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Mapping the geographical consolidation of fishing activities in Iceland during the maturation of the ITQ fisheries management system

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Abstract

Consolidation of the fishing industry worldwide is an issue heavily debated among scholars. Many economists have argued for its necessity, while others – such as sociologists, anthropologists and geographers – have pointed out negative effects of consolidation on fishing communities.

The aim of this paper is to measure the geographical consolidation of fishing in Iceland since the introduction of the quota management system in 1984, and during its development into an individual transferable quota system (ITQ). Lorenz curves, Gini calculations and maps are used for this purpose. Consolidation of the fishing sector is a logical outcome of ITQs and the analysis shows that the ITQ system has led to increased geographical consolidation in the demersal and pelagic sectors in Iceland. Regions and communities are unequally affected by geographical consolidation and many small fishing communities are vulnerable to changes in the industry.

The results are of value for fisheries management policy formation. When designing fisheries policy for the 21st century it is important to not only consider economic efficiency, but also geographical consolidation and its impact.

Keywords:

Fisheries management, ITQs, Spatio-temporal mapping, Gini coefficient, Consolidation, Community development, Regional policy, Iceland

1. Introduction

In 2016, the Food and Agricultural Organization of the United Nations estimated that 89.5% of the world's fish stocks are fully- or overexploited, a growing trend in the 20th century and into the 21st (FAO, 2016). Most nations who part take in fishing acknowledge that protecting our common oceans is one of the major challenges of our times. To address this serious issue, rights-based fisheries management approaches have been proposed as a means to better control fishing efforts (Fulton, Smith, Smith, & van Putten, 2011). Individual transferable quotas (ITQs) present a form of such management. Based on their prior experience, fishers are allocated a share in a total allowable catch (TAC) set by authorities. ITQs have been introduced in around 25% of the world's fisheries (Grainger & Costello, 2016). They are usually framed in classical liberal economic thinking, where individuals maximise profits from their private property and generate wealth which trickles down the economic hierarchy. (Ragnar Arnason, 2008).

ITQs have been linked to the neoliberal wave which swept through the world in the last decades of the 20th century (Mansfield, 2004). At its core, ITQs turn a common pool resource into private property in the name of sustainability (Carothers & Chambers, 2012a). When discussing sustainability, the three core aspects of the concept need to be addressed: ecological, economic and the social (Holm, Raakjær, Becker Jacobsen, & Henriksen, 2015). ITQs have come under sustained critique for being too narrowly focused on economic sustainability and almost disregarding social aspects. The stated goals of ITQs in fisheries are to increase economic efficiency and waste in fisheries and prevent overfishing. A universal problem in the world's fisheries is too many fishers chasing too few fish, and resource economists have set out to eliminate this problem. In theory this will lead to a system with fewer but more efficient players, evoking the idea of the economics of scale. Hence, consolidation is expected with ITQs.

Iceland has been at the forefront in experimenting with quota-based fisheries. Along with New Zealand, it was the first country to implement a nationwide ITQ program in all its fisheries. Starting in the 80s, a comprehensive system of vessel quotas was introduced, the quotas being made fully transferable in 1991 (Runolfsson & Arnason, 1996). During that gestational period some significant social changes occurred, which have continued since.

This article takes a further look at the consolidation of the fishing sector in Iceland during the maturation of the ITQ system. While previous research has concentrated on the firm level (Agnarsson, Matthiasson, & Giry, 2016; Pálsson & Helgason, 1995), the focus is on the geographical perspective. The question of geographical concentration has been one of the most contested aspects of the debate on fisheries management in Iceland. This also applies to other fishing nations, where concerns about the vulnerability of small coastal communities are often prominent (Carothers, Lew, & Sepez, 2010; Haas, Edwards, & Sumaila, 2016; Olson, 2011; Urquhart, Acott, Reed, & Courtney, 2011). It is therefore of great interest for the formation of regional development policy to show the actual extent to which this has happened. For this purpose, we analyse the period between 1982 and 2014. The Gini coefficient is applied on a geographical level, measuring the distribution of fish landed at 83 locations.

In the next section we discuss the reasons and theory behind fisheries management followed by a section on fisheries management in Iceland specifically. The fourth section introduces the methodology and how Lorenz curves and Gini calculations are used to generate a geographical Gini index to measure consolidation. In the fifth section the results of the study are mapped out for each fishing category. We conclude the study with discussions of the geographical implications of the results.

2. Fisheries management

While fisheries management is not a new concept, marine resources have worldwide historically been treated as an open-access commons. Overfishing has been framed as a classic example of Garrett Hardin's 'tragedy of the commons'. Open access fishing incentivises overfishing (Ostrom, 2000) as fishermen engage in a race to fish as much as possible in the shortest amount of time, putting pressure on both men and the resource (Emery, Gardner, Hartmann, & Cartwright, 2016). Since ownership of the catch is not established until the fish is caught, there is very little incentive for fishermen to exercise stewardship over the commons (Hannesson, 2005). In his work, Hardin argued that individuals will continue to degrade the common resource until it is either taken over and managed by the state or turned into private property (Hardin, 1969).

The 'tragedy' thesis has been heavily criticized (Feeny, Berkes, McCay, & Acheson, 1990; Mansfield, 2004), but it continues to be used as a basis for fisheries management efforts, not least the introduction of ITQs. In theory, ITQs effectively privatise the commons and lead to better stewardship of resources, while maximising the efficiency of the fisheries (Grafton et al., 2006). ITQs seek to economically rationalise access to the resource by allocating ownership of the catch before it is caught. Providing fishermen with a fixed share in the yearly TAC it is seen as way to end the race to fish by enabling fishermen to plan their operations in advance without risking losing out to their competitors (Acheson, Apollonio, & Wilson, 2015; Anderson, 2000; Asche, Bjørndal, & Bjørndal, 2014). To maximise efficiency, quotas have been made tradable between individuals. This provides the inefficient fishers with an exit strategy and the more efficient ones with a possibility to expand (Arnason, 2000; Arnason, 1991; Neher, Arnason, & Mollett, 1989; Nguyen, Schilizzi, Hailu, & Iftekhhar, 2017).

The overall ecological effects of ITQs are mixed or unknown (Branch, 2009). Positive effects seem to stem from setting the TAC at a precautionary level rather than as a direct effect of ITQs (Gibbs, 2010; Soliman, 2014). The setting of TACs on its own, however, does not address the issue of overfishing and in many cases accentuates problems such as bycatch, high grading (keeping only the most valuable catch and discarding the rest) and misreporting (Acheson, Apollonio, & Wilson, 2015; Branch, 2009; Harrington, Myers, & Rosenberg, 2005). The claim that ITQs promote better stewardship has come under criticism as being based on false presumptions (Gilmour, Day, & Dwyer, 2012). Van Putten, Boschetti, Fulton, Smith, & Thebaud (2014) call for further validation of this theory before it is stated as a fact.

ITQs are set up directly to address the issue of economic inefficiency while protecting the resource. Some result has been gained in terms of reducing the size of fishing fleets. Better efficiency of the fishing fleet has been observed in most cases where ITQs have been implemented (Batstone & Sharp, 1999; Bess, 2006). There are legitimate concerns that the consolidation mechanisms built into ITQ systems will lead to a monopoly of capital, excluding small scale fishermen from the system (Carothers & Chambers, 2012b; Pálsson & Helgason, 1995; Stewart & Callagher, 2011; Yandle & Dewees, 2000).

Two countries that were early adopters of ITQs are Iceland and New Zealand. A growing body of evidence indicates that considerable consolidation has occurred in the two countries. Concentration of quota ownership in both countries has increased. The ownership share of the 25 largest firms in Iceland increased from 39% to 74% over the period between 2001 - 2014 (Agnarsson et al., 2016). In 2006, between 80% and 99% of quotas in New Zealand's various fisheries was owned by 20 of the largest firms (Stewart & Callagher, 2011).

3. The Icelandic fisheries

For the fishing year 2016–2017 the Marine Research Institute recommended a TAC for some 37 species of marine life in the ocean around Iceland (Marine Research Institute, 2016). Those species are quite diverse and are generally classified into three categories: demersal fish, pelagic fish, and crustaceans.

The demersal fisheries (Fig.1) (gadoids, redfish, various flatfish species etc.) are operated all year round, but subject to area closures during spawning season and to prevent fishing of juvenile fish (Ministry of Industries and Innovation, 2017). The pelagic species (e.g. capelin, herring, and mackerel) are of lower economic value than the demersal and crustacean (Directorate of Fisheries, 2017e). Pelagic fish (Fig. 2.) are caught in huge numbers at certain times of the year when they migrate in large schools into the Icelandic exclusive economic zone (EEZ). The most valuable catch is processed for human consumption while the rest is used for fishmeal. The pelagic species are found in the middle or upper part of water column and are generally smaller. Hence, the industry relies on different gear, depending on the species being targeted (Marine Research Institute, 2016) Due to the migratory nature of these pelagic species, and of some demersal species, Iceland has signed several multilateral agreements, allowing transboundary fishing between neighbouring countries such as The Faroe Islands, Greenland, Norway, and Russia. A considerable part of the catches are made outside of the exclusive economic zone (EEZ) due to these agreements (Figs. 1 and 2.) (The Directorate of Fisheries, 2017a, 2017d).

The crustacean fisheries (Fig. 3.) are quite different from the other categories. The main species caught are shrimp and langoustine. Shrimp is found all around Iceland and is divided into deep- and shallow-water stocks. These have different seasonality traits, but shrimp fishing is now severely restricted due to a record-low stock size (Jónsdóttir, Skúli Bragason, H. Brynjólfsson, Guðlaugsdóttir, & Skúladóttir, 2017). (The Directorate of Fisheries, 2017b). Other crustacean species are harvested as well, but in such low volumes that they are almost negligible. The value of the crustacean products is the highest per tonnage caught, but the catch is so small that they are not considered as important as a whole as the pelagic or demersal sectors.

The roots of fisheries management in Iceland system date back to the early 1960s with growing concerns of overfishing of shrimp (Matthíasson, 2003). To address the issue, a TAC was set to limit shrimping efforts. The TAC was divided up among fishermen as individual quotas based on their previous fishing history. TACs were set for herring in 1975 and in 1980 for capelin (Saevaldsson & Gunnlaugsson, 2015). The demersal fisheries followed a different path. The first attempts to limit efforts came in the form of effort restrictions. At certain times, ships were only allowed to have cod as 15% of the catch (Runólfsson, 1999). The industry responded by investing in more and better ships.

This did not suffice. The catch kept increasing, which led to further restrictions of fishing days. Finally, in 1984, the effort restriction system was put aside and a quota management system was introduced for the main species. This action had the effect of reducing catches, but not the overall capacity of the industry: (Runolfsson & Arnason, 2001). An explanation for this can partially be found in the fact that the small scale fishing fleet was excluded from quota management in the initial years of the system. Many fishermen saw an opportunity to escape the restrictions of the new management regime by entering into the small scale fisheries. Eventually the system was redesigned in its entirety to address the overinvestment and inefficiencies in its 1991. This resulted in the small scale fisheries being incorporated into quota management and the quotas made transferable, securing in place an ITQ system for all harvested species in Iceland. To try to address the issue of overcapacity and economic

inefficiency, fishing quotas were made transferable between vessels in 1991 (Arnason, 2005; Eythórsson, 1996; Karlsdóttir, 2008).

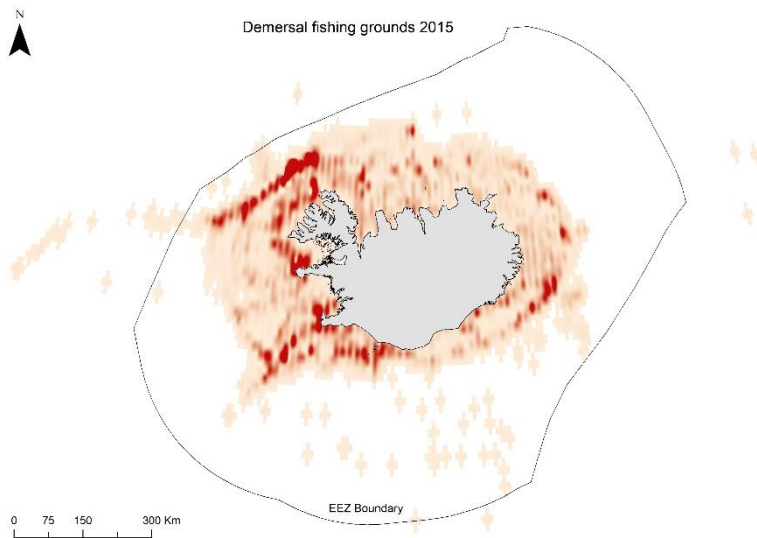


Fig. 1. Main demersal fishing grounds for Icelandic vessels in 2015 (Marine and Freshwater Research Institute, 2015)

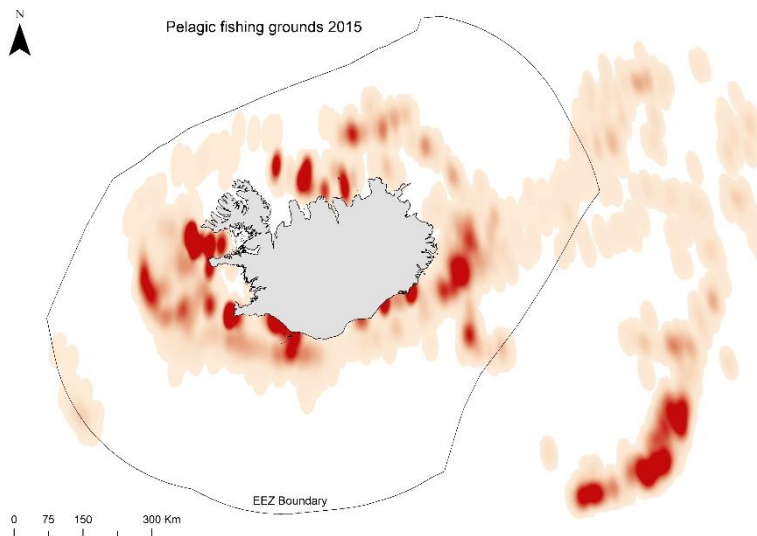


Fig. 2. Main pelagic fishing grounds for Icelandic vessels in 2015 (Marine and Freshwater Research Institute, 2015).

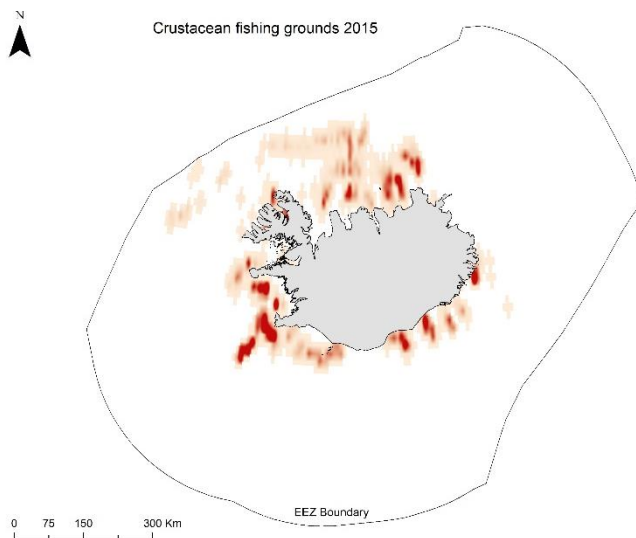


Fig. 3. Main crustacean fishing grounds for Icelandic vessels in 2015 (Marine and Freshwater Research Institute, 2015)

Today, fewer fishing companies are operating. After the implementation of ITQs a reduction of 900 fishing vessels or 35% over a 10 year period was observed, while the gross tonnage remained relatively stable (Runolfsson & Arnason, 2001). Today there are many small operators but a handful of very large ones. The larger companies have taken full use of technological advances, allowing them to be less dependent on proximity to fishing grounds with large highly technologically advanced fishing vessels. This allows large quantities of fish to be landed by a single vessel in one location. Such operations require good infrastructure at harbours to process the fish at once and service the vessels. Smaller communities are at a disadvantage in this development, as they get bypassed by larger fishing companies when they decide where to set up operations (Eythórsson, 2000). Another factor that has impacted harbours in Iceland is the threat of the loss of fishing quotas as fishermen are free to sell their holdings on an open market (The Directorate of Fisheries, 2017c). Some single harbours have lost the bulk of their fishing quotas as it has been sold to another community with devastating consequences (Eythórsson, 1996; Skaptadóttir, 2000). The question has arisen whether all existing coastal towns and villages in Iceland can be sustained as strictly fishing communities in this new economic reality of limited access to fishing.

In general, consolidation is on the increase in the Icelandic fisheries economy (Agnarsson et al., 2016; Eythórsson, 2000; Saevaldsson & Gunnlaugsson, 2015) and the distribution of stakeholder power also seems to be moving away from local communities and the actual workers in the industry (Kokorsch, Karlsdóttir, & Benediktsson, 2015). (Barnett & Eakin, 2015; Pinkerton & Edwards, 2009).

4. Methods

4.1. Datasets and spatial units

The datasets used in the study are obtained from the Icelandic Directorate of Fisheries: Fish landings as point data in tonnes per registered harbour, and the value of the catch landed at each harbour, corrected for inflation. The data covers a period of 32 years, from 1982 to 2014. The two datasets are subdivided further into the three main fisheries categories: demersal, pelagic and crustacean. The same dataset is then aggregated for the Icelandic statistical areas for a lower resolution overview.

A harbour is considered an active fishing harbour if some landing of fish was registered there during at least one year in the dataset. This broad definition yielded some 83 locations (Fig. 4). It should be noted that a 'fishing harbour' is not always associated with a 'coastal community'. There are some harbours in rural areas where few or no people live. Conversely, there are some larger and/or compound communities with more than one fishing harbour. The country is divided into eight statistical areas (Fig. 4), each with their own characteristics. The *Capital region*, with over 200.000 inhabitants out of Iceland's roughly 330.000, has the highest level of infrastructure and almost every type of industry. The *West* has a mixture of farming and fishing activities, as well as some heavy industry plants. Roughly 15.000 people live in the West mostly in small villages along the coastline, but farms are found scattered around the countryside. The *Westfjords*, with a population of around 7000, mostly depend on fisheries. Towns in the region are small. The *Northwest*, with a population of around 8000, is dominated by agriculture, while fishing has been a minor industry. The *Northeast* is strong in both fishing and agriculture, but industry and high-tech firms are also located there along with higher educational institutions, notably in the town of Akureyri, the second largest in Iceland with around 18.000 residents out of the roughly 26.000 in the region. The *East* is an area highly dependent on fishing and has a history of specialising in the pelagic fisheries whilst also strong in demersal sector. The *South*, with its 24.000 inhabitants, has very few fishing harbours due to unfavourable conditions. Finally, the *Southwest*, an area historically almost exclusively devoted to fishing, is now an urbanised region with just over 20.000 inhabitants.

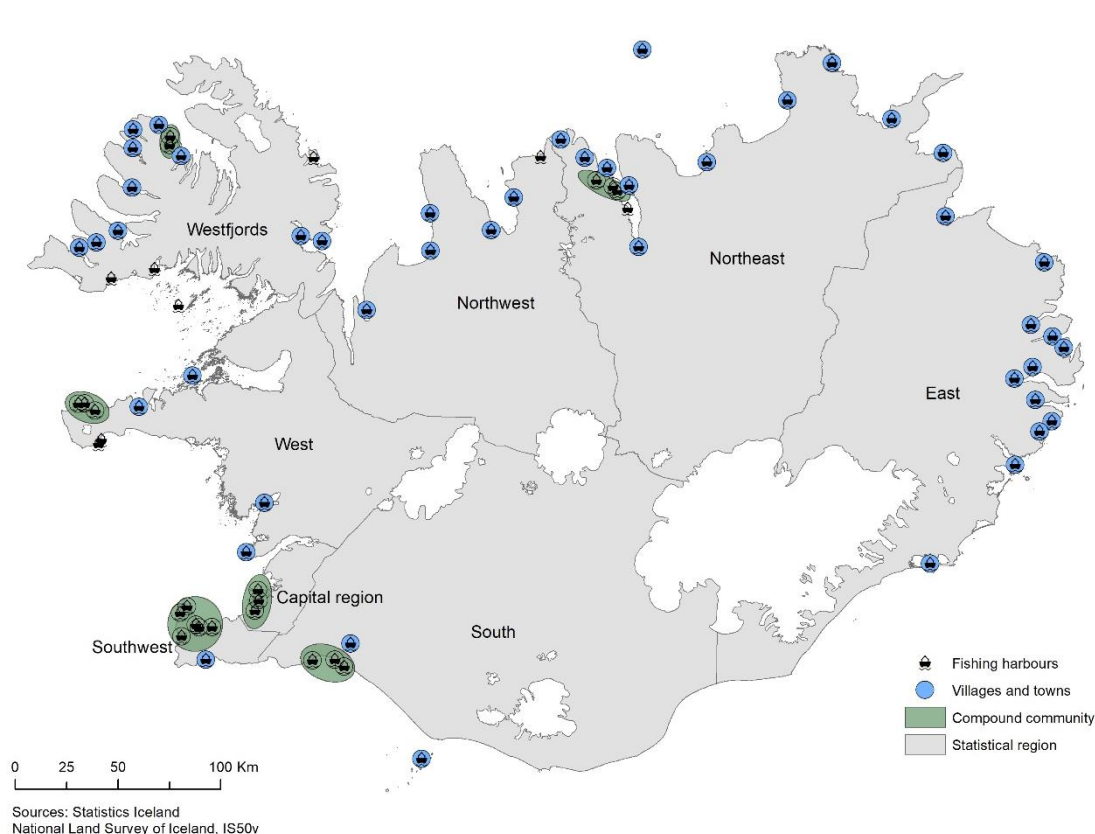


Fig. 4 Icelandic fishing communities and harbours

4.2 Measuring geographical concentration

Economic geographers have used various methods to measure geographic concentrations to search for agglomeration of firms both spatially and non-spatially (Holmes & Steven, 2004). The three main tools used are the Hirschman-Herfindahl index (Kwoka Jr., 1985), the Ellison and Glaeser index (Ellison & Glaeser, 1997) and the Gini index (Fornahl & Brenner, 2009; Guillain & Gallo, 2010). The Gini index is a calculated scale from 0 to 1, where 0 represents perfect equality and 1 is perfect inequality (Gini, 1921). Traditionally used by economists to measure wealth and income distribution, it has been used to address various other issues of equality. Thomas, Wang, & Fab (2001) used the Gini coefficient to measure education attainment among a number of countries over a specific time period. Weymark (2003) proposed to use the Gini coefficient as a way to measure the equality of opportunities. The method has also been used for geographical data in a study conducted by Druckman & Jackson (2008) where the AR-Gini (area-based Gini) was proposed as a method to measure resource inequality. In fisheries research, the Gini coefficient has been used to measure the concentration of quota ownership in New Zealand (Abayomi & Yandle, 2012) and Iceland (Agnarsson et al., 2016). Krugman (1991) proposed the “Locational Gini” coefficient where he gave space and distances different weight dependent upon their spatial characteristics in his calculations (Fujita, Krugman, & Venables, 1999). The Gini version used in this paper focuses on Iceland as a whole and calculates consolidation in the 83 fishing harbours active during the period in question. Every harbour in the dataset has the same weight and distance is ignored since the research question revolves around changes in time.

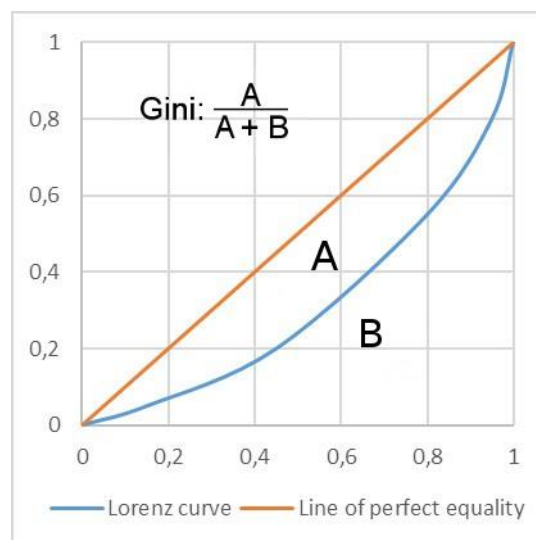


Fig. 5 The Lorenz curve

The Gini coefficient is built on top of the Lorenz curve which measures concentration on a graph, where the cumulative percentage of total national income (or some other variable) is plotted on the y-axis against the cumulative percentage of the corresponding population on the x-axis (variables on both axes are ranked in ascending order). This creates a curve known as the Lorenz curve Fig. 5.), and the area between the line of perfect equality and the Lorenz curve is a measure of inequality (Morgan, 1962). The Gini coefficient then calculates the area between the line of perfect equality and the Lorenz curve, which gives a number between 0 and 1 as an indication of inequality. The Gini coefficient can be calculated using the equation:

$$Gini = 1/n \left(n + 1 - 2 \sum_{i=1}^n (n + 1 - i) y_i / \sum_{i=1}^n y_i \right)$$

where n = total number of data points (harbours), i = summation index of harbours in ascending order and y = quantity (tonnes landed or catch value).

5. Results

This section focuses on the results of the Lorenz/ Gini analysis and is divided into five sections. The first part gives an overview of the trends observed on a countrywide basis for the three main fisheries in terms of both landed catch and value over the time period. The second part introduces the Gini calculations on a countrywide basis for the same variables. The last three parts introduce a series of maps which are intended to visualise the concentration of fishing activities on a geographical level. The maps are constructed of two layers, a regional layer and a harbour layer which calculate. Both layers show the number of landings in tonnes as a percentage of total. The regional layer is an aggregate of the harbour layer based on traditional statistical divisions which divides the country into 8 sections.

5.1. Overall trends

The demersal catch has declined from 650.936 tonnes in 1982 to 438.873 in 2014. The trend has been towards a relatively stable decline over the period although it fluctuates somewhat. The pelagic sector has been much more volatile, with landed catches ranging from only 69.785 tonnes in 1982 to 620.514 in 2014 peaking in 1997 when 1.611.352 tonnes were landed. The crustacean fisheries paints a much bleaker picture than the two main ones (Fig. 6). A decrease from 23.850 tonnes in 1982 to 11.087 in 2014 is observed, the bulk of it shrimp which is as of today at an all-time low.

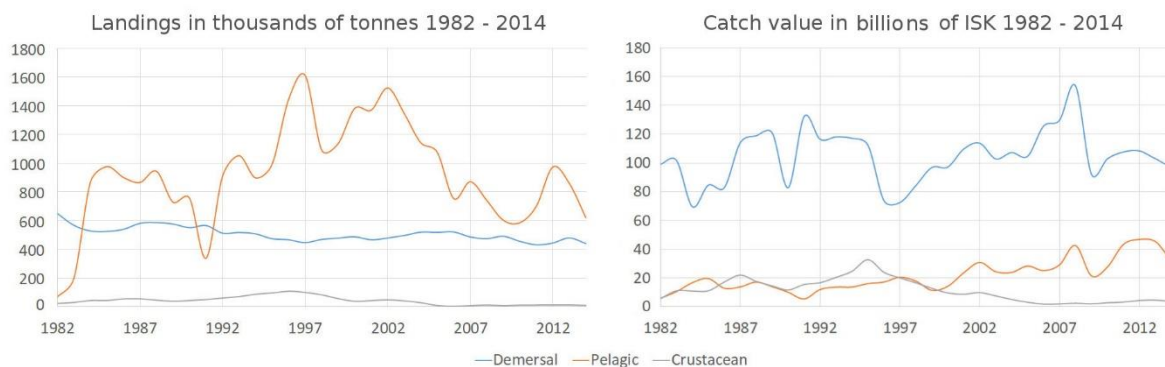


Fig. 5. Total landings and catch value of Icelandic fishing vessels 1982–2014 (data from Statistics Iceland, 2015)

On the value side the data indicates that the fishing industry is sensitive to the whims of the market. Not only does the value depend on supply and demand, but also the exchange rate of the Icelandic currency (króna) against the currency of the buyer nation. A yearly drop and subsequently an increase of 40 billion krónas seems to be a common fluctuation in the demersal fisheries on average. The fluctuation of the pelagic sector is more dramatic but the amounts at play are generally smaller than in the demersal sector. It is also worth noting that the demersal fisheries which are more stable than the pelagic in terms of tonnage are much more volatile in terms of value. When the crustacean fisheries are observed trends in tonnage landed are followed by the trends in value, indicating that the market for the crustacean fisheries is the most stable one.

The total value of landed demersal catch has increased despite diminishing catches, indicating better utilisation of the catch. The value of the demersal catch has been increasing at a similar rate overall as the increasing catch numbers indicating similar utilisation of the catch. The value of the landed crustacean catch has followed the same pattern as the tonnage numbers and goes almost hand in hand with the shrimp fisheries.

5.2. Geographical Gini

A geographical Gini coefficient was calculated for the three fisheries categories, both for tonnes landed and value, at each harbour. This was done to see whether the increase in the value of demersal fisheries would affect the Gini for value differently than raw landings. Comparison of the two Gini coefficients indicates that the two variables follow a similar trend over the period, so it is enough to focus on one of them to get an idea of how both landings and value have consolidated geographically over the period (Fig. 7.).

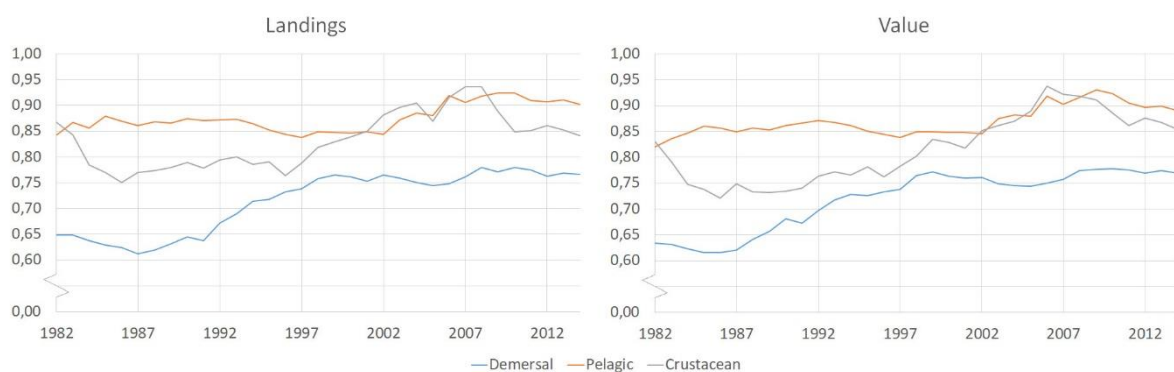


Fig. 6. Development of the Gini coefficient for landings and value 1982–2014.

In 1982, when some 650.936 tonnes of demersal catch were landed in Icelandic harbours, the strongest fishing regions were the Southwest, Capital region, Westfjords, Northeast and the South. That same year 69.785 tonnes of pelagic catch was landed in the Icelandic harbours, the strongest region being the East with almost twice as much as the second strongest in the South. The Southwest registers a large share of the catch while the other five reporting very low landings.

The crustacean fisheries presents a different picture, since it is a much smaller operation than the two other main classes. Generally, the shrimp fisheries are found in the north and to the west of the country while langoustine and various bivalvia species are found in the south and south-western areas. The main changes during the period have been in areas of shrimping as the shrimp stock has been in a serious decline in recent years.

5.3. The demersal fisheries

The demersal fisheries have traditionally been the backbone of the Icelandic fisheries with the cod fishery dominant in terms of prices and they are easier to catch. The cod fisheries accounts for 70% of the overall demersal value. In 1982 the demersal fisheries in Iceland were rather evenly spread around the country, with the Northwest region being the exception. The Northwest has never had a history of fishing that compares to the rest of the country and can be considered more of a farming region (Fig. 8.). The Southwest, Capital region and the South, all have large fishing harbours while tendency is towards fewer harbours than other areas. Fig. 9. shows the Lorenz curve and Gini coefficient for 1982 and how it has changed in 2014.

In 2014 (Fig. 10) the Gini index stands at 0,76 indicating that the concentration of demersal fishing activity has increased. The two strongest regions are the Northeast and the Capital Region with over 70.000 tonnes of demersal landings. The other six regions hover around 50.000 again with the exception of the Northwest with catches just over 30.000 tonnes.

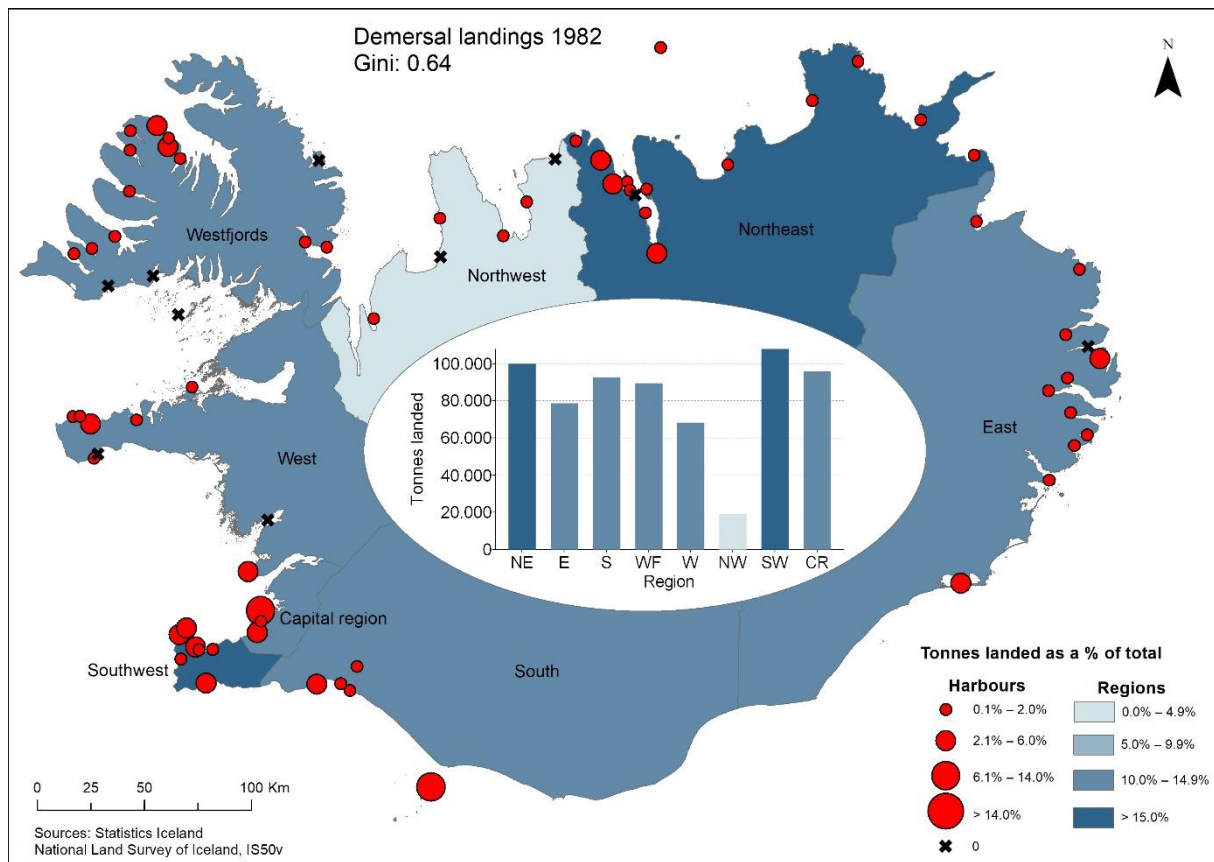


Fig. 7. Geographical concentration of demersal fishing activities in 1982

Looking at individual harbours an interesting pattern has emerged: now there are a few strong fishing harbours and many small ones. Only three harbours in the Southwest register any landings now as opposed to seven in 1982, the largest one being Grindavík with 41.686 tonnes. The second largest one, Sandgerði, has 12.668 while Keflavík, the largest harbour in 1982, now has only 4.815 tonnes landed.

Moving to the Capital region there is evidence of a marked change. The only two major fishing harbours in the region are Hafnarfjörður and Reykjavík, Reykjavík having been marginally stronger in 1982. In 2014, Reykjavík has the most landings of all harbours in the country or 76.947 while Hafnarfjörður has only 9.077 tonnes landed.

The West is, like it was in 1982, still a vibrant fishing region. The numbers are similar since 1982 with the main change in the 3 towns that lie close to each other on the norther tip of the Snæfellsnes peninsula Hellissandur, Rif and Ólafsvík. In 1982 all of them were active harbours with Ólafsvík being the strongest one. In 2014 the strongest one is Rif, and neighbouring Hellissandur is no longer registering any landings. Grundarfjörður has also increased its total share and now boasts landings of 11.981 tonnes which is a large change since 1982. Other harbours in the region are still in operation but register low numbers of catches.

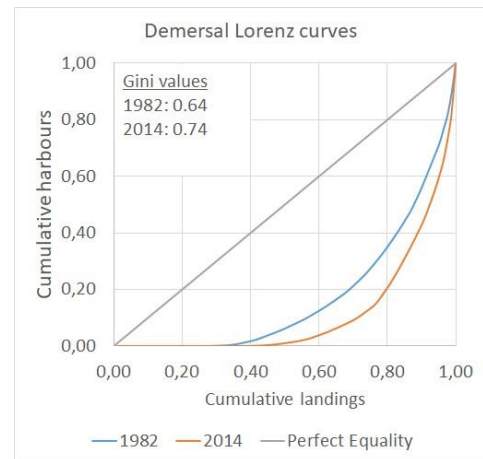


Fig. 8. Lorenz curves 1982 and 2014 for the demersal fisheries.

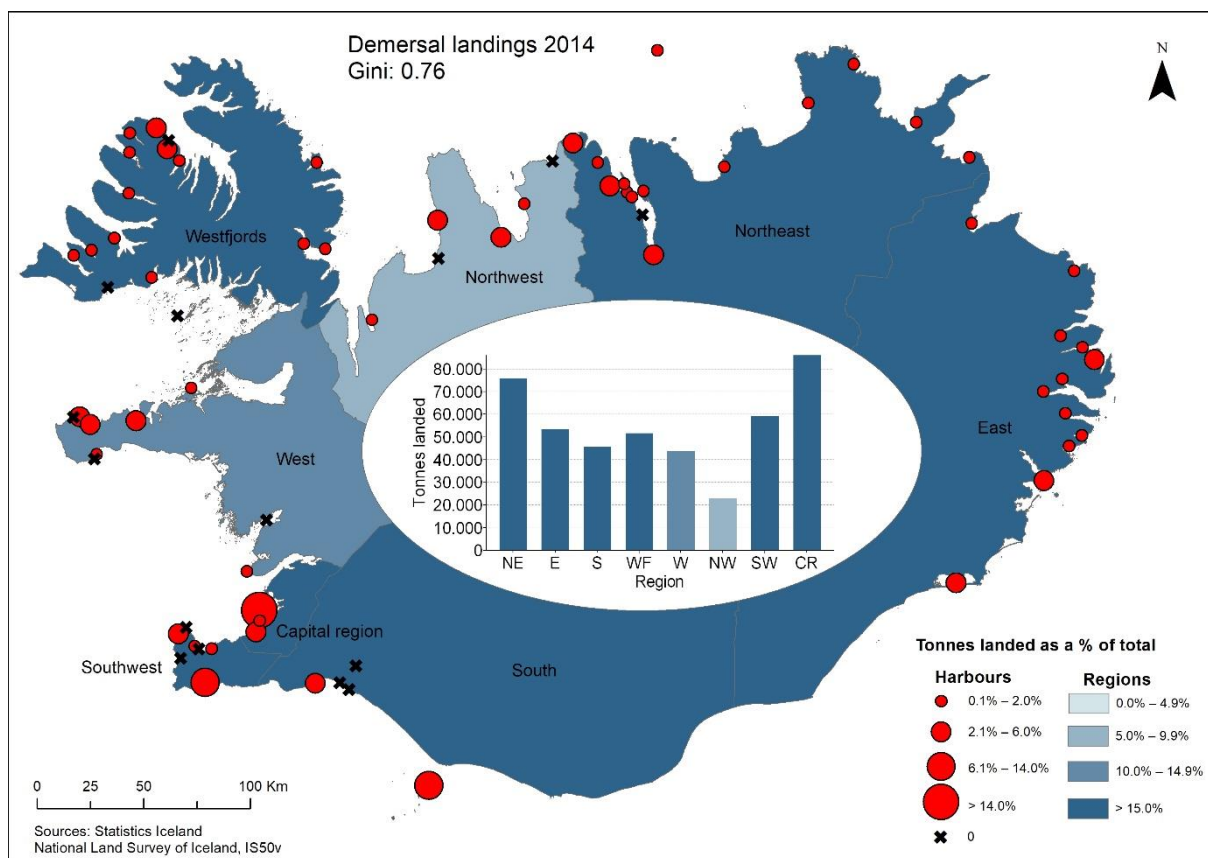


Fig. 9. Geographical concentration of demersal fishing activities in 2014.

The Westfjords have gone through a rough time during those 32 years, having lost a lot of quota and many harbours have been severely threatened. Now surprisingly in 2014 they all seem to be registering landings, most of them low or under 3.000 tonnes indicating that they are coming back as active harbours. However, two harbours, geographically close to each other, are the main hubs of fishing activities: Bolungarvík with 13.524 tonnes and Ísafjörður with 18.115 tonnes landed.

The Northwest is still the weakest fishing region, with two harbours registering catches over 500 tonnes. Sauðárkrúkur and Skagaströnd both register catches over 10.000 tonnes and account for almost all fishing activities in the region.

The Northeast is a vibrant fishing region and almost all the harbours close to the Eyjafjörður area have now increased their total share of fishing and a cluster of fishing activity is strengthening in the area. Moving further away from that region to the east there are still historically strong fishing communities to be found there but they all seem to be registering low catch numbers of under 3.000 tonnes landed.

In the East there are many fishing communities, most of them have low to medium catch shares with the three largest registering around 10.000 tonnes, Hornafjörður, Djúpvogur and Neskaupstaður.

With few harbours on the long coast, the South has most of its demersal fisheries occurring in two places, Vestmannaeyjar and Þorlákshöfn. Vestmannaeyjar is by far more important with 32.875 tonnes landed, while Þorlákshöfn is about three times smaller with landings of 12.774 tonnes. The two other harbours in the area Eyrarbakki and Stokkseyri have lost all their demersal catch shares.

5.4. The pelagic fisheries

The pelagic fisheries are substantially more concentrated than the demersal fisheries. The Eastern region has historically been the main region for the pelagic sector. Other regions, except the Northwest, do engage in some pelagic fishing and at times a real pelagic explosion occurs for example in the Northeast region. In the starting year of 1982 there is a considerable low in the industry with only 69.785 tonnes landed and about half of it in the East. The second largest landings number are reported in the South followed by the Southwest (Fig 11.).

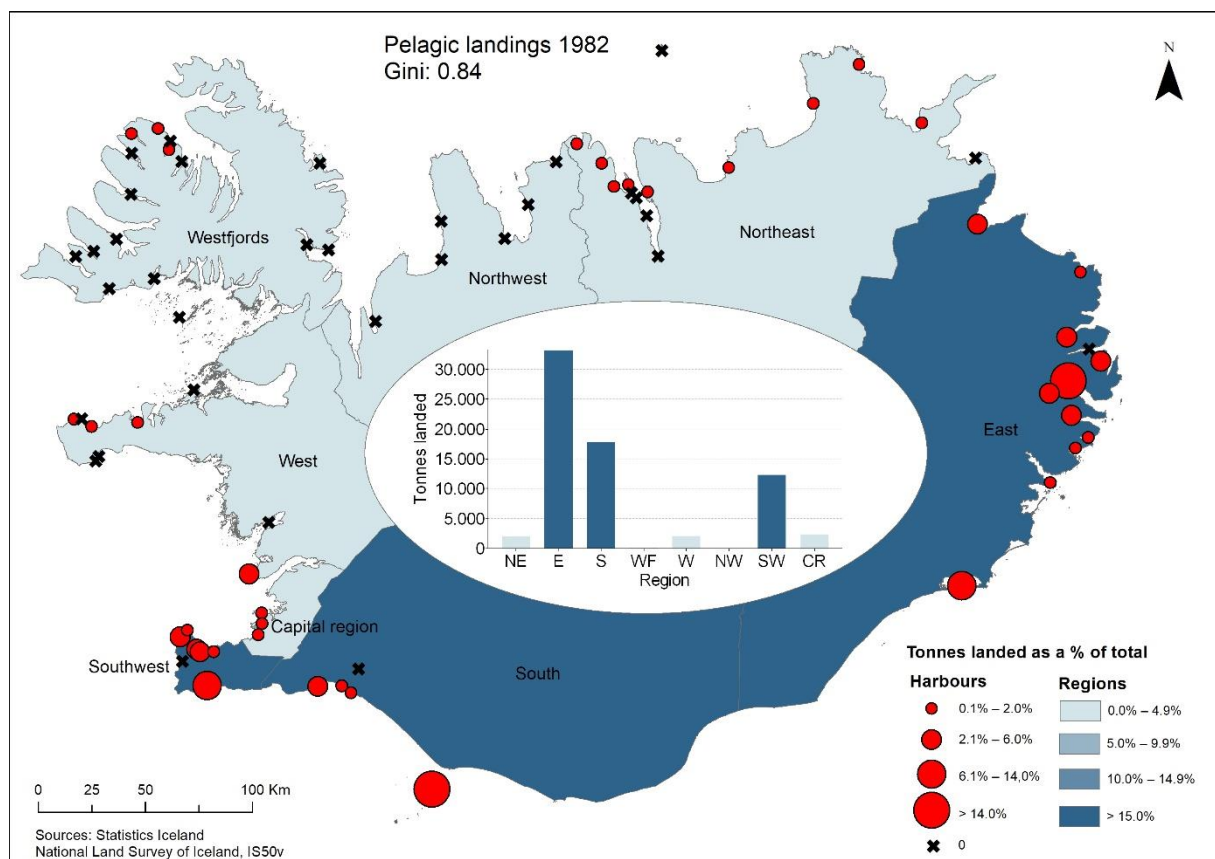


Fig. 10. Geographical concentration of pelagic fishing activities in 1982.

The geographical Gini coefficient for this years was calculated to be 0.84 indicating a highly concentrated industry right from the start (Fig. 12.). In 1982 the strongest pelagic harbours can be found in the east, with all harbours registering catches with the exception of Mjóifjörður. The strongest is Eskifjörður followed by Hornafjörður. Second strongest region is the South region with a majority of landings registered in Vestmannaeyjar. The Southwest is the third strongest region where all harbors register landings with the exception of Hafnir and Grindavík. The five remaining regions The Capital Region, West, Westfjords, Northwest, and Northeast all register landings of under 2384 tonnes, the strongest being the Capital Region.

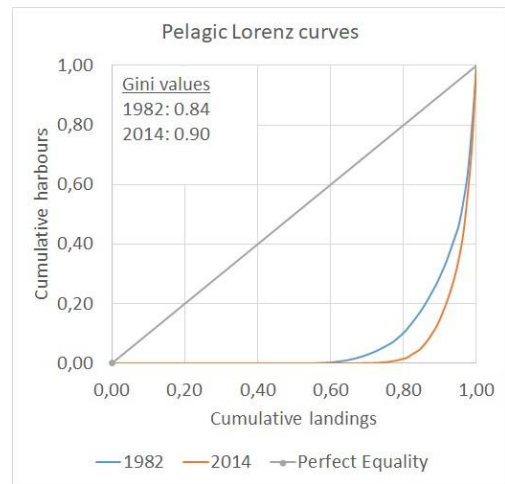


Fig. 11. Lorenz curves 1982 and 2014 for the pelagic fisheries.

In the year 2014 (Fig. 13), an increase in the pelagic landings is observed on a countrywide basis. In the Southwest a 50% increase in the pelagic landings is observed but the number of active harbours is down to three from a previous six.

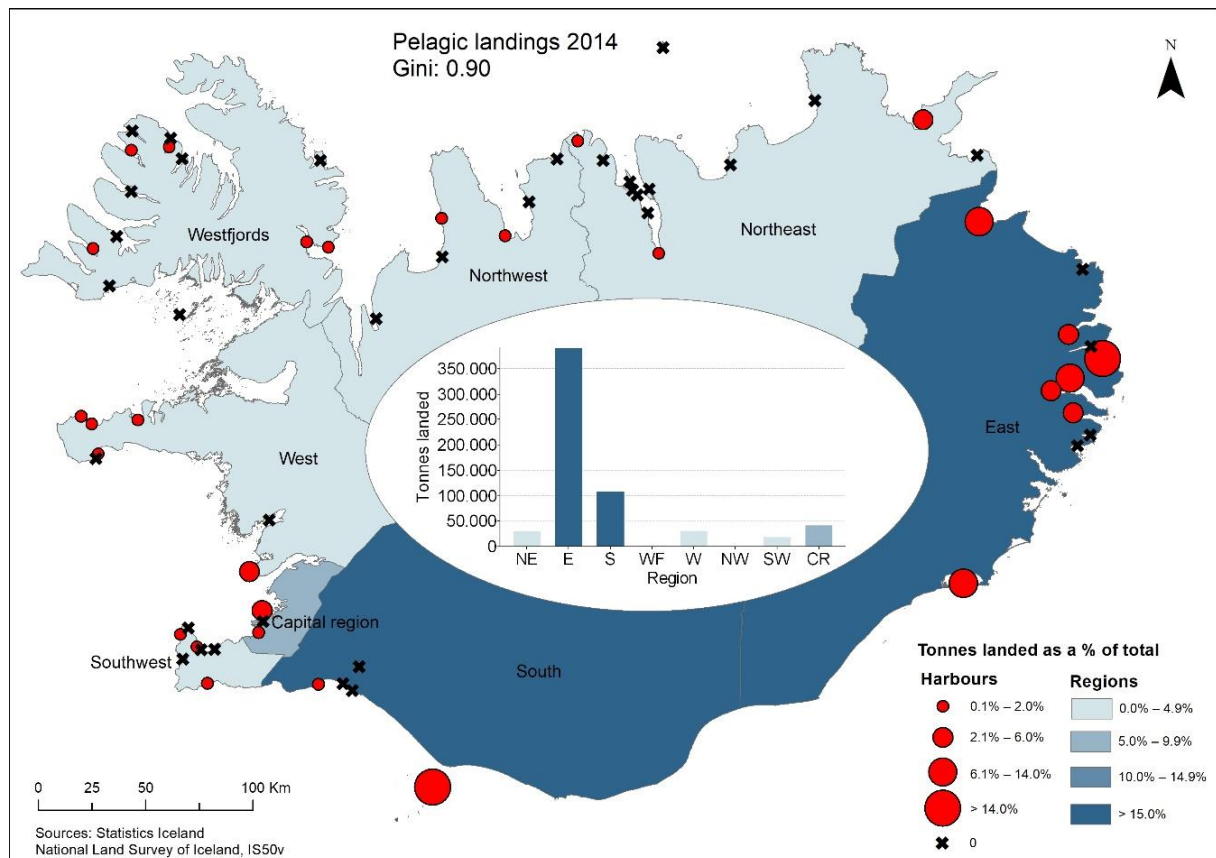


Fig. 13. Geographical concentration of pelagic fishing activities in 2014.

The Capital region has increased its landing numbers 17-fold with Reykjavík registering the strongest and Hafnarfjörður trailing. All harbours in the West with exception of tiny Hellnar register pelagic landings with a similar amount in each place; the region has increased its landings 14-fold from the starting year. The Westfjords have increased their catch from 76 tonnes to 1.467 in 1982 when 3 harbours were engaged in the pelagic fisheries. In 2014, 6 harbours are registering landings all with

low landing numbers. The Northwest is the weakest region in the pelagic fisheries with only 281 tonnes landed in Sauðárkrókur and Skagaströnd. The Northeast in 1982 registered a low number of pelagic landings in 9 of its 14 harbours. In 2014 increased consolidation is clearly observed as catches now only registered in 5 harbours. In the big picture they are low for 2014 but have substantially increased since the base year, the region has increased its catch from 1.968 tonnes to 29.823 or 15-fold. Most of this catch lands in a single harbour in the easternmost part Þórshöfn or 23.141 tonnes that does not have to come as a big surprise since the east has always been the centre for the pelagic industry.

The East Region is in a class of its own with the major part of all pelagic fish landed in 2014 or 390.989 tonnes landed. The majority of landings happen in the harbour of Neskaupstaður or 161.603 tonnes, the second largest has about half of that number or 82.221 tonnes. The rest of the active pelagic harbours in the area all register landings under 52.000, while the number of active harbours has gone down from 11 to 8. The South has had sixfold increase in landings and the majority of them occurring in Vestmannaeyjar or 105.077 tonnes. A tiny amount, or 2.271, tonnes is landed in Þorlákshöfn and Eyrarbakki and Stokkseyri have fallen out of the picture.

5.5. The crustacean fisheries

The crustacean fisheries are the only fishing category that has actually seen a decrease in concentration over the period. At the start of the period, the western areas of Iceland had the lion's share of the crustacean fisheries (Fig. 15). On a countrywide basis there are 23.850 tonnes of crustaceans landed. That number increases to 107.544 tonnes in 1996, and the increase is for the most part increase in shrimping activities. The Gini value falls during this time as more places engage in the shrimp fisheries from 0.87 in 1982 to 0.76 in 1996 (Fig. 7). From that point on the shrimp fisheries start to wind down and in 2014 only 11.087 tonnes of crustaceans are landed or roughly half of what it was in 1982. As landings start to fall after 1997 the Gini value starts increasing again and continues to do until 2008. Then it sharply falls down to 0.85 and remains around that level until the end year in 2014 (Fig. 14).

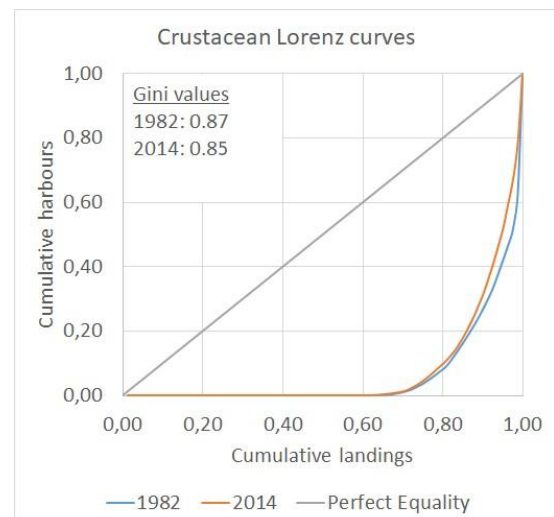


Fig. 14. Lorenz curves 1982 and 2014 for the crustacean fisheries.

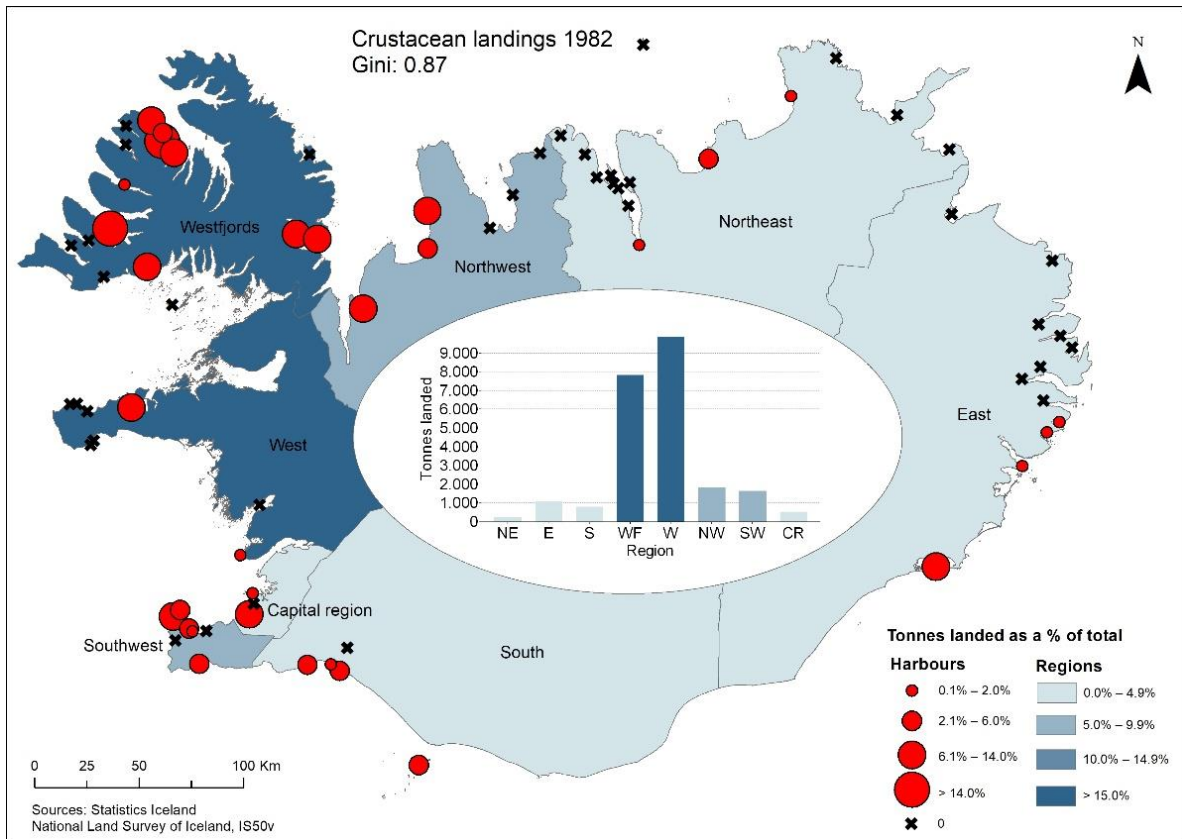


Fig. 15. Geographical concentration of crustacean fishing activities in 1982.

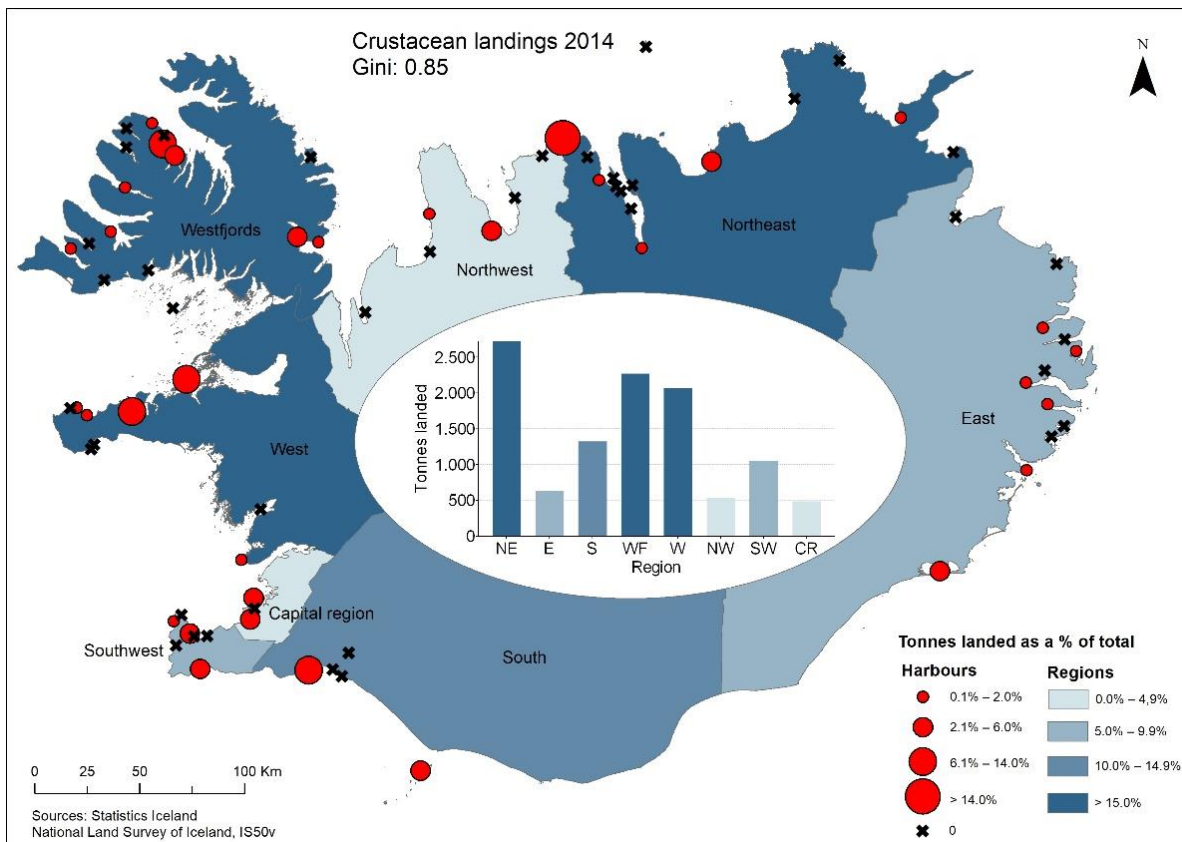


Fig. 16. Geographical concentration of crustacean fishing activities in 2014.

6. Discussion

The Icelandic fisheries have been under comprehensive quota management for over thirty years. Some fundamental changes have taken place. Demersal catches have decreased by a third, the pelagic catches have fluctuated wildly, and the crustacean catch has declined by half. During this period, a marked geographical consolidation of the industry is observed. In the two most important sectors, demersal and pelagic the Gini index grew 12 and 6 percentage points respectively over the period this article covers.

The most valuable fisheries, the demersal sector, responded first to the quota management system. A significant increase in their efficiency is evident: the value of the catch has increased despite reduction in the tonnage landed. A period of geographical consolidation started in the demersal sector in 1986 and in the 1990s and 2000s the rate of geographical consolidation increased (Fig. 7). This was a time of great changes in many communities, leading to a real crisis in some areas such as the Westfjords, which lost a considerable amount of their original quotas (Mariat-Roy, 2014). The harbours in the regions which suffered the most relied historically on the demersal fisheries as their main economic driver. Losses of quota shares in the demersal sector meant job losses and exacerbated the outmigration of people, that had been an ongoing concern in many communities. Villages such as Bíldudalur in the Westfjords, and Raufarhöfn and Grímsey in the Northeast are examples of struggling communities. The government has recognised these areas as 'vulnerable communities' in need of special attention. Bíldudalur has managed to partially reinvent itself through fish farming and other new activities. Raufarhöfn and Grímsey on the other hand do not have the same conditions and their options seem to be more limited.

As the struggle with this new economic reality continues in many communities in Iceland, there are others that flourish. Akureyri in the Northeast, and above all the Capital region, have raced ahead of all other regions. These two urban centres are the largest in terms of population. The largest share of quota ownership and fishing in the demersal sector is also found there. It is thus safe to assume that in this new economic reality the efficiency is gained by concentrating fishing activities close to where the high-tech service and financial industry are the strongest.

The pelagic industry has continued to be extremely volatile, with large fluctuations in landings from year to year. The industry has managed to increase its value per landed tonnage during the period, with the proportion of the catch that is processed for human consumption growing considerably. The East, a region with a strong pelagic industry historically, has seen most of the growth. The region still has a locational advantage, as it is closest to where the pelagic species enter the EEZ. Infrastructural investments in pelagic processing have cemented this advantage.

Most fishing communities of Iceland owe their origin and 20th-century growth largely to their location and proximity to the resource. The growth in the fisheries – and the fishing communities – in the 20th century was not sustainable, however. This led to the introduction of the ITQ system. Capping the fisheries in with such a system, that favours economics of scale, not only limits further growth but also provides a strong incentive for consolidation. Proximity to fishing grounds is no longer enough to guarantee the existence of coastal communities.

We have shown that considerable geographical concentration has occurred since the ITQs were introduced. This has threatened the livelihood of numerous small fishing villages. Some partial solutions have been tried, such as small-scale coastal fishing outside of the ITQ system, and 'community quotas' allocated to communities that have seen their fishing rights traded away. However, these measurements do not seem to be particularly effective. Certain communities still

struggle, often the more isolated and smaller communities. Communities that have reoriented their economies have done so by switching the economic focus to other sectors, such as fish farming and tourism.

Fisheries management is a constant work-in-progress, and many countries are now redesigning their management regimes. In this regard, ITQs have been heavily promoted. They prioritise economic concerns and represent the neoliberal 'financialisation' of natural resources. Apart from this contestable ideological baggage of ITQs, a number of dimensions other than the economic need to be addressed when designing fisheries policy for the 21st century. Social and geographical impacts of a chosen management regime cannot be overlooked. Geographical concentration is a logical outcome of ITQ-based fisheries management. Geographical concentration brings complex ethical and ideological dilemmas that need to be taken seriously by those formulating resource management policies.

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