, inshore vessels, or both) on the use of particular fishing gears (e.g. low impact gear to reduce the impact of fishing on the marine environment), limits on technical measures (e.g. engine size, vessel capacity, or limits on the number of lobster pots, or number of scallop dredges, or even the number of vessels able to fish simultaneously within a designated area).

Recognising the potential impacts of fisheries on the wider marine environment, new legislation could include an explicit requirement for ecosystem-based fisheries management, which is linked to the variety of different intertidal and subtidal ecosystems and the impact of different forms of fishing on them. Requiring all vessels fishing in UK waters to comply with these ecosystem-based zonal fisheries management measures, and introducing specific temporal and spatial measures to protect biologically sensitive areas (e.g. spawning or nursery areas) will contribute to the conservation of a public good.

Institutional aspects, such as the WMFAG and Welsh IFGs, would also need to take account of such changes. The involvement of the industry and stakeholders in developing technical measures, and their implementation at a national level in Wales using statutory instruments in accordance with agreed management plans will be important to continue into the future post Brexit.

Regulation of inshore fisheries through management plans and byelaws enforced by regulators, would be the main means of achieving this. Setting regulations, which include technical regulations on what can be harvested and how (e.g. allowable gears, minimum landings sizes), effort controls and spatial/temporal closures would be possible through regional, inclusive co-management groups, also providing an opportunity to include fishers' local ecological knowledge in spatial management regimes (Pantin, 2015).

Level five: Allocation of fishing opportunities to fleets/vessels

TACs were first introduced for UK vessels for pelagic species in 1974 (NEAFC), then extended to other stocks with the CFP in 1983. Initially, the UK government managed TAC allocations centrally through monthly vessel landings limits. Concurrently, some large-scale operators were grouped into producer organisations (POs), which over time (starting in Shetland) obtained the agreement for devolved quota management on behalf of their members. POs determine their own allocation method, either via pools, individually, or a combination of both. After 1996, quota shares could also be transferred between POs thus creating an informal market (Cardwell, 2017).

The original allocation of quota was based on the historic track record of each vessel's landings over a three-year period. Since 1999 a Fixed Quota Allocation (FQA) units system, which changes according to the tonnage available, has been in place.

The trade in FQAs has given individual fishers the flexibility to shop around for quota, and the legal status of quota ownership has been examined in the UK courts (Carpenter and Kleinjans, 2017), concluding that quota holders have a 'legitimate expectation' to continue to receive their allocation and the benefits therein (either direct through fishing against that quota or through sale or lease).

Policy option 5.1: Continue system of grandfathering

Fishing opportunities in Wales, like most jurisdictions, allocated fishing opportunities based on established fishing patterns ('grandfathering') (Lynham, 2013). As outlined in level three, the historic share via the Concordat has disadvantaged Wales relative to Scotland and England. Continuing along this trajectory is likely to perpetuate the impact on the Welsh fleet leaving little prospect for positive change going forwards.

The track record approach to allocation has disadvantaged a large majority of vessels, led to concentration of quota and has also meant (as no safeguards were put in place) that this gifting is not time-limited, nor does it compensate the public for the use of the common resource in the form of rent (Carpenter & Kleinjans, 2017). With an FQA market valued at over £1 billion (Appleby, 2016) it is only recently (2015) that a register of FQA ownership is published by the UK Government.

The lack of quota allocation for the majority of vessels has meant an increase in fishing pressure on non-quota species like sea bass and shellfish. This has limited the fishing opportunities available to the Welsh fleet and resulted in its current specialisation. This has also limited the development of shore-side infrastructure and processing, and potential for

value-added activities that can contribute to economic and social development. Addressing the lack of access to quota for the Welsh fleet could facilitate a diversification of fishing activities, reduce the reliance on non-quota stocks, and generate environmental, economic and social benefits in coastal communities and beyond.

Policy option 5.2: Develop a system of criteria-based allocation for fishing opportunities

Another alternative system for the allocation of fishing opportunities is to develop a list of criteria to use for the preferential allocation of fishing opportunities. These criteria could support the achievement of fisheries policy objectives, as well as wider environmental and social objectives. Such systems of allocation are sometimes referred to as 'beauty contests' or 'sustainability scorecards'.

Welsh Government objectives for the commercial fisheries sector are detailed in strategic policy documents such as the Interim Draft Marine Plan (2015) and Wales Fisheries Strategy (2008). Aligning allocation to support fisheries policies in such documents will also support the delivery of wider policy objectives, for example in the Wellbeing of Future Generations (Wales) Act 2015 and the Environment Act. The Well-being of Future Generations (Wales) Act 2015 requires public bodies to pursue the economic, social, environmental and cultural well-being of Wales in a way that accords with the sustainable development principle. It also foresees a healthy and resilient environment and vibrant, cohesive communities. The Environment (Wales) Act 2016 aims to promote sustainable management of natural resources in Wales.

The Initial Draft Marine Plan (the most recent relevant strategy document to detail fisheries-related policies) states that, as a consequence of history, Welsh fishing vessels have only very limited access to quota under the CFP and further opportunities are not expected to develop. Accordingly, the Welsh fleet has evolved to target mainly non-quota species, principally shellfish (e.g. scallop, lobster, crab species), but also some finfish, notably sea bass (which currently is the subject of urgent stock conservation action at EU level via Emergency Measures). Some crustacean shellfish stocks are also believed to be fully exploited, leaving little opportunity for expansion in most areas, although the Welsh fishing industry do have long term plans to enhance stocks of lobster. In that context, existing policies (within the draft Welsh Marine Plan) are based on the assumption that any opportunity for growth in the sector needs to focus on added value, not on increased catch levels. However, if Brexit results in a change to quota allocations between the UK and the EU, and/or a change to quota distribution to the days-at-sea, there could be new opportunities in Welsh waters for fisheries targeting quota stocks.

A ‘beauty contest’ could take into account these policy objectives for the allocation of fishing opportunities which would help contribute to the sustainable management of the marine environment and sustainable exploitation of marine fisheries resources which are fundamental to the well-being of future generations. In relation to shellfisheries, this approach could be implemented through the use of Several and Regulating Orders, which the Welsh Ministers have powers to make.

Specific policy FIS-03 (in the Draft Marine Plan) provides a list of criteria by which other marine sector development proposals should be assessed with regard to whether they enhance the Welsh fisheries sector. Such a list of criteria (shown below) could form part of a ‘beauty contest’ or sustainability score card allocation system:

a. Supporting sustainable fishing; and
b. Increasing, and where possible maximising its value added; and / or
c. Supporting diversification; and / or
d. Supporting access to fishing grounds; and / or
e. Improving resilience to the effects of climate change; and / or
f. Support market incentives that encourage sustainable fishing; and
g. Increase recreational access to a quality resource.

Other criteria that could be considered include:

- Low-impact and selective gear types;
- Proportion of catch to be landed in Welsh ports (thus supporting on-shore activities and contributing to supply for value-added processing);
- Local economic links to Welsh coastal communities (in terms of company or vessel ownership, crew composition, skipper-owned vessel, other linkages supporting Welsh coastal communities).

Policy option 5.3: Use an auction system to allocate fishing opportunities

Fishing opportunities can be allocated through auctions to the highest bidder. This method is relatively uncommon in fisheries — only 3% of quota systems used auctions exclusively to allocate shares, but up to 30% had used auctions to allocate some fraction of the catch shares (Lynham, 2013). In Europe, there are historical examples of the use of auctions to distribute fishing rights, for example oyster bed leases in the Dutch province of Zeeland were allocated through auction from 1870 until shortly after the outbreak of the First World War (van Ginkel, 1988). In Estonia until 2005, 90% of rights were allocated according to historical track record, with 10% of fishing rights distributed at auction each year (Vetemaa *et al*., 2002). Chile and

New Zealand have also used auctions for part of their quota allocation systems (Lynham, 2013).

Based on the examples of where auctions have been used in other fisheries, an auction for fishing opportunities in Wales could be used for a portion of the available fishing opportunities, once allocations have been made on the basis of other criteria and priorities. This would enable other priorities to be addressed first through preferential allocation to certain sectors (e.g. under-10m vessels) or vessels based on criteria to be determined (e.g. historical track record, beauty contest criteria), with any remaining fishing opportunities, or a portion of any new fishing opportunities (e.g. if additional quota can be brought in to Welsh fisheries) being allocated through auction. A review of catch share allocation mechanisms, Lynham (2013) highlights that auctions appear to work only in newly-developed fisheries and for species that are not migratory (e.g. whelks, crabs, scallops).

Depending on objectives, the auction could be open to any participant (which would help maximise the potential revenue from the auction), or participation could be restricted on the basis of criteria set by the Welsh Government (e.g. established track record in the fishing industry, local economic link to Wales, commitment to land catches to Welsh ports etc), although this would likely reduce the overall revenue potential of the auctions.

Important design features to consider, which affect who can participate in the auction and the degree of concentration among shareholders include (Lyndham, 2013):

- the type of auction used (e.g. English, sealed-bid);
- the size of the shares sold at the auction;
- consolidation limits; and
- whether bids are paid up front or when fish are landed.

The quota of fishing opportunities to be auctioned may be set by the Welsh Government in some cases (i.e. those stocks for which Welsh Government has management responsibility), or may be the portion of the UK quota that is allocated to Wales as a Devolved Administration. The auction could be run by the Welsh Government, or by a separate independent body established for this purpose.

Policy option 5.4: Reform the role of producer organisations

In the current system of fisheries management, particularly in the governance of fishing opportunities, producer organisations have a significant role in managing the fishing opportunities of their membership. There are several areas relating to PO management that have been identified for reform.

The first issue relates the failure of the PO system to involve the small-scale fleet. As of 2017, 98.5% of the UK TAC in terms of weight is allocated to PO members although they comprise only around 15% of the UK fleet by number of vessels (Carpenter & Kleinjans, 2017). In Wales, the Wales and West Coast Fish Producers' Organisation has six registered vessels, covering 1% of the Welsh fleet. The recent recognition of the Coastal PO (a PO specifically for under 10m vessels), shows intent to resolve some of this distributional problem, but the effectiveness of the Coastal PO will be in large part dependent on the provision of quota which members can access. It is clear that to deliver improved managed of the small-scale sector, a fit-for-purpose PO for the small-scale sector would need to be accompanied by changes to the method of quota allocation.

There is also a question of representativeness within the PO structure. Decision-making has been criticised as benefiting the largest, wealthiest members of the organisation (Low-Impact Fishers of Europe, 2017). Alternative models of governance and decision-making like the co-operative model would change POs into more representative organisations.

Questions over the representativeness of POs often brush up against the issue of transparency. POs tend to be fairly closed in their operations. One particularly controversial issue involves the degree of foreign ownership within producer organisations. This concern involves the Wales and West Coast Fish Producers' Organisation and significant Spanish ownership.

Finally, there is a question regarding whether the role of POs should be expanded to meet the needs of their members. Labelling and branding, with a special focus on sustainability, is one potential area, as is a greater role in the managing non-quota fishing opportunities. As much of the Welsh fishing fleet targets non-quota species, this is an especially important area for an expanded role. Indeed, the original intention of POs was a much wider remit than what is currently observed (European Parliament; Low-Impact Fishers of Europe, 2017). Post-Brexit there is also a role for POs to provide guidance and support to their membership in applying for and using catch certificates for selling fish to third countries.

Discussion

The current system of allocating fishing opportunities to vessels through FQAs is riddled with issues. While allocating fishing opportunities has always been left to Member States, Brexit has focused attention on fisheries management and provides a context through which to reform the system.

Auctioning fishing rights can help to ensure that fishing rights go to the most economically efficient participants in the fishery, on the basis that they are more likely to have resources available to out-bid competitors. The payments for fishing rights result in the capture of economic rent from the fishery, which can be reinvested to support data collection, management advice and enforcement.

Additionally, Lyndham (2013) summarises the (economic) arguments in favour of auctions in a fisheries context as 'compensating the general public for allowing private individuals to profit from exclusive access to a public resource; allowing all interested parties the opportunity to enter without favouring incumbents; and encouraging competition and efficiency, especially if the transactions costs associated with trading permits are high or there are tight restrictions on trading permits'.

However, auctioning access to fishing rights can result in larger industry players with more financial resources and access to capital dominating the process, forcing smaller players out. It can also result in the capture of fishing rights by non-fishing interests.[18] This may result in the industry (the part of it for which rights are auctioned) being dominated by larger players and larger companies, and by non-fishing interests, which might go against Welsh Government policies to optimise the economic value of fisheries to local communities, as the connection with local communities could be lost.

Allocation of fishing opportunities by way of specific criteria can enable wider social and environmental objectives to be considered within fisheries policy. It is unlikely to result in the most profitable operators harvesting the fishery, and may therefore reduce the resource rent, but objectives of Welsh legislation may be able to be increased and non-market impacts of fisheries (i.e. externalities) addressed.

The importance of producer organisations in the management of fishing opportunities is likely to continue post-Brexit and may even increase (as fishers will require support in applying for and using catch certificates for selling fish to third countries). The Welsh Government should encourage wider PO membership by promoting the newly formed Coastal PO to small-scale vessels, or else develop a specific Welsh Coastal PO for Welsh small-scale vessels. Other reforms will require further research to determine feasibility and appetite within the industry, also Defra has indicated that it will be reviewing the role of POs post-Brexit including an expansion of role to data collection and/or the development of different, sector-specific POs (Defra, 2017).

[18] In the Dutch oyster fisheries, the majority of access rights were secured by wealthy urban entrepreneurs rather than established oystermen, who consequently had to find jobs with the new oyster companies.

Level six: Post allocation policies

In designing fishing opportunities, it is important to first consider strategic objectives. From these specific objectives, a system of design can emerge. In *Who gets to fish?* (Carpenter & Kleinjans, 2017) fishing opportunities are characterised by the extent to which they deliver on 12 objectives: secure, flexible, accessible, viable, equitable and fair, publicly owned, meet government objectives, limited government expense, capture resource rent, transparent and accountable, objective, and are at the right governance level and representative. The following policy options target one or more of these specific objectives.

Policy option 6.1: Implement new processes to enhance flexibility

In light of the landing obligation and the issue of choke species in mixed fisheries (see level one), there are calls to reform catch quota to better cope with these challenges, in particular by increasing flexibility within the quota system. How fishing opportunities are allocated to fleets, as well as the characteristics of these opportunities, has always been a decision of individual EU Member States.

There are many different methods to increase flexibility within quota systems (McIlwain, 2015). Inter-species flexibility substitutes one species' quota to cover catch of a different species based on an 'exchange rate' between species. Banking and borrowing allows a portion of catch quota to roll over to the next year. A system of 'deemed values' allows fish to be landed without quota but with a pre-agreed fee paid to the government.

A buffer quota for a species would set a portion of national quota aside from allocation through FQAs to be released when the Welsh Government (or community quota group) deemed necessary, such as when a choke has been reached.

Some commentators have pointed to the Icelandic system of individual transferable quotas (ITQs) as a potential model for post-Brexit fishing opportunities (Pirie, 2016), and the transferability of quota has been cited as aiding flexibility (McIlwain, 2015). The Netherlands, Sweden, and Denmark all have versions of ITQ systems in their fisheries management. As one of the most controversial issues in fisheries management due to the consolidation that inevitably follows, the advantages and disadvantages of these systems are well established, with proponents often pointing to increased profitability as a result of consolidation and opponents pointing to job losses in coastal communities (Carpenter & Kleinjans, 2017). ITQs are touted for their ability to add flexibility to a quota system, however this is only true if fishers have the capital to make large transfers of ownership. This is frequently not the case and is also an issue that has plagued the quota leasing market in the UK.

Other quota management tools besides transferability can utilise peer networks to increase flexibility. Risk pools are used to combine quota for a group of fishers together and therefore act as an insurance system. Existing POs can serve this function for their membership. An alternative system to add flexibility into the quota system would be to scale-up systems of quota swaps (e.g. cod for haddock), which do not involve financial transactions. New technologies and mobile phone apps could be used to a foster a flexible system of peer-to-peer quota swaps that do not require producer organisations (Carpenter & Kleinjans, 2017).

Policy option 6.2: Create a reserve of fishing opportunities separate to initial allocations

The initial gifting of fishing opportunities to POs and the emerging sense of 'legitimate expectation' of continued use of these rights presents a difficult situation for new fishers wishing to enter the industry (Carpenter & Kleinjans, 2017). In Denmark, the 'Fishfund' is a quota reserve that is set aside for new entrants to the fishery, as well as specific objectives, such as increasing the amount of quota available to the small-scale coastal fleet. There may be overlap between a reserve for this purpose and some of the allocation schemes from previous policy options, such as implementing a criteria-based quota reserve and/or filling the quota reserve with any quota gains as a result of zonal attachment or other forms of 'uplift'.

Policy option 6.3: Introduce a levy on catches, landings, or fishing activity

Fisheries management is extraordinarily expensive, especially relative to the size of the industry in economic or employment terms. Fisheries management also generates resource rent through limiting entry to the fishery – rent that the government does not directly recover. A quota auction, as previously detailed is one form of revenue generation. Another is to institute a landings tax, which would extend beyond quota fisheries and cover all species.

The most likely design is through a levy on Welsh vessels. While this would avoid the situation of incentivising landing in Ilfracombe or Fleetwood instead of Wales, it could potentially put Welsh fleets at a competitive disadvantage – although the financial performance of the fleet is improving and is healthy in many fisheries (STECF, 2017) – and may result in the re-registration of Welsh vessels to other UK administrations. The most effective system would be for a landings tax on landings from all UK vessels than could build on the existing Seafish levy.[19] Several fisheries in the US have a landings tax, whereas Iceland has a tax on fisheries profits (Carpenter & Kleinjans, 2017).

[19] Seafish, an organisation created to promote the activities of the fishing industry, whilst also regarding the interests of consumers of sea fish and sea fish products, is funded through a levy on all first-hand purchases of sea fish, shellfish, and sea fish products including fishmeal landed in the United Kingdom.

There may be an option to use a differentiated landings levy as an incentive to address the issue of the economic link (Carpenter & Kleinjans, 2017). In an attempt to ensure that fishing opportunities provide a real benefit to British coastal communities and wider society, the current economic link policy specifies that in order to hold a UK fishing licence and fish against UK quota one of the following options must be met:

1. At least 50% of landings by weight should be made in UK ports;
2. At least 50% of the crew must be normally resident in UK coastal areas;
3. At least 50% of operating expenditure must be spent in the UK;
4. Demonstrate other benefits to the fishing community e.g. by quota donations to under 10 metre fleet.

As an alternative, a landings tax could provide an incentive (rather than a requirement to land in the UK (or Wales) through the use of a differentiated rate for domestic and foreign landings. One first step would be to set this differentiated rate to deduct current port duties in the UK. The treatment of landings from foreign vessels into UK ports under this levy is an important considersation as it should balance the incentive to land in the UK with the perception of disadvantaging domestic vessels.

Discussion

All three policy options to change the characteristics of fishing opportunities explored here hold some promise. Brexit has raised the issue of ensuring that fisheries as a public resource are delivering a public benefit, just as the Landings Obligation, and increasingly climate change, are generating discussions about injecting flexibility in systems of fishing opportunities. Brexit has also raised the issue of financing fisheries, as many potential reforms to access agreements require robust (and well-financed) control and enforcement. While all of these policy options would benefit from a wider base (implemented across the UK), the Welsh Government has the power to implement any of these reforms immediately.

Conclusions on post-Brexit fishing opportunities for Wales

Brexit presents a potentially radical moment for fisheries policy and management. This report has outlined some of the key potential impacts of different Brexit scenarios on Welsh fisheries and offered policy options on potential changes to the management of fishing opportunities.

The analysis presented in sections one and two of this report illustrate the unique structure of the Welsh fishery within the UK. Its differences should be understood and recognised to avoid the risk of being 'left behind' by the demands of other, larger fishing interests in UK-EU negotiations. Several conclusions emerge from the research:

- The current focus of Welsh fisheries on non-quota species means that the immediate benefits of zonal attachment quota allocations would be limited in Wales.
- The current reliance on the EU market for selling the catch means that maximising EU market access, whilst minimising tariff and non-tariff barriers for fish and fish products, are important for the Welsh fleet. For most Welsh vessels, this is currently seen as more important than quota allocations.
- Wales could benefit from increased quota of quota-managed species if zonal attachment is used to divide fishing opportunities with the EU and/or in the distribution of UK quota to the devolved administrations.
- Support for vessel adaptations and port, market and logistics infrastructure would help to fully exploit such opportunities and maximise the potential benefits for Wales.

Section three focuses on fishing opportunities and analyses key policy options that can be considered for reform as part of a post-Brexit fisheries management strategy. A six-level model of policy decision-making is employed to highlight some of the major choices the Welsh Government faces. The key implications are:

Level 1: Total catch limits. These will either be set bilaterally between the UK and the EU as part of the negotiated exit settlement, or by the UK Government. The Welsh Government could advocate an alternative framework to the current maximum sustainable yield (MSY). Many alternative frameworks lower overall fishing mortality below the level required for MSY, so improving sustainability. This however may be purely aspirational in the short term: there is a real danger that the shared commitment to some form of sustainable yield that MSY represents is put at risk during negotiations if countries begin to compete for their 'fair share'. It is recommended that the Welsh Government advocate for maintaining the target of sustainable fisheries and MSY.

Level 2: Division of quota between states. The method of dividing fisheries quota between states could be renegotiated, either as part of the Brexit negotiations or in a separate fisheries agreement. The UK would stand to benefit from an increase in quota as a result of any change from the current model of 'historical share' to 'zonal attachment' owing to its large and productive exclusive economic zone (EEZ). It is estimated that a change in EU-UK quota sharing based on zonal attachment would increase Welsh quota holdings by 170%. However, for Wales there may be mixed effects from an increase in UK quota at the expense of EU vessels. If the catches from UK vessels (primarily English) are not landed in Wales (as Belgian vessels currently do), there could be a reduction in landings to Welsh ports and associated supply chains. Renegotiated quota shares could also present a risk for Wales as they could result in increased quota swaps *out* of species the Welsh fleet has an interest in. All considered, the potential for receiving more quota for those species that occur in UK and Welsh waters should be pursued as this can then provide currency for further quota swaps or access negotiations.

Level 3: Division of quota between devolved UK administrations. Currently both the EU-UK and UK-Wales division of quota are determined through fixed shares (largely based on historical landings). The implication of this system is that any increase in post-Brexit fishing opportunities would accrue to existing UK quota holders, of which there are very few in the Welsh fleet. Alternatively, there is a reasonable argument for the extension of the zonal attachment principle from the international level to the division of quota within the UK. Such a change would significantly increase fishing opportunities for Wales. Based on the location of landings, using Welsh waters instead of quota holdings to divide EU-UK quota would increase UK quota by 407% (15,130 tonnes). Using Welsh waters for the division of UK quota to the devolved administrations would increase Welsh quota by a further 257% (1,758 tonnes). These potential gains are significant owing to the relatively small size of Welsh activity currently. This potential is also tempered by the fact that the existing Welsh fleet and port infrastructure are not yet operationally prepared to harvest this additional quota based on Welsh waters, especially for the main quota species that would be gained (e.g. herring, Nephrops, haddock). On this basis, it would be in the interest of the Welsh fleet to renegotiate the allocation of quota according to FQAs through a new UK Concordat between the devolved administrations for species that could reasonably be utilised by the Welsh fleet.

Level 4: Overall fisheries management system. It is as yet unclear whether power to define and run the overall management system (OMS) will be devolved to Wales from the UK level. If the OMS were devolved, the Welsh Government would have the opportunity to introduce an approach better aligned to its future generations policy stance – for example, requiring an

ecosystem-based approach to fisheries management, and changing technical spatial management rules to limit fishing in inshore waters. At the same time, given the importance of non-quota species to Wales, there would also be the option to establish catch quotas for whelks, scallops, sea bass, or other non-quota species – although this is controversial. Policy leadership of fisheries is however a significant commitment, requiring dedicated research and development management institutions and regulation alongside central government policy oversight. Going beyond fishing opportunities, a wider review of fisheries policy, management and governance, may help ensure that Wales can achieve the goals in the Wellbeing of Future Generations Act and Environment Act and to reap the benefits from a healthy, productive and biodiverse marine environment. One bold initiative that would underpin many policy options in this space would be for the Welsh Government to develop a system of real-time data to support the management of fishing opportunities. Real-time data collection be part of a license requirement for the whole Welsh fleet or for particular fleet segments.

Level 5: Allocation to fleets/vessels. In the context of Brexit, the Welsh Government has an opportunity to take a more active role in the allocation of fishing quota. If new fishing opportunities post-Brexit are to be used as 'fishing currency', these fishing opportunities should be confirmed as a *public resource* rather than a private property. Given the Government's policy priorities, including the Wellbeing of Future Generations Act (2015), distributing fishing opportunities based on fleet performance to meet broader policy objectives ('beauty contest' or 'sustainability scorecard' approach) is more fitting than historic share alone or the use of a quota auction (although the use of an auction is more appropriate for quota that the Welsh fleet does not have an interest in targeting). A quota reserve should be held back to facilitate new entrants.

Level 6: Post-allocation policies. Some characteristics of fishing opportunities may be considered as further potential reforms. A market for quota is opposed by many stakeholders and particularly the Welsh fleet, which is composed almost entirely of small-scale vessels. An online peer-to-peer system of quota swapping would add flexibility without the issues associated with quota concentration through permanent transfer of quota or prohibitive pricing of quota leasing. Maintaining a reserve of fishing opportunities for new entrants could help address incumbency; and a landings tax holds real potential to aid in meeting the costs of fisheries management. While all of these policy options would benefit from a wider base (implemented across the UK), the Welsh Government has the power to implement any of these reforms immediately.

Research needs

From the analysis it is clear that further research is required to take advantage of opportunities. These research needs include:

- Liaison with the Welsh fishing industry to identify quota species of most interest to the current fleet, to inform negotiations at both UK and EU levels. Explore the baskets of quota (for mixed fisheries) that might compose new quota fisheries in Wales, and the tipping points for quota utilisation (i.e. the level of quota needed to make a fishery viable);
- Further research into zonal attachment shares in Welsh waters (from stock biomass surveys and analysis of quota uptake and species economic value), as well as options to support the development of the Welsh fleet to successfully utilise this greater share;
- Further research on the implications of Wales' preparedness for substantial quota gains, including: vessel and fleet capacity; scope to issue new licences versus the need for a cap; current gear usage and potential for adaptation to alternative species or fisheries; ability to attract new fishers.
- Trials of new management approaches (e.g. days at sea with flexible catch composition, or more flexible quota system with quota pooling and buffers);
- Assessment of the whole supply chain and the potential to develop further up- and down-stream activities from the basis of current fishing sector activity, including: port infrastructure availability and need; additional land-side infrastructure and transport connections; potential for development of a live auction (none currently exists in Wales); developing supply chains and value-added processing; and market opportunities, such as market demand, product development, branding.

In summary, there is little doubt that Brexit will precipitate transformation in the way fisheries are managed in Wales and the rest of the UK. These changes carry both risks and opportunities. How these risks and opportunities balance depends on the type of fishing vessel, the market that is supplied, and of course the type of Brexit that is negotiated.

The Welsh fleet, characterised by small-scale vessels supplying shellfish to the EU market has a unique set of needs that does not align with the UK fleet as a whole. For most vessels in the Welsh fleet, a successful Brexit would require as few barriers to trade as possible and low tariffs. As any increases in post-Brexit fishing opportunities would accrue to quota holders, the Welsh fleet requires a different arrangement of quota sharing within the UK to get its fair share. There should also be targeted policy change in the management of these fishing opportunities so that benefits are felt in Welsh ports and wider society from what is a public resource.

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Appendix A: Key data and tables

Table A: Change in the value of UK fish landings assuming zonal attachment

Study	Unit	Net change
Napier (2017)	Landed value	+53%
HM Government (2017)	Landed value	+48%
Fishing for Leave (2017)	Landed value	+99%
Goulding & Szalaj (2017)	Cod equivalents	+61%
Carpenter (2017a)	Gross earnings	+49%

Table B: Welsh share of UK fleet segments

Fleet	Welsh vessels	All UK vessels	Percentage
Pots & traps 0-10m	220	2615	8%
Drift/fixed net 0-10m	117	751	16%
Hook & line 0-10m	46	666	7%
Demersal trawl/seine 0-10m	31	597	5%
Pots & traps 10-12m	16	207	8%
Beam trawl 0-10m	12	73	16%
Pots & traps 12-18m	5	85	6%
Dredgers 0-10m	4	206	2%
Dredgers 12-18m	3	120	3%
Demersal trawl/seine 10-12m	2	89	2%
Demersal trawl/seine 24-40m	1	99	1%
Beam trawl 24-40m	1	27	4%
Drift/fixed net 10-12m	1	14	7%
Demersal trawl/seine 40m+	1	12	8%
Dredgers 24-40m	1	4	25%
Beam trawl 18-24m	1	17	6%
Hook & line 24-40m	1	14	7%

Source: EU Fleet Register 2016 (2017)

Table C: Main fleet type landing in major Welsh ports

Port	Main fleet type	Landed value (2016)
Aberdaran	Pots and traps - 10m&Under	109,101
Aberystwyth	Pots and traps - Over10m	766,326
Amlwch	Pots and traps - Over10m	1,004,916

Burry Port	Gears using hooks - 10m&Under	201,966
Caernarvon	Pots and traps - 10m&Under	192,103
Cardigan	Pots and traps - 10m&Under	179,921
Fishguard	Pots and traps - Over10m	1,832,255
Holyhead	Dredge - Over10m	3,136,740
Milford Haven	Beam trawl - Over10m	10,607,807
Morfa Nefyn	Pots and traps - 10m&Under	679,060
New Quay	Pots and traps - 10m&Under	281,819
Neyland	Pots and traps - 10m&Under	260,354
Penrhyn	Pots and traps - Over10m	193,839
Porthgain	Pots and traps - 10m&Under	165,357
Pwllheli	Pots and traps - 10m&Under	178,998
Saundersfoot	Pots and traps - 10m&Under	2,023,939
Solva	Pots and traps - 10m&Under	127,205
Swansea	Beam trawl - Over10m	3,481,566
Tenby	Pots and traps - 10m&Under	147,555

Source: MMO 2016 (2017)

Table D: Increase in economic value from reaching MSY

Geography	Benefit	Source
World	£66 billion per annum ($86 billion)	Arnason et al (2017)
EU	£4.1 billion per annum (€4.64 billion)	Guillén et al (2017)
UK	£251 million per annum (€284 million)	Carpenter (2017d)
Wales	£3 million per annum	Proportional by Welsh share of UK quota

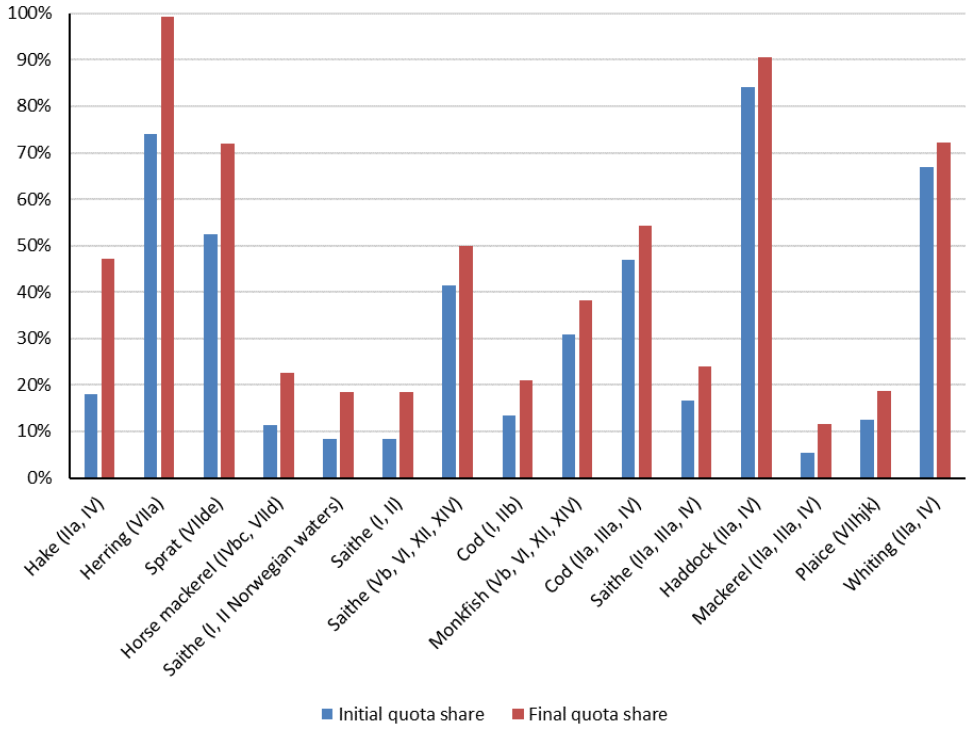
Table E: Changes to UK quota shares and Welsh tonnage from zonal attachment

		UK share			
Quota	**Welsh 2016 tonnage**	**Relative stability**	**Zonal attachment**	**Percentage change**	**Welsh final tonnage**
Angler 7	208.0	18%	45%	149%	518.0
Megrim 7	157.8	14%	39%	173%	430.7
Skates & Rays 67 xd	106.1	26%	94%	263%	385.4

Hake 67	96.1	18%	35%	95%	187.0
WS Nephrops	81.4	98%	100%	2%	83.3
Pollack 7	34.1	17%	57%	227%	111.6
Whiting 7bk	34.0	11%	65%	511%	207.8
Plaice 7de	26.9	29%	77%	166%	71.6
Angler 8abde	20.9	0%	0%	0%	0.0
Hake 8abde	14.2	0%	0%	0%	0.0
Haddock 7bk	13.4	10%	65%	552%	87.4
Ling 6-10,12,14	9.6	34%	66%	95%	18.7
Sole 7fg	9.4	28%	98%	250%	32.9
Plaice 7fg	5.8	13%	82%	529%	36.5
NS Cod	5.4	47%	54%	16%	6.3
Greater Forkbeard 567	5.3	40%	72%	79%	9.5
Nephrops 7	5.0	33%	80%	144%	12.2
Haddock 7a	4.3	48%	97%	103%	8.7
Plaice 7a	4.0	28%	91%	221%	12.8
NS Plaice	2.8	28%	39%	39%	3.9
NS Nephrops	2.8	87%	87%	1%	2.8
Cod 7bk xd	2.7	8%	69%	783%	23.8
Saithe 7	2.7	14%	18%	34%	3.6
Sole 7d	1.8	19%	69%	259%	6.5
NS Haddock	1.8	84%	85%	1%	1.8
WS Mackerel	1.8	58%	71%	21%	2.2
Sole 7e	1.5	59%	76%	29%	1.9
Skates & Rays 7d	1.5	15%	80%	432%	8.0
WS Saithe	1.3	41%	95%	132%	3.0
WS Mackerel o/w 4a	1.1	58%	71%	21%	1.3
Plaice 7hjk	0.7	13%	41%	228%	2.3
Cod 7d	0.7	9%	74%	695%	5.6
NS Sole	0.7	4%	67%	1470%	11.0
Herring 7ef	0.6	50%	93%	85%	1.1
Sole 7a	0.4	23%	97%	332%	1.7
Totals	**867**			**170%**	**2,336**

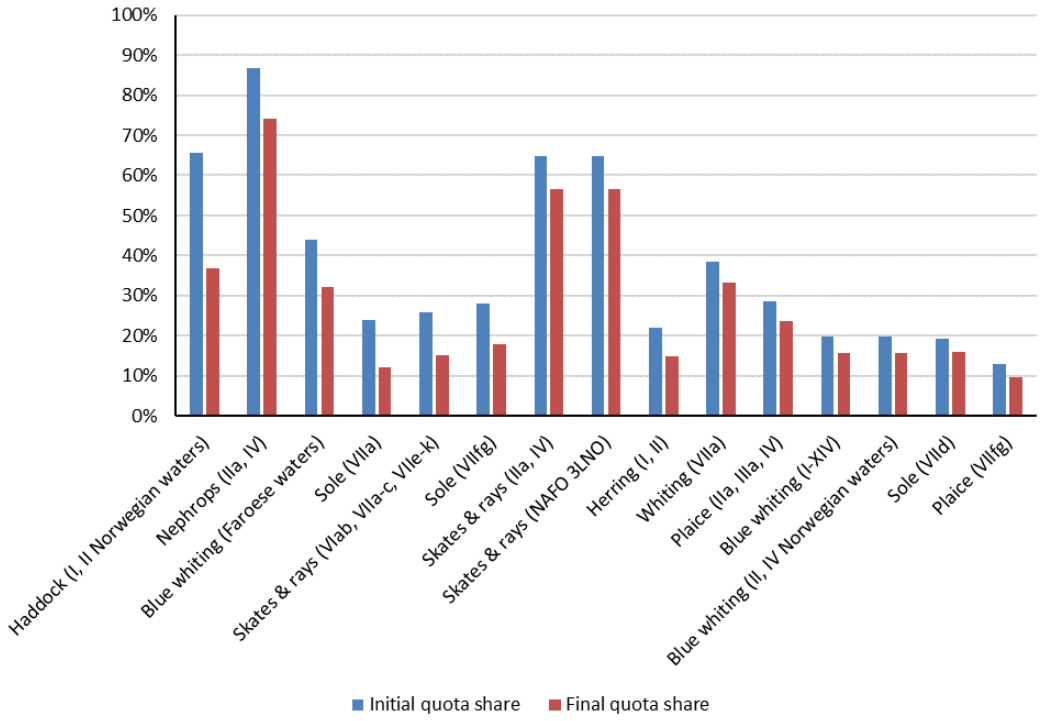
Sources: Authors' calculations based on MMO 2016 (2017); Fishing for Leave (2017)

Figure Aa: UK share of EU quota before and after quota swaps – largest inward swaps



Sources: Authors' calculations based on Council agreed TACs and FIDES adapted quota (2012-2015).

Figure Ab: UK share of EU quota before and after quota swaps – largest outward swaps



Sources: Authors' calculations based on Council agreed TACs and FIDES adapted quota (2012-2015).

Table F: Quota swaps with a Welsh interest

Quota	Welsh 2016 tonnage	Quota swaps
Angler 7	208.0	3%
Megrim 7	157.8	4%
Skates & Rays 67 xd	106.1	-11%
Hake 67	96.1	-3%
WS Nephrops	81.4	0%
Pollack 7	34.1	-1%
Whiting 7bk	34.0	-4%
Plaice 7de	26.9	-6%
Angler 8abde	20.9	0%
Hake 8abde	14.2	0%
Haddock 7bk	13.4	-1%
Ling 6-10,12,14	9.6	-2%
Sole 7fg	9.4	-15%
Plaice 7fg	5.8	-2%
NS Cod	5.4	9%
Greater Forkbeard 567	5.3	-11%
Nephrops 7	5.0	-1%
Haddock 7a	4.3	4%
Plaice 7a	4.0	-4%
NS Plaice	2.8	-9%
NS Nephrops	2.8	-31%
Cod 7bk xd	2.7	1%
Saithe 7	2.7	0%
Sole 7d	1.8	-6%
NS Haddock	1.8	6%
WS Mackerel	1.8	-3%
Sole 7e	1.5	-1%
Skates & Rays 7d	1.5	1%
WS Saithe	1.3	6%
WS Mackerel o/w 4a	1.1	-3%
Plaice 7hjk	0.7	4%
Cod 7d	0.7	0%
NS Sole	0.7	3%
Herring 7ef	0.6	0%
Sole 7a	0.4	-6%

Source: Authors' calculations based on Council agreed TACs and FIDES adapted quota for 2012-2015.

Table G: UK and EU quota landings by Welsh EEZ

Rectangle	UK EEZ	EU EEZ	UK Landings	EU Landings	Difference (tonnes)
36E6	99%	0%	40%	60%	55

36E5	100%	0%	86%	14%	40
36E4	52%	47%	47%	53%	289
35E6	100%	0%	96%	4%	0
35E5	100%	0%	55%	45%	3
35E4	32%	67%	18%	82%	50
34E5	100%	0%	11%	89%	3
34E4	42%	58%	11%	89%	27
33E5	100%	0%	37%	63%	9
33E4	62%	37%	7%	93%	79
32E7	100%	0%	0%	0%	0
32E6	100%	0%	42%	58%	0
32E5	100%	0%	27%	73%	11
32E4	98%	1%	14%	86%	585
32E3	13%	86%	6%	94%	236
31E7	100%	0%	0%	100%	0
31E6	100%	0%	77%	23%	3
31E5	100%	0%	48%	52%	44
31E4	100%	0%	6%	94%	1,090
31E3	68%	32%	1%	99%	10,899
30E3	100%	0%	14%	86%	1,332
30E2	28%	71%	8%	92%	375
				Total EEZ difference	**15,130**
				Current UK landings in Welsh EEZ	**3,717**
				Percentage change	**407%**

Source: Authors' calculations based on STECF 2012-2015 (2017); Marineregions.org (2017).

Table H: UK landings in the Welsh EEZ and Welsh landings in the UK EEZ by quota species (tonnes)

TAC species	Welsh EEZ, other UK vessels	Welsh vessels, other UK EEZ (tonnes)	Difference
Herring	783.40	0.00	783.40
Nephrops (Norway Lobster)	675.62	2.99	672.63
Haddock	181.68	0.44	181.24
Blonde Ray	49.28	16.86	32.42
Monks or Anglers	41.30	12.21	29.09
Thornback Ray	44.90	19.86	25.04
Pollack	15.92	1.18	14.75
Whiting	14.13	2.83	11.30
Megrim	11.14	0.25	10.90
Cod	10.71	1.25	9.46
Hake	8.13	0.01	8.12

Ling	4.95	0.35	4.60
Turbot	5.86	3.11	2.76
Saithe	1.15	0.00	1.15
Cuckoo Ray	0.67	0.00	0.67
Mackerel	0.22	0.02	0.20
Shagreen Ray	0.04	0.00	0.04
Spotted Ray	1.03	0.99	0.04
Horse Mackerel	0.01	0.00	0.01
Starry Ray	0.00	0.04	-0.04
Redfishes	0.00	0.11	-0.11
Undulate Ray	0.00	0.36	-0.36
Small-eyed Ray	13.37	14.06	-0.68
Lemon Sole	1.71	4.11	-2.40
Plaice	7.33	16.77	-9.44
Sole	2.67	18.93	-16.26
Total	**1,875.26**	**117.56**	**1,757.70**
		Welsh quota landings	**683.59**
		Percentage change	**257%**

Source: Authors' calculations based on MMO 2016 (2017).

Appendix B: Inshore fisheries management in the devolved administrations

England

Inshore Fisheries and Conservation Authorities (IFCAs) are committees or joint committees of local authorities, which took over from the Sea Fisheries Committees following the Marine and Coastal Access Act (2009). Each IFCA manages a district that covers part of the English coast that goes out to 6nM and its inland boundaries align with those of its constituent local authorities. IFCAs also manage sea fisheries resources in estuaries that fall within their districts. There are ten IFCAs in England. They are tasked with the sustainable management of inshore sea fisheries resources, including Marine Protected Areas, in their area. They are made up of representatives from the constituent local authorities (who provide funding) along with sectoral stakeholders and experts. The Marine Management Organisation, Environment Agency and Natural England also each have a statutory seat on each IFCA. IFCAs widen the scope of stakeholder involvement in the protection and enhancement of their inshore marine environment (AIFCAs, 2017).

Scotland

Inshore Fisheries Groups (IFGs) are non-statutory bodies that aim to improve the sustainable exploitation, management and conservation of Scotland's inshore fisheries resources (fish and shellfish) out to 6nM, giving commercial inshore fishermen a voice in management and ensuring a viable fishing industry and fishing communities. These original IFGs have been replaced by Regional Inshore Fisheries Groups (RIFGs) since April 2016 (Scottish Regional Inshore Fisheries Groups - RIFGs; 2013, 2016).

Northern Ireland

Northern Ireland's inshore fisheries are managed by the Inshore and Environment Branch, which also has responsibility for regulation of fisheries within marine Natura 2000 sites. The management of Northern Ireland's inshore fisheries comprises fishing vessels that target mostly shellfish. Responsibility also extends to scallop and queen scallop fisheries within the inshore region. Spatial pressures are presented as a major issue of concern in the sustainable development of the sector (DARDNI, 2014).

The Public Policy Institute for Wales

The Public Policy Institute for Wales improves policy making and delivery by commissioning and promoting the use of independent expert analysis and advice. The Institute is independent of government but works closely with policy makers to help develop fresh thinking about how to address strategic challenges and complex policy issues. It:

- Works directly with Welsh Ministers to identify the evidence they need;
- Signposts relevant research and commissions policy experts to provide additional analysis and advice where there are evidence gaps;
- Provides a strong link between What Works Centres and policy makers in Wales; and
- Leads a programme of research on What Works in Tackling Poverty.

Note: In October 2017 the PPIW became part of the Wales Centre for Public Policy. The Centre builds on the success of PPIW, and will continue the Institute's work of meeting Welsh Government Ministers' evidence needs, alongside a new mission to support public services to access, generate, evaluate and apply evidence about what works to address key economic and social challenges. This assignment was commissioned for the final PPIW work programme.

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