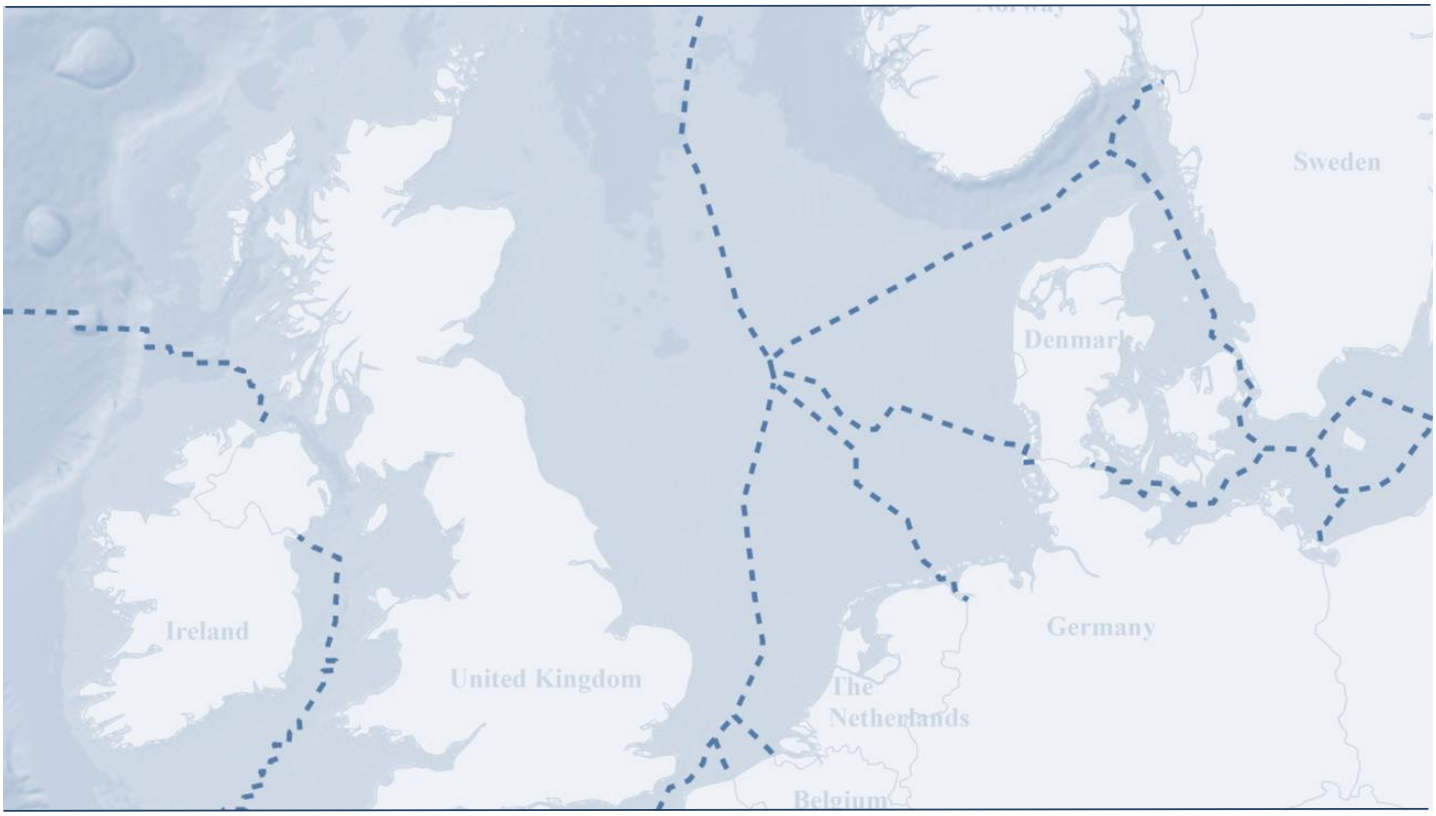
SOCIO-ECONOMIC CONSEQUENCES OF BREXIT FOR FOUR LARGER FISHING PORTS AND THEIR COMMUNITIES

An assessment of potential consequences of Brexit for the ports and communities of Skagen, Hirtshals, Hanstholm and Thyborøn.



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January 2018

AALBORG UNIVERSITY
DENMARK

Eliasen, Søren Qvist; Kirkfeldt, Trine Skovgaard; Aaen, Sara and Jacobsen, Rikke Becker 2017. Socio-economic consequences of Brexit for four larger fishing ports and their communities. An assessment of potential consequences of Brexit for the ports and communities of Skagen, Hirtshals, Hanstholm and Thyborøn. Aalborg University,

ISBN nr. 978-87-91404-98-6, the serie 91404 Teknologi, Miljø og Samfund, Institut for Planlægning.

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FOREWORD

Innovative Fisheries Management (IFM), a research centre at the Department of Planning at Aalborg University (AAU), has undertaken an analysis of economic and employment consequences of the United Kingdom leaving the European Union (Brexit) for four major Danish ports. The work has been conducted based on a contract with The Danish AgriFish agency, later The Fisheries Agency, The Ministry of Foreign Affairs Denmark. The contract entered into force 1 May 2017 and ended 1 December 2017.

The work has been conducted by Associate Professor Søren Qvist Eliasen (team leader), Research Assistant Trine Skovgaard Kirkfeldt, Assistant Professor Sara Aaen and Assistant Professor Rikke Becker Jacobsen. Professor Jesper Raakjær has participated in the process of quality control.

1 SUMMARY

The report focuses on the economic, employment and other socio-economic consequences of the United Kingdom leaving the European Union (hereafter referred to as Brexit) for the four ports and communities of Thyborøn, Hanstholm, Hirtshals and Skagen. In this regard the Brexit consequences are only the effects on the communities from the possible loss of fishing opportunities for Danish vessels within the Exclusive Economic Zone of UK (UK EEZ). The report is made by the research group IFM at Aalborg University through a contract with the Danish Fisheries Agency, the Danish Ministry of Foreign Affairs.

The report outlines brief profiles of the four communities: their history, infrastructure, population, the port activities and other activities related to the fisheries in the communities. Fishing activities in the ports are described in terms of vessels registered to the port and the pattern of landings in volume, value and geographical origin. This also includes a brief analysis of the importance of foreign landings from the UK EEZ.

The descriptions and profiling of the communities and fisheries activities related to the ports are the basis for assessments of potential socio-economic consequences for the four communities of two scenarios of Brexit, both assuming the closure of the UK EEZ for non-UK vessels. For scenario 1, the quotas are retained and fished outside the UK EEZ, whereas scenario 2 assumes that this cannot be fished, leading to a loss of catches currently fished in the UK EEZ.

- **Scenario 1** assumes that Danish fishermen are losing access to the UK EEZ and retain the quota which will be caught elsewhere. This is not likely to happen, as some of the very good fishing grounds are within the UK EEZ. It is therefore assumed that the vessels will lose 50% of the present catch value from the UK EEZ, based on higher cost because of a reduced catch per unit effort (CPUE) and/or decreasing income due to reduced quality of the fish. Although particular fuel costs might increase, as well as the fishing pattern most likely will change, these factors are kept constant due to uncertainty on what impact to expect.

- **Scenario 2** assumes that all fish previously caught in the UK EEZ cannot be fished elsewhere and are lost for the Danish vessels, and thus all current landings from Danish vessels in Danish ports from the area are lost for the Danish processing industry.

The short-term consequences for the communities and the region will be analysed; however, the dynamic effects are outside the scope of this report. The analyses consist of two parts:

1) Calculations of the economic and employment consequences for the two scenarios based on a range of assumptions about how loss in income in the fleet will spread on land. This leads to figures on calculated economic loss and regional job losses under the two scenarios.
2) An assessment of the broader socio-economic consequences for the communities based on a modelled dependency on UK-EEZ landings for the communities and an interview-based assessment of local resilience of the four communities in relation to the potential effects of Brexit. This leads to qualitative discussions of possible effects of Brexit on the four communities.

Assessment of economic and employment consequences

Thirty-five vessels obtain more than 15% of their landing value from catches in the UK EEZ. The UK-EEZ catches, primarily herring, mackerel and species for non-human consumption, represent a landing value of DKK 982 million. In the two scenarios, the UK-EEZ landing value for the vessels is reduced by 50% and 100%, respectively. The calculations are based on the assumption that loss of income in the fleet will lead to the same reduction in the variable costs: wages, fuel, landing activities and maintenance in the home ports. In reality, the vessels operate at a regional level rather than locally. Therefore, the calculated consequences are regional – addressed here as the area surrounding and in-between the four towns – rather than at local level.

The loss of landings from the UK EEZ for Danish vessels in scenario 2 primarily influences five large processors of herring, mackerel and fishmeal, and oil. A loss of jobs is seen as directly proportional to the loss of fish resources for processing. The real consequences may be larger if the loss of raw material influences the overall profitability of the firms or causes an economic tipping point to be crossed.

For the two scenarios, the calculated loss of income (turnover) for the vessels, which leads to a loss of turnover for service providers (including fishermen in the communities) is at the level of DKK 491 million and DKK 982 million, respectively.

Table 1.1: The calculated direct loss of income (turnover) for vessels and induced loss of turnover for service providers, regional level.

	Total loss of income (turnover) in the fishing industry and for service providers (million DKK)
Scenario 1	491.0
Scenario 2	982.0

The loss of turnover for the land-based industries is assessed to lead to a direct loss of jobs of 272 jobs under scenario 1 and 844 jobs under scenario 2. This is at regional level and distributed to sectors according to the cost pattern of the vessels.

Table 1.2: The calculated direct loss of jobs (full-time equivalents) under scenario 1 and 2 – all at the regional level.

	Fisher-men (no)	**Oil industry** (no)	**Landing, sale, distri-bution** (no)	**Mainte-nance** (no)	**Processing** (no)	**Total loss of jobs** (no)
Scenario 1	183	17	14	58	0	272
Scenario 2	366	33	28	117	300	844

The induced effects of economic and employment losses are not calculated. Using the rule of thumb that 1 job at sea generates 3 on land would lead to a loss of up to 1,500 jobs in scenario 2. Based on the catchment analysis, calculation of direct and indirect job generation of port activities would lead to up to 2,100 jobs lost in scenario 2.

Assessment of socio-economic consequences at the community level

How the four communities might respond to potential changes that could come from Brexit, such as the loss of jobs and income presented above, was assessed through an analysis of how the four communities depend on the landings from the UK EEZ along with an assessment of the overall resilience of the four communities.

The first analysis indicated that the impact on the four communities will be different, as they are dependent on landings from the UK EEZ to varying degrees. Skagen and Thyborøn are highly dependent, and this dependency appears to be more locally anchored than in Hirtshals and Hanstholm, where the dependency is judged to be more regional. The regional extent of the dependency of Hirtshals and Hanstholm is both due to the location of processing facilities, which in the case of Hirtshals is located away from Hirtshals in the municipality of Frederikshavn. Hanstholm and Hirtshals both experience relatively high levels of inbound commuting, which increases the regional spread of the dependency on UK-EEZ landings. While at least three of the communities are significantly dependent on UK-EEZ landings (1), it varies whether this dependency is primarily found within the fishing industry or whether it is due to the influence of the fishing industry relative to the overall port activities (2), or, finally, if the high dependency is due to the significance of the port relative to the size of the community (3).

Table 1.3: Assessment of community dependencies on UK-EEZ landings.

Communities	**(1) Fisheries dependency on UK-EEZ landings**	**(2) Port dependency on fisheries**	**(3) Community dependency on the port**
Skagen	medium	high	medium
Hirtshals	high	low/medium	high
Hanstholm	low	high	high
Thyborøn	medium	medium/high	high

How the impacts of Brexit can affect the four communities also depends on the conditions for resilience. The assessment of community resilience was based on interviews with actors in the fishery sector (ports, fishermen organisations, service providers, processors) as well as inhabitants and local historians. This assessment showed a more similar picture for the four communities. For all four communities, it was found that certain factors increase the communities' resilience. These include the fact that actors within the fishing industry are used to facing large structural changes, while their source of income sometimes

fluctuates highly both because of the mobile and changeable nature of fish stocks but also because of institutional changes such as the annual changes in quotas and introduction of new quota systems and regulations. In addition, the industry on land has in many cases built a diversified catalogue of customers and services/products. This makes them less dependent on the Danish landings from the UK EEZ and increases the resilience.

These positive resilience factors are connected to the fishing industry, but when shifting the focus to the rest of the communities, other factors decrease the overall resilience. The most significant of such factors is the decreasing numbers of inhabitants, which is noteworthy for all four communities and especially in Skagen. Also, the resilience was assessed based on the level of potential alternative employment opportunities for inhabitants who may become unemployed because of Brexit. While all four communities have relatively small populations, the extent of alternative employment opportunities is limited. To some extent, tourism activities could offer alternative jobs in Skagen, where the tourism industry is growing; however, these jobs would be far from sufficient.

The two assessments indicate that a possible recession for the fishing industry following Brexit will influence the four communities in different ways. Based on the presented assessments, potential effects of Brexit are expected to be locally severe in Skagen and Thyborøn, while the effects connected to the fishing industry in Hirtshals and Hanstholm should be expected to be more geographically dispersed. For all the communities, there are concerns that a recession within the fishing industry could influence the financial state of the four municipalities. Cultural consequences could be expected if the financial support to local festivals from the fishing industry is missing in the future. This could further weaken the connection to the historical background as fishing communities for the four towns.

Trends and future changes

The interviews revealed other elements that could have a significant influence on the overall consequences of Brexit. These include potential trends and effects that are difficult to forecast the outcome of; however, they should be considered in the overall assessment of potential consequences of Brexit. These include:

- **Displacement effect:** Some interviewees predict that Danish vessels excluded from the UK EEZ will move their activities into the Danish EEZ, leading to a displacement of activities. The increased fishing pressure on the non-UK-EEZ fishing grounds could reduce the catch per unit effort (CPUE) for the minor vessels fishing there at present. These would then tend to seek alternative fishing grounds in order to keep their CPUE at a higher level. The effects of scenario 1 could therefore spread to other vessel groups than the vessels currently active within the UK EEZ.
- **Breaking a trend in the demersal fisheries:** Interviews revealed that there is a recent increasing tendency for larger and more modern demersal vessels to fish in the UK EEZ. A closing of the UK EEZ will therefore influence such development and can be seen as a missed opportunity. It is not possible to estimate the value for the Danish fishing industry if Brexit were not to occur, but the likely potentials should not be neglected. However, it can be considered more as a shadow cost.
- **Counteracting capabilities within the Danish processing industry**: Under scenario 2, the processing industry will lose raw material from Danish vessels. The pelagic processing sector is dynamic and has previously proven able to attract landings from vessels from other countries, which would compensate for the losses, and thus the impact on the processing sector may be marginal in the short term.

2 INTRODUCTION

On 29 March 2017, the government of the United Kingdom (UK) officially announced that it would leave the European Union (EU) as a consequence of the referendum vote in June 2016. This process of the UK leaving the EU is referred to as "Brexit". According to the Article 50 of the Treaty on European Union, the process has to be concluded within two years, i.e. by 29 March 2019.

Fishery is expected to be an important part of the negotiations between the UK and the EU, where in addition to the general economic importance it is of importance at the local and regional level for livelihoods and jobs in coastal regions, which often have limited alternative employment opportunities.

As an input for negotiations, the Danish ministry wanted to shed light on possible consequences for ports, local communities and processing industries influenced by Brexit due to changed fishing opportunities for Danish vessels. The report therefore presents an assessment of economic and employment consequences of two scenarios for the outcome of Brexit negotiations on the fisheries at the local level (Thyborøn, Hanstholm, Hirtshals and Skagen communities) and at the regional level.

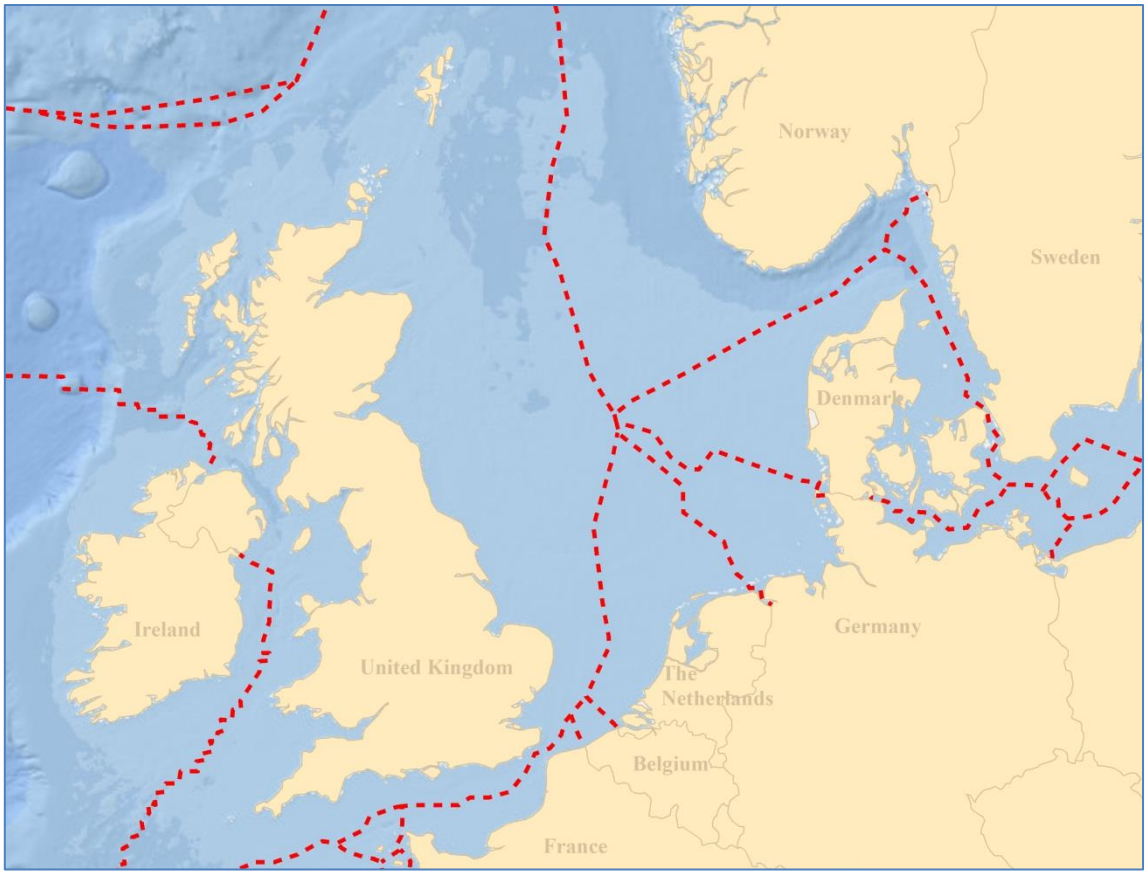

Figure 2.1: Map of the North Sea countries and UNCLOS EEZ lines. Source: Own figure. Data from: Esri, DeLorme, GEBCO, NOAA NGDC.

Fishery is an important industry for the Danish economy, with total annual direct landings of 900,000 tonnes with a first-hand value of more than EUR 550 million (2016). More than half of the landings come from the North Sea alone. The four ports are not only of importance in the national economy but are also significant in the European fishing industry. The port of Skagen is among the largest ports in Northern

Europe in terms of landings of pelagic fish, and Hanstholm is one of the leading fishing ports in Northern Europe in terms of fish for direct consumption. Together with Thyborøn and Hirtshals, these ports are the largest fishing ports in Denmark.

With an exit from the EU, the UK will also withdraw from the EU territorial water. Access to UK waters is then regulated by the United Nations Convention on the Law of the Sea (UNCLOS). This leads to an exclusive economic zone (EEZ) of 200 nautical miles from the coast or to the midline between the UK and the EU. The vast areas of sea around the UK will therefore no longer be freely accessible for Danish vessels as EU waters but could only be used for fishing depending on bilateral UK-EU negotiations.

Fishing rights are allocated to member states within the EU according to allocation keys of fixed percentages of the total allowable catches (TAC) for each stock to the member states, the so-called relative stability. The relative stability was established as an agreement between the member states in 1983, and since then it has included new member states. Therefore, there is no default structure for an exit, and a possible new key for allocation between UK and the EU member states is up for negotiation in the Brexit process.

Based on this, in March 2017, the Danish ministry formulated two scenarios for an outcome of the negotiations. Both scenarios are based on the assumption that the UK EEZ is closed for Danish vessels.

> **In scenario 1**, the quotas according to the relative stability is maintained for the Danish vessels, but must (and will) be fished outside the UK EEZ. It is assumed that the vessels are able to fish and land the normal volume. The landings and thereby resources for the processing industry are therefore not changed in this scenario.
>
> **In scenario 2,** the catches so far fished in the UK EEZ cannot be fished elsewhere and are lost for the vessels and the landings in Denmark are reduced by 100% of what has so far been caught by Danish vessels in the UK EEZ. This is seen as a loss of raw materials for the processing industry.

Regional consequences

Of the total landings in Denmark in 2016, 90% were landed in the regions of Mid- and North Jutland. The importance of the fisheries is therefore higher in this region than at the national level. At the local level, fishery activities based on direct landings and import generates income and jobs in the fishing ports, in fish processing and all the services around the fisheries.

An analysis of the catches in the UK-EEZ zone and landings from Danish vessels of fish caught in the UK EEZ (presented in section 4) show that the landings from the UK EEZ are primarily species for non-human consumption along with herring and mackerel. These are almost exclusively landed in four large fishing ports on the west coast of Jutland.

The focus in this report is therefore the possible consequences of the two scenarios for the four communities of Thyborøn, Hanstholm, Hirtshals and Skagen.

The consequences are assessed in economic and employment terms based on simple modelling. This is supplemented by an assessment of the dependency of the four communities on Danish landings from the UK EEZ and the resilience of the four communities.

Data, information and definitions

The analysis is based on different types of data sources.

For the assessment of the landings from the UK EEZ, second-hand data from IFRO (in relation to calculations for the report by Andersen et al. (2017)) and the ministry was used, as IFM/AAU does not have access to the databases of the Danish AgriFish Agency at this level of detail.

Supplementing data on landings in ports, composition of vessel sizes etc. are public available data extracted from the Dynamic landing statistics at the homepage of The Danish AgriFish Agency is used. Statistics of employment, salaries, etc. are based on data from Statistics Denmark (see Appendix 8.2).

Finally, the qualitative assessment is based on a range of interviews with representatives from national and regional organisations in the fishing industry, local companies and central observers in the local communities (see Appendix 2). The interviews were conducted in August–October 2017, the majority being face-to-face meetings supplemented with telephone interviews.

3 PRESENTATIONS OF THE FOUR COMMUNITIES

The origin and initial development of the four communities have been somewhat similar, but the development they have taken during the last century has varied and has emphasised their unique identities. The four communities all have similar historical backgrounds, having originated on the basis of fishing activities and having undergone significant growth when harbours were constructed. Since then, the four communities have created unique profiles that set them apart from the other fishing communities. These developments were based on different strategies of the communities and the ports.

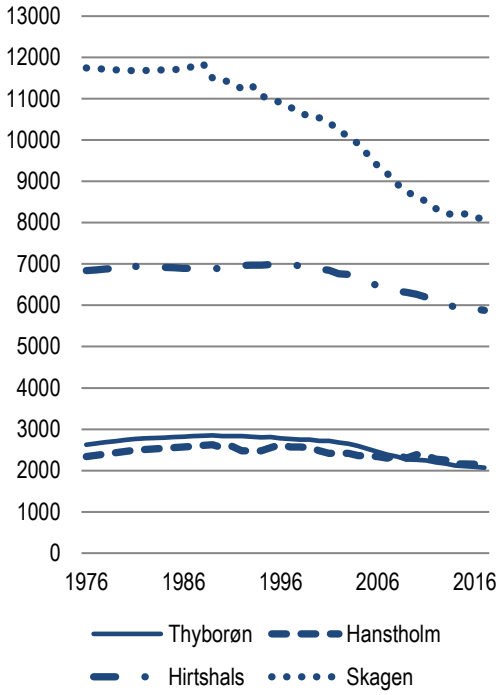

Figure 3.1: Development in number of inhabitants in the four communities, 1976-2016. Source: Statistics Denmark

One challenge that the four communities have in common is declining populations (see Figure 3.1). While Thyborøn and Hanstholm, with the smallest numbers of inhabitants, only experienced slight decreases during the last decades, Skagen has seen a more serious decline. Although the rate of decline is different, they are all experiencing a net loss of inhabitants, especially during the last two decades. The four communities have all been exposed to the industrial and technological development and globalisation, which first reduced the demand on manual labour at processing factories. Manual labour was in many cases moved to other countries with lower minimum wages. This decrease in the need for manual labour resulted in a change where people to an increasing extent sought longer educations and non-manual jobs. Where it was previously natural for children and young adults to find work in the fishing industry or within other port activities, they now move to larger cities when they take their educations, and many never move back.

Although the meteorological conditions of the west coast have repeatedly caused great problems and loss of lives and vessels during the development of the communities, this position at the northwesternmost point of Denmark has proven advantageous in being positioned between the North Sea to the west and Skagerrak, Kattegat and the Baltic sea to the east.

The four communities are situated in the northern part of Jutland, with Thyborøn located south of the Thyborøn channel, Hanstholm located further north, at what is called the “shoulder” of Jutland, followed by Hirtshals further north, and Skagen at the most northern point (see Figure 3.2).

Figure 3.2: The northern region of Jutland showing the locations of the four communities**.** Data from Kort10, the Agency for Data Supply and Efficiency.[1]

In administrative terms, Skagen, Hirtshals and Hanstholm are situated within the North Denmark Region, which is the northern part of Jutland, while Thyborøn is located just south of this, in the northern part of the Central Denmark Region. The communities are located in four different municipalities, Lemvig in the Central Denmark Region and Thisted, Hjørring and Frederikshavn municipalities in the North Denmark Region. The municipalities have other, larger communities (generally inland communities) as centres for the municipality. The port communities make up 5–13% of the total population in the municipalities.

Table 3.1: Population in the communities and their municipalities, 2017. Source: Statistics Denmark, BY1.

Community	Population	Municipality	Population (1st qtr. 2017)
Thyborøn	2,069	Lemvig	20,291
Hanstholm	2,154	Thisted	43,826
Hirtshals	5,880	Hjørring	65,307
Skagen	8,088	Frederikshavn	60,356

No data is available on unemployment at the community level. The labour market is generally regional rather than local. The average commuting distance in the North Denmark Region is 23 km each way (2014) (Thisted kommune, 2016).

[1] All maps in this section are made from the same data as this.

Table 3.2: Unemployment as a percentage of the labour force in the municipalities of the four communities, per January. Source: Statistics Denmark, AUP02, month 1.

Municipality (town)	2010	2011	2012	2013	2014	2015	2016
Lemvig (Thyborøn)	5.2	5.1	5.2	4.4	3.1	3.2	3.8
Thisted (Hanstholm)	6.6	6.4	5.7	5.7	4.9	4.9	3.9
Hjørring (Hirtshals)	7.8	7.6	7.2	6.2	5.5	5.3	5.1
Frederikshavn (Skagen)	8.1	7.7	7.1	6.3	6.1	5.7	5.6
Denmark	6.3	6.0	6.3	5.7	5.0	4.4	4.3

The general unemployment rate has been decreasing in recent years, both in Denmark as a whole and in the municipalities of the four communities. Unemployment levels in the two southern communities, Thyborøn and Hanstholm, is below the national average of 4.5%, while it is above average in Hirtshals and Skagen. Meanwhile, Skagen has a negative commuting rate (more commuting out of the community than into the community), while Hirtshals and Hanstholm have a positive commuting rate (a higher number of persons commuting into the community, than out) (2013 data) (Thisted kommune, 2016).

3.1 Skagen

Skagen was established as a commercial fishing community in the beginning of the 15th century, with a significant trade nationally and internationally. In spite of the commercial success, the community was strongly challenged in subsequent centuries due to environmental pressures such as storms and sand drift, which hampered both agricultural and fishing activities. The negative development was further accentuated by the fact that Skagen was not connected to the rest of Denmark through any on-land infrastructure. In the 1870s, Skagen began attracting artists from across the country, and this led to an emerging tourism industry. The historical background in fishing was also captured by the painters in paintings that are now national treasures, and thus they have created a permanent link between Skagen and fishery. It was shortly after this influx of artists that Skagen was connected to the rest of Vendsyssel by road and railway (Den digitale byport, 2012).

Figure 3.3: Skagen at the northern tip of Jutland. Data from Kort10, the Agency for Data Supply and Efficiency.

In the late 19th century, Skagen held the largest fishing fleet in the country, employing over half of the inhabitants. However, it was not until the beginning of the 20th century, in 1907, that Skagen harbour was built. Until then, the fleet was pulled onshore and stayed on the sand. The harbour underwent continuous expansion and the population of Skagen increased significantly during the century. The tourism industry started competing with the fishing industry in being the most important industry of Skagen.

For the community of Skagen today, annual variations in landings usually spread out and affect various parts of society both in good and bad years. One example for this is how a good season of sand eels can affect the entire community, since not only the fishing industry is affected but also associated industries and companies such as the local newspaper due to an increase in income from advertisements.

Infrastructure

Skagen is still connected to the rest of Denmark by railway, a local rail line to Frederikshavn that connects to the rest of the national and international rail system. The road from Skagen is 44 km from the nearest motorway. The previous ferry connections from Skagen have been moved to other ports (Frederikshavn or Hirtshals).

Population

The population of Skagen stagnated in 1970 and has steadily decreased by 31% since 1976 (Den digitale byport, 2012; Statistics Denmark, BY1). Today, Skagen has 8,088 permanent residents and approximately 2 million annual visitors (Statistics Denmark, BY1; Toppen af Danmark, n.d.).

While Skagen is already an established tourist destination for national and international tourists, there is still considered to be a large potential for the community to develop the tourism industry further. Based on this, Skagen was chosen by the organisation Danish Coastal and Nature Tourism for their new tourism development project (Frederikshavn Kommune, 2017).

Figure 3.4: Skagen town. Data from Kort10, the Agency for Data Supply and Efficiency.

The port

The port of Skagen is the largest fishing port in Denmark and the largest pelagic port in Europe. Inland, processing industries have generally concentrated and consolidated over the last decade. Today, two of the largest pelagic industries in Denmark are located in the port of Skagen: the production of fishmeal and oil and the largest herring processor. These attract Danish as well as foreign landings. In 2015, foreign landings made up 63% of the volume and 52% of the value of the total landings in the port (Skagen Havn, 2016b; Skagen Havn, n.d.). The geographical position of Skagen has led to the port experiencing an increasing demand for services for fishing as well as non-fishing vessels. With an increasing demand from the international maritime fleet that travels between the Atlantic Ocean, North Sea and the Baltic, this continues to bring opportunities for transit and bunkering. The port of Skagen thus also provides services for the visiting vessels, many organised in "Service Team Skagen", which consists of 43 companies. This covers the servicing and repair of vessels (the regionally largest shipyard, net makers, ice, oil, packaging solutions etc.), fish auction, transportation and processing as well as financial and educational institutions. These companies supply the local as well as the foreign fishing industry.

The goal of the port is to become the leading fishing port in Europe in terms of landed amount in 2020 and in the top three in terms of landed value in 2030. This will be achieved through, among other means, the third step of a large expansion plan, where the on-land capacity will be increased along with the development of a new quay, which is expected to be finished in 2019. The focus is also based on the continued improvement of the reception of cruise ships (Skagen Havn, 2016c).

The fishery of Skagen has been an integrated element of Skagen throughout its development, and it continues to have a significant role in the community today. The harbour and fish auction house is a central area where many activities take place on a daily basis, such as the fish auction in the morning, which is open to visitors, and annually for festivals. The visitors consist of tourists living in the community or in summer cottages in the surrounding area, as well as an increasing number of cruise ship tourists. In 2015, a new cruise ship terminal was established with space for up to 330 m long cruise ships. Since then, the number of cruise ship visitors has drastically increased from 11,000 in 2016 to 39,239 expected in 2017 and 59,000 so far reported for 2018 (Skagen Havn, 2016a).

A catchment analysis of the importance of the port of Skagen based on 2013 data states that port activities in Skagen (all activities in companies dependent on the port – located in the port area or dependent on port activities) generate 1,588 jobs (full-time equivalents) directly and 619 jobs for suppliers to the first companies. The companies are assessed to have a turnover of DKK 3.9 billion. The employment effects directly and indirectly are assessed to be 10% of the jobs in Frederikshavn municipality, not taking the induced job and economy into consideration (Skagen Havn, 2015).

Other activities

Many activities in Skagen are related to the tourism industry. There are several museums dedicated to the work and life of the painters of Skagen, and tourists are also attracted to the natural phenomena of the top of Denmark, the wandering sand dune of Raabjerg Mile and the silted church. The community also has a Coastal Museum of Skagen, a museum of natural history, Skagen Nature Centre and a Centre of Migratory Birds, since the area around Skagen has a rich bird life.

The community also has an annual festival for the celebration of folk music. Skagen music festival is the oldest music festival in Denmark, and was first held in 1971. Today, this festival attracts tourists and inhabitants to the harbour area and is achieved through the work of approximately 650 volunteers. The

festival originally took place in the old fish auction hall. Today, this site is occupied by the Cultural and Recreational Centre of Skagen.

3.2 Hirtshals

The first mentioning of Hirtshals in historic papers is from 1532. It was however not until centuries later, with the establishment of the harbour, that the community took shape and started to develop (Hirtshals Havn, 2016; Nordsøen Forskerpark, 2017).

Figure 3.5: Hirtshals and the near surroundings. Data from Kort10, the Agency for Data Supply and Efficiency.

The establishment of a harbour in Hirtshals was already discussed in the beginning of the 19th century. At that time, the argument for the construction was to ease the transport of goods between Norway to Denmark, which back then were transported via Sweden. However, it took another century before the financial conditions were in order. Piers were then built with the purpose to protect the local fishing fleet, and the harbour was officially operating in 1929. Immediately after its opening, one third of the landings came with foreign fishing vessels, and with a growing demand the harbour was expanded with additional piers and quays. In 1935, the first ferry connection to Norway was established, first to Arendal and later to Kristiansand, whereto it is still operating, in addition to routes opened later (to Larvik, Stavanger and Bergen). In the mid 20th century, the fishing activities had grown with several expansions and the establishment of a new and larger fish auction house. The development continued over the next decades with additional expansions. In the 1990s, fishing activities related to the processing industry experienced a decline, and the five fishmeal factories were demolished in order to make room for the growing ferry traffic. The 2000s led to new developments, some in order to maintain the pelagic fishery and others in favour of the ferry traffic (Hirtshals Havn, 2017).

Infrastructure

In 2015, a railway terminal and a direct connection from the harbour to the E39 motorway were established. The E39 connects to the motorway only 5 km from the port of Hirtshals, which provides a direct link south to the rest of Denmark and Europe.

As mentioned, the port of Hirtshals today is a hub for three ferry companies transporting goods and passengers to several locations in Norway, as well as the Faroe Islands and Iceland. The close motorway connection also contributes to making Hirtshals attractive as the hub to Denmark and Europe for guests from the northern parts of Europe.

Population

The number of permanent residents stagnated in 1996 with 7,009, which was then followed by a 16% decline leading to the 5,880 permanent residents today (Statistics Denmark, BY1). In addition to the permanent residents, approximately 3,300 people come to Hirtshals each day to work from outside of Hirtshals, many of whom are working in the fishing industry or in related industries. Hirtshals is visited by many tourists each year for the larger attractions of the North Sea Oceanarium and the North Sea Science Park. Many tourists stay in summerhouses close to Hirtshals. Visitors from Norway also play an economic role in Hirtshals, for example as commercial tourists who come to Hirtshals from Norway only to do grocery shopping and return to Norway the same day (Steffensen, 2017).

The port

The port of Hirtshals was established for fisheries as well as for transportation, as described above. This is still the profile of the port, where the ferries have taken over as the most important activity in the economy of the port, as the fisheries only provide 10% of the turnover for the port company. The full importance of fish and fisheries is however considerably larger than this would indicate. Large landings of mackerel and herring are mainly transported inland for processing, while a number of minor processors process demersal species and fish landed by container ships. The fisheries have generated a range of service providers for fisheries as well as other vessels such as cargo ships, naval vessels, ferries and supply vessels for the oil sector. These include service as well as repairs and remodelling – a yard, ship electronics, blacksmiths, painting and ship carpenters etc. Since 2011, Hirtshals has also managed to attract maintenance of off-shore oil rigs.

A catchment analysis of the importance of the port of Hirtshals based on 2013 and 2016 data assesses that activities in the port directly generate 2,245 jobs (full-time equivalents) in the municipality of Hjørring, equal to 8% of the total employment in the municipality. The companies are assessed to produce value added of DKK 1.5 billion in port companies. This does not include the indirect effects (Center for Regional- og Turismeforskning and SDU, 2017a).

Figure 3.6: Hirtshals town, with ferry lines. Data from Kort10, the Agency for Data Supply and Efficiency.

During the last two years, the port has made its so far largest investment in a 250,000 m^2 on-land development. Today, the port has a large capacity in the processing and handling of fish, which, along with its geographical position and infrastructure linkages to the rest of Denmark and Northern Europe, makes it a significant actor in the Danish fishing industry (Steffensen, 2017).

Other activities

The industry of Hirtshals is first and foremost related to the port and primarily to the fishing industry. Other activities in Hirtshals take place at the North Sea Science Park and North Sea Oceanarium, which attract and employ scientists related to fishery research as well as tourists, both Danish and international (Nordsøen Forskerpark, 2017). The two centres attract 270,000 visitors a year and are well connected to the community through activities of research and knowledge sharing. Scientists from the science park cooperate with the fishing industry in the research of fishing methods, development of tools and fishing methods. Also, if the fishermen of Hirtshals catch a rare fish, it is likely to end up living in the large aquarium at the Oceanarium. The activities of the two centres are therefore also dependant on the survival of the fishing industry in Hirtshals.

The fishing industry plays an important role in the life of the social associations in Hirtshals. They also provide, together with the other companies in Hirtshals, an essential financial support to the annual festivals. The fishery of Hirtshals is celebrated each year during the local Fish Festival, where around 250 volunteers from the community work together to create activities for participants with the support from over 50 sponsors also related to Hirtshals (Hirtshals Fiskefestival, 2017). The festival spans from Thursday to Saturday and includes different activities and themes of the day, such as a day for children and their knowledge about fish. Many tastings are offered for both children and adults, and it is possible to visit various activities and actors of the port. For instance, visitors can see the box terminal, where boxes are handled and cleaned. It is also possible to meet net makers and see their work and go to the fish auction and learn about how fish are bought and sold and who the involved actors are. All this is a way for Hirtshals to not only celebrate the fishery of Hirtshals and to have a community festival, it is also a way to brand Hirtshals and to brand fresh fish so that visitors learn to appreciate fresh fish and to remember Hirtshals when they buy fish in the future.

3.3 Hanstholm

Before the 20th century, the community of Hanstholm was made up of only a small settlement of fishing families.

When the construction of the port was initiated in the beginning of the 20th century and finalised in 1967, Hanstholm started to grow and became a community strongly connected to the port. The construction of the port was delayed significantly due to the Second World War, in which Hanstholm was used as a fortress by the Germans (Thy Turistforening, n.d.). The delay made the port of Hanstholm the youngest port in the country (Port of Hanstholm, 2017).

Figure 3.7: Hanstholm at "the shoulder of Jutland". Data from Kort10, the Agency for Data Supply and Efficiency.

Infrastructure

On the landside, Hanstholm is connected by highway route 26, which is the main entrance for fish export or travellers for Hanstholm. The highway ends in Herning, 133 km from Hanstholm. A motorway under construction will end in Holstebro, 100 km from Hanstholm. There is no railway connection to Hanstholm.

In the 1980s, the port of Hanstholm became a destination for ferries and had several established ferry routes. However, the ferry activities came to an end in 2010, when large parts of the activities moved to Hirtshals (Port of Hanstholm, 2017).

Population

Over the last seven years, Hanstholm has experienced a 10% decline in population to its current level of 2,154 residents. This further emphasises the importance of the port to the local community, taking into account that a catchment analysis estimates that the number of jobs that are connected to the port is estimated to be approximately 1,600 (Statistics Denmark, BY1).

The harbour

In 1977, ten years after the opening, the harbour was expanded with a new basin followed by the construction of yet another basin in 1987. In the 1980s, Hanstholm harbour also became a destination for ferries with several established ferry routes. The ferry activities however came to an end in 2010 (Port of Hanstholm 2017).

Figure 3.8: Hanstholm port and town. Data from Kort10, the Agency for Data Supply and Efficiency.

Hanstholm harbour is the largest fishing harbour in Denmark in terms of landings of fish for direct consumption and therefore plays an important role in the Danish fishing industry. In 2013, the harbour sought to expand further and formed an ambitious plan that would enhance the activities within fishing, freight, offshore and sustainable energy. The plan was however dropped at the last second because the costs turned out to be higher than firstly calculated. Since 2013, the harbour has sharpened its focus and is now primarily focused on how to improve the conditions for the fishing industry, which is responsible for 75% of the harbour's income. The new focus is evident in the newest expansion plan of the harbour, which among others is focused on making the entrance to the harbour wider and on increasing the depth, thereby accommodating larger fishing vessels. The plan has received support from the municipality, and the expansion is thus expected to be initiated in 2018 and finalised in 2020/2021 (Andersen, 2017). The expansion of the port is expected to increase the number of jobs, especially in the fishery related industries, which increased the importance of fisheries for the community. This has given rise to new ideas about how to revitalise Hanstholm and lead the community towards a future with growth and developments.

A catchment analysis of the importance of the port of Hanstholm was made in 2007 based on 2006 data. The 2006 assessment pointed to 1,700 jobs (direct and indirect) from the port and a production value of DKK 1.6 billion. Today, the number of employees is 1,600 (Hanstholm Havn, 2007; Port of Hanstholm, 2017). The high number of jobs in the port and port-related industries indicates a high level of inwards commuting to Hanstholm when compared to the number of inhabitants (of approx. 2,100). It also emphasises the role of the port for the community of Hanstholm. The port celebrated its 50th anniversary in 2017 with a big event, with different activities, visits from politicians and a joint dining event in the evening.

The port includes a processing plant for fishmeal and fish oil and a large number of fish processors and traders of demersal fish. The fisheries and landings in the port are supported by a range of service companies within refrigeration, smith services, hotel accommodation, unloading and loading, oil and fuel, net making, ship supplies, floating dock, etc. (Port of Hanstholm, 2017).

Other activities
The port of Hanstholm is primarily occupied with fishing-related activities. Still, other sea-related activities are based in or nearby the port.

The focus on sustainable energy can be seen in a centre for Danish wave energy in Hanstholm. Futhermore, the port is also used as landing place for parts for the national test centre for large wind turbines, which is located in Østerild, just 20 km from Hanstholm.

Finally, Hanstholm has developed a tourist industry related to coastal summerhouses and the natural reserve of Thy National Park, including Cold Hawaii in Klitmøller, 12 km from Hanstholm, which has become a national hotspot for windsurfing.

3.4 Thyborøn

The first written record of Thyborøn is from 1531 where it was used as a name for the area. In 1862, the isthmus on which Thyborøn was situated was breached in a storm surge, which separated Thyborøn from the area of Thy. From 1875, the new opening of the isthmus was artificially kept open through coastal protection. The established connection between sea and fjord then opened up new opportunities for trade and transportation. Around this time, Thyborøn consisted of nine houses but started to grow some decades later with the construction of the harbour (Kulturstyrelsen, 2009).

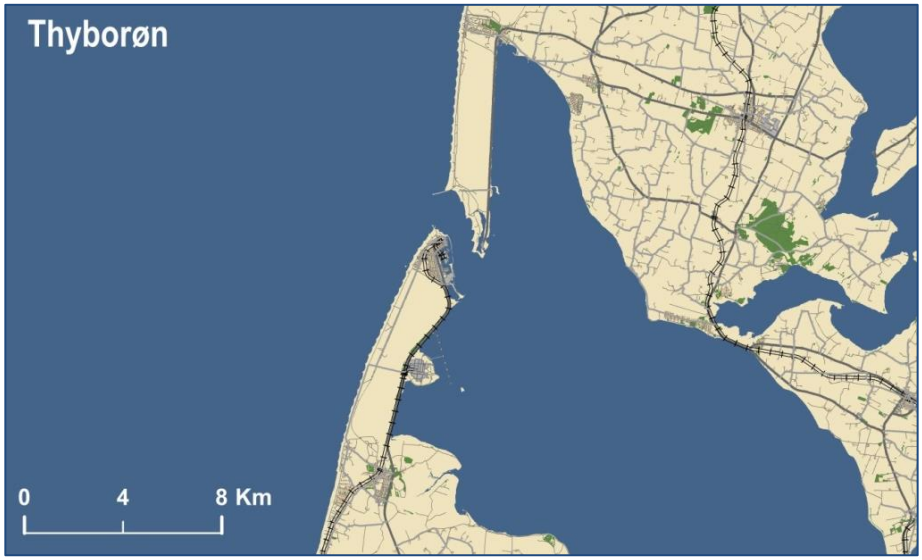

Figure 3.9: Thyborøn and the near surroundings. Data from Kort10, the Agency for Data Supply and Efficiency.

Infrastructure
In spite of the remote location of Thyborøn, the community is connected by rail and road to the south and by ferry to Agger, north of the fjord. The railway between Vemb and Lemvig was extended to Thyborøn in 1899 and has since then been used for passenger and goods transportation (Meesenburg, 2017).

Thyborøn is connected by route 181, the southbound highway. After 90 km, the road connects to the motorway in Herning. From 2018, a motorway will reach Holstebro, which is 55 km from Thyborøn.

Population
The above-mentioned infrastructures connect the 2,069 residents of Thyborøn with the rest of Denmark.

During the last three decades, the population of Thyborøn has shown a steady decline of 27%, from a population of 2,851 in 1989 (Statistics Denmark, 2017, BY2).

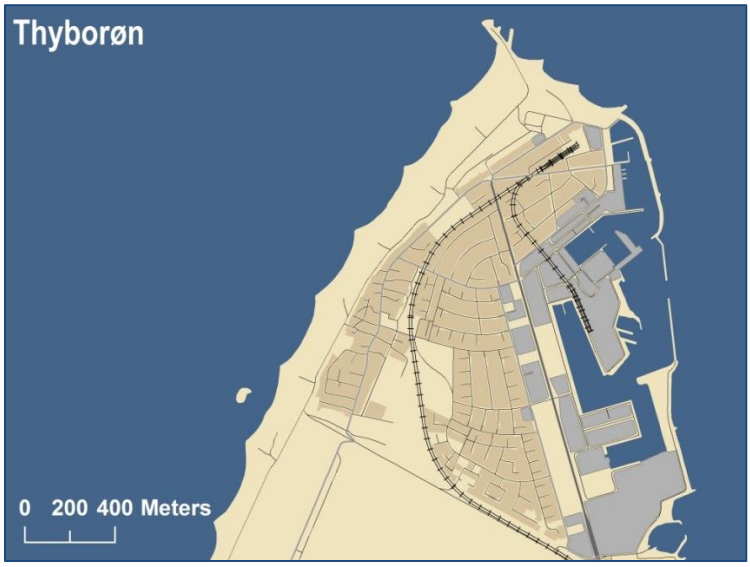

Figure 3.10: Thyborøn town. Data from Kort10, the Agency for Data Supply and Efficiency.

The harbour

The harbour was established in 1915–1918 and was further expanded with a southern inner harbour and a western inner harbour in 1929 and in the 1940s, respectively. The latter was expanded further with two quays for industry and repairs in the 1960s, and in the 1970s the southern harbour was expanded with a harbour for fish processing (Meesenburg, 2017). Plans for future developments are mainly focused on improving the capacity and depth of the harbour in order to accommodate larger vessels (Thyborøn Havn, 2017).

At present, the port holds the second largest fishmeal and fish oil processing company in Denmark as well as other companies within fish processing and export. There is a range of service companies supplying support for landing (landing, ice, bunkering, etc.), as well as net makers and repair and maintenance, e.g. shipyards, electronics, carpenter, etc.

A catchment analysis of the importance of the port of Thyborøn based on 2013 and 2016 data estimates that activities of the port generate 1,039 jobs (full-time equivalents) in the municipality of Lemvig, equal to 10% of total employment in the municipality. The companies are assessed to produce value added of DKK 848 million in the port companies. This does not include the indirect effects (Center for Regional- og Turismeforskning and SDU, 2017b).

Other activities

Besides jobs related to the harbour, the chemical factory of Cheminova/FMC is one of the larger employers in the area.

Several steps have been taken during the last two years in order to develop the tourism industry in Thyborøn (Thyborøn Guiden, 2017). Today, tourists can visit the Coastal Centre (Kystcentret), the Aquarium of Jutland (Jyllandsakvariet) and the Sea War Museum Jutland along with other museums and exhibitions (Meesenburg, 2017).

In addition, the importance of the fishery to the local community is celebrated each year through the annual Fish Days, the first weekend in August, with activities related to the fishery and the port (Thyborøn Guiden, 2017). At this festival, the fishery is celebrated, large tents are raised on the harbour and the inhabitants come together in a joint dinner event. At one point, this festival attracted approximately 10,000 people. This festival is Thyborøn's community festival, since the inhabitants and local companies all cooperate in making the festival an attraction for tourists as well as a local celebration that brings people together. This is also why young people raised in Thyborøn return to the community for this festival like they do on national holidays.

Also, Thyborøn is part of the "Day of the Fish" initiative, which is an annual event where representatives go to the capital, Copenhagen, to ensure that inhabitants of the capital and politicians remember the fishing industry and related communities.

4 THE FISHING INDUSTRY IN THE FOUR COMMUNITIES

The fishing industry in Denmark includes all full-time fishing vessels, vessel owners and fishermen, and the on-land facilities of port services, maintenance, processing facilities and sales services.

The on-land fish processing industries depend in a variating degree on landings from the UK EEZ, while the service industries partly service vessels fishing in the UK EEZ. Currently, approximately 35 vessels have a minimum of 15% of their landed value coming from the UK EEZ. In total, these 35 vessels catch 98% of all Danish landings from the UK EEZ. Almost all these vessels are registered in Skagen, Hirtshals, Hanstholm and Thyborøn, as will be expanded in section 5.

The following sections therefore present the fleet registered in the four ports and the landings in the port.

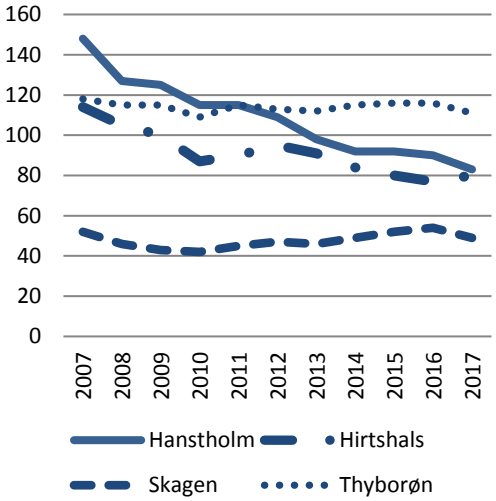

Figure 4.1: Number of vessels by home port, 2007–2017 Source: LBST 2017 dynamic tables.

4.1 The fleets

In 2016, 337 vessels were registered as full-time occupational fishing vessels in the four ports in total. This is 25% less than a decade ago. The fleet has undergone a structural change towards concentration of the fishing activities at a reduced number of vessels. In the same process, the fishermen has invested in new and larger vessels. This has been reinforced by the implementation of transferable quotas in 2007.

For the individual ports, Hanstholm has seen the largest decrease in the number of vessels registered in the port (i.e., home port). As can be seen from Figure 4.1, Hanstholm and Hirtshals have experienced a steady decrease in the number of vessels, while Skagen and Thyborøn have maintained their numbers with a slight increase. Today, Thyborøn holds the largest number of vessels.

The fleets have changed significantly over time, from having been fleets of primarily smaller, wooden boats to today, where the picture is more nuanced. Development in technology and vessel construction and growing financial resources made it possible to build larger vessels with an increasing level of comfort to offer the fishermen on-board. The fleets today are therefore a mix of smaller boats, medium-sized vessels and larger vessels that can travel far and for many days in order to get the right catch.

Figure 4.2 shows the development of the number of vessels according to length distribution for the vessels at the four ports over the last decade. The size groups of 10–20 m and 30–39.9 m has seen a decrease, which has led to the overall decrease in the number of vessels. However, the largest size group, ≥40 m, has seen a slight increase, and it is predominantly this category that get their landings from the UK EEZ.

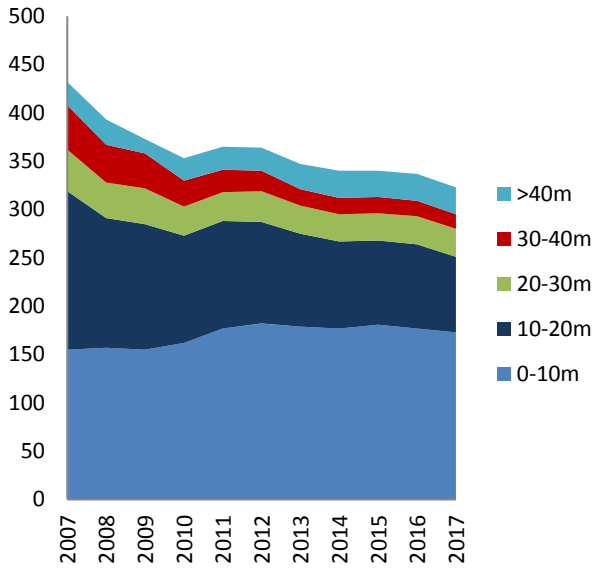

Figure 4.2: Number of vessels in length groups. Sum of vessels in the four ports divided by size category, 2007-2017. Source: LBST 2017, dynamic vessel statistics.

When looking at the length of vessels in the ports, it is evident that Thyborøn holds the highest number of the largest and smallest categories of vessels. While almost no vessels of the largest category are registered to Hanstholm, Hanstholm holds the largest number of vessels in the 20–30 m category.

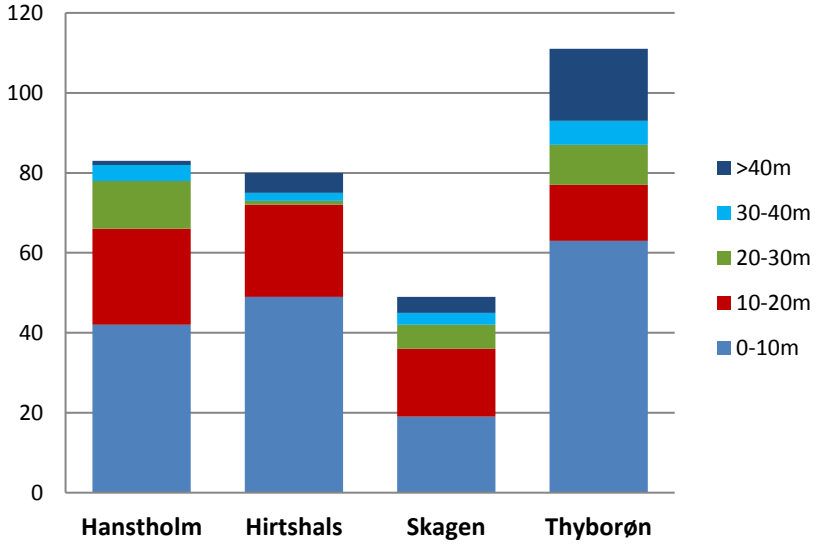

Figure 4.3: The number and size of vessels in the four ports, 2017. Source: LBST 2017. Dynamic vessel statistics.

The number of employees on fishing vessels has decreased by approximately 25% during the last decade, corresponding to the 25% in the overall number of vessels. The development at the harbour level can be seen in Figure 4.4. Hirtshals and Hanstholm have seen the largest decrease in the number of fishermen, while the number has increased in Skagen and slightly decreased in Thyborøn.

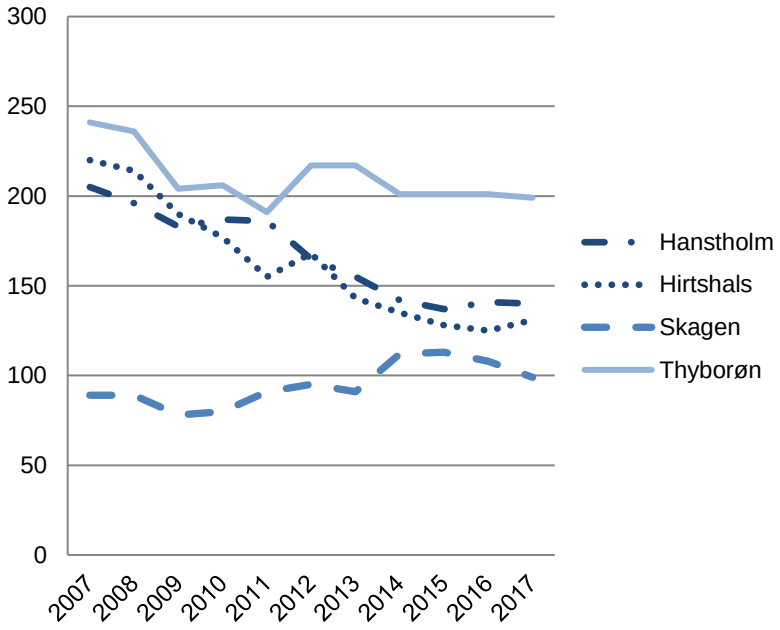

Figure 4.4: Number of fishermen per home port 2007-2017. Source: LBST dynamic tables 2017.

The size and capacity of vessels can also be seen by the tonnage of the fleet. The tonnage of the fleets has seen an overall increase of 10%, going from 107 tonnes per vessel in 2007 to 138 tonnes in 2017. Hanstholm is the only community that has experienced a decrease in the number of vessels, fishermen on vessels and the tonnage of the fleet.

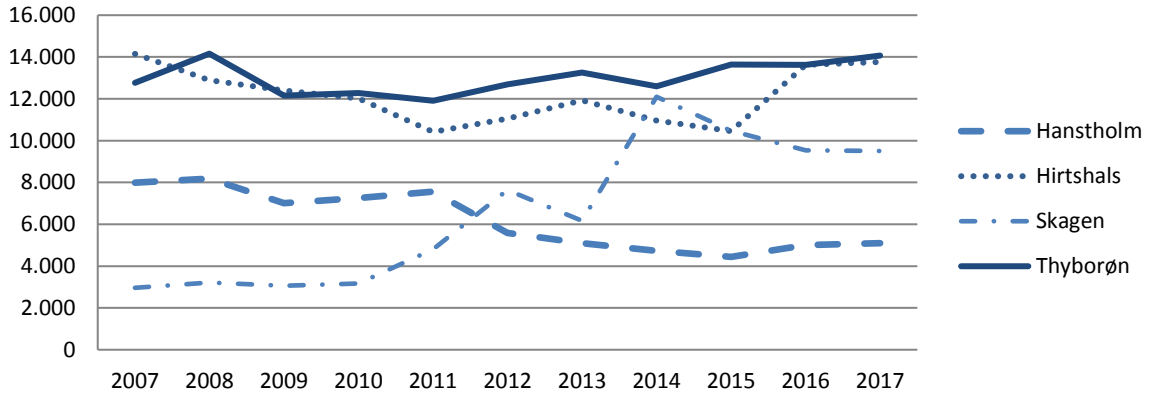

Figure 4.5: Total vessel tonnage per home port, 2007-2017. Tonnes. Source: LBST 2017: Dynamic vessel statistics.

The potential consequences of Brexit are most likely to affect the largest vessel group, because these vessels are designed for longer trips, e.g. to the UK EEZ. If one vessel group is affected, it would however most likely affect the other categories as well because of the dynamic and interlinked nature of the fishing industry. This is discussed further in section 6. Even the smallest vessels might therefore feel the effects of Brexit.

4.2 Landings

While Thyborøn holds the largest fleet, this does not correspond to the distribution of landings. To some degree, the fleet is decoupled from their home port in terms of service and processing in land, because the vessels generally land where they obtain the highest fish price (or result) and especially for direct landings of pelagic species, in the port of the buyer. However, the profit depends on prices, as well as costs related to landings such as the distance to port, landing charges, etc. Finally, port facilities such as supply of services and resources, depth of basin, etc. can influence the decision of where to land. Following this, the processing industry depends on landings from local vessels, as well as vessels registered in other Danish or non-Danish ports. The following sections therefore present the geographical origin of landings as well as the volume and value of landings (both total and Danish from the UK EEZ) in the four ports. Finally, the influence of non-Danish landings from the UK EEZ is considered.

4.2.1 The geographical origin

The most important species for the Danish fishing industry are primarily caught in the North Sea. Here, there are important fishing grounds, where some species are geographically concentrated. One example is the Dogger Bank, which is a shallow area approximately 100 km east of the UK stretching approximately 260 km to the east with an area of 17,600 km^2. This location is particularly important for sand eel, cod and herring along with other fish species. The high concentration of fish in this area can be explained by a high primary production (Encyclopaedia Britannica, 2017).

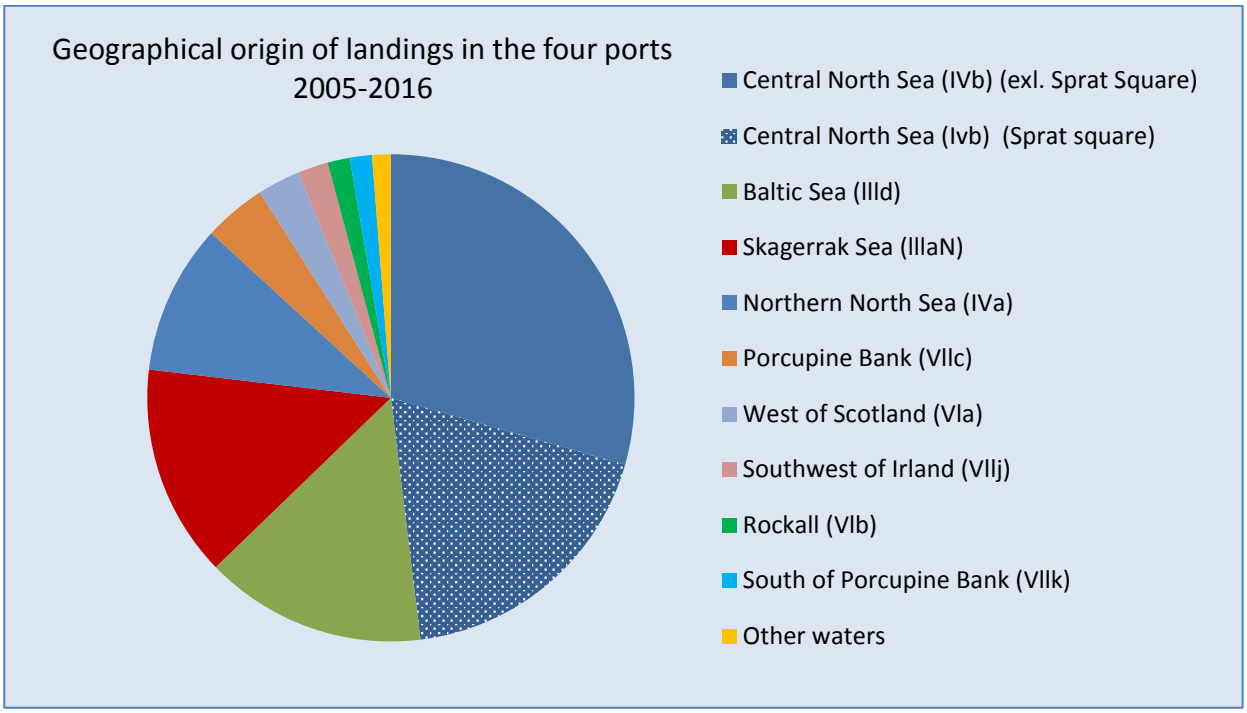

Figure 4.6: Catching area for landings in the four ports. ICES fishing areas, total 2005–2016. Other waters include: The sound (IIIb), Western English Channel (VIIe), West of Ireland (VIIb) and Kattegat IIIaS. Source: The Ministry for Environment and Food, 2017. /LBST 2017, Dynamic landing statistics.

The fishing nations that land their fish in the four ports are primarily Denmark, The Netherlands, Norway, Sweden and the UK. The landings in the four ports come primarily from the central part of the North Sea (47%), followed by landings from the Baltic Sea (15%), Skagerrak (14%) and the northern part of the North Sea (10%), as illustrated in Figure 4.6, below. The fishing areas are illustrated in Figure 4.7.

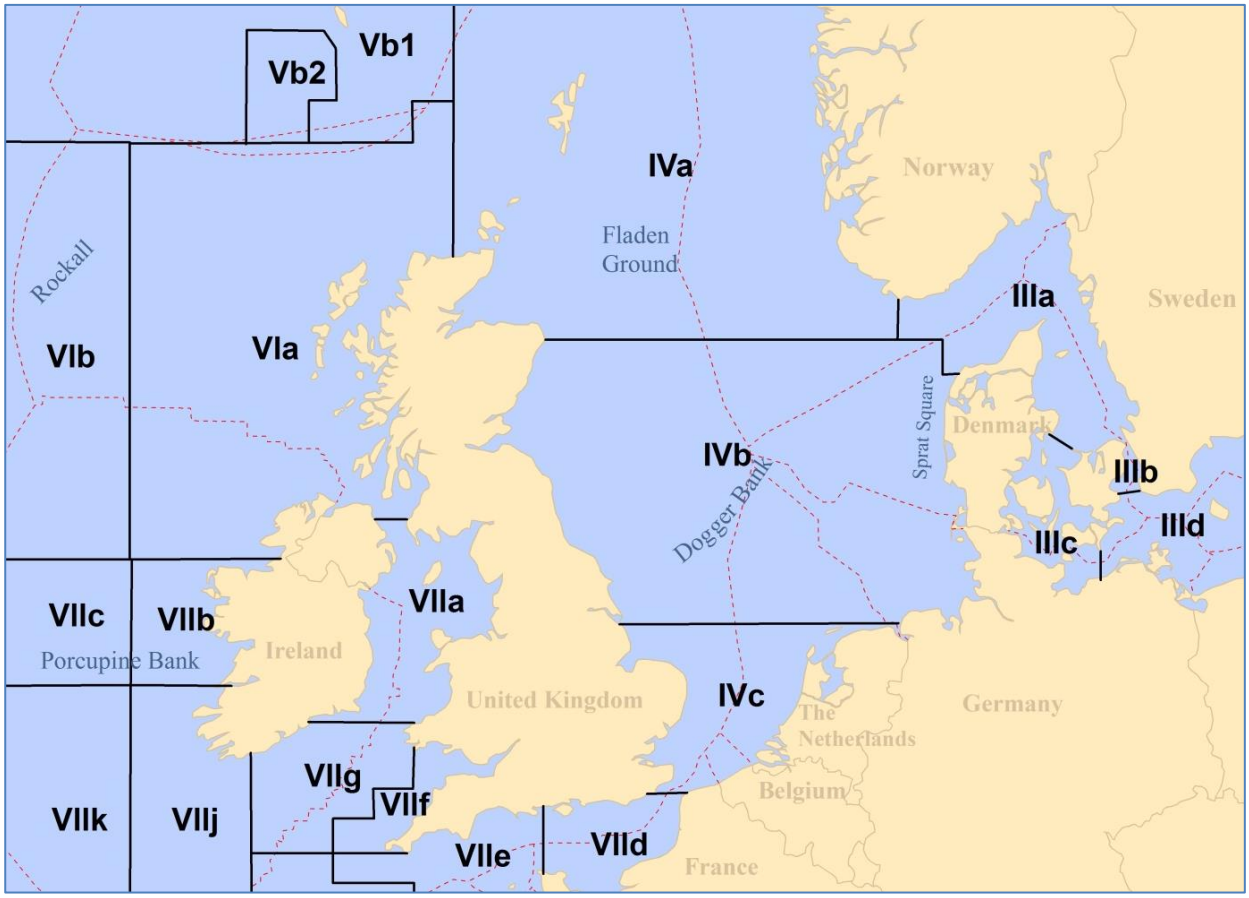

Figure 4.7: Map of the most important fishing areas, ICES fishing areas, important fishing grounds and national EEZ borders. Source: Own figure. Data from: Esri, DeLorme, GEBCO, NOAA NGDC and ICES.

4.2.2 Landing volumes

On average, 703,270 tonnes of fish was landed in the four ports annually in the period 2011–2015. Skagen received the largest amount of the landings (41%), followed by Thyborøn (31%), Hanstholm (19%) and Hirtshals (8%). Of these amounts, landings for the production of fishmeal and fish oil are the most dominant. This includes species of sand eel, sprat, Norwegian pout and blue whiting. Species for non-human consumption (for the production of fishmeal and oil) make up 91% of the total landings in Thyborøn, 71% in Hanstholm and 59% in Skagen. Species for non-human consumption are therefore important raw material for the industries connected to these ports. Herring is also an important species for the industry in Skagen (34%) and Hirtshals (37%). Mackerel also makes up 37% of the landings in Hirtshals, while Hanstholm is more reliant on other species (29%).

Table 4.1: Volume of all (Danish and foreign) landings in the four ports, tonnes, average 2011–2015. Most important species in the port are marked in bold. Source: Dynamic landing statistics, lbst.dk.

Port	Non-human consumption (T)	Mackerel (T)	Herring (T)	Other species (T)	Total (T)
Hirtshals	4,598	**21,539**	**21,530**	10,507	58,174
Hanstholm	**96,566**	9	622	**39,681**	136,877
Thyborøn	**200,746**	2	1,105	18,248	220,101
Skagen	**169,536**	414	**96,671**	21,497	288,118
					703,270

Catches from the UK EEZ landed by Danish vessels in the four ports have the same overall division, primarily mackerel, herring and species for non-human consumption, as presented in Table 4.2, below.

Table 4.2: Landings from the UK EEZ, Danish vessels. Average 2011–2015, tonnes. Most important species in the port marked in bold. Source: The Danish AgriFish Agency vessel register, logbook and sales notes register.

Port	Non-human consumption (T)	Mackerel (T)	Herring (T)	Other species (T)	Total (T)
Hirtshals	1,350	**10,674**	**12,459**	7	24,490
Hanstholm	**26,905**	6	179	1,101	28,192
Thyborøn	**74,611**	9*	700	399	75,719
Skagen	**39,020**	23	**29,091**	8	68,142
All other ports in Denmark	18	0	1	75	94
Total	141,904	10,712	42,430	1,590	**196,637**

*A higher UK zone landing than total landing indicates errors in reporting – as the volume is low, this can originate from a misreported landing or discrepancies between the logbooks (the basis for calculation of the UK zone landings) and the landing registration (the basis for all landing volumes at the Agency database). This discrepancy is seen as insignificant in the larger volumes.

The Danish landings from the UK EEZ has the same pattern in the ports (Hirtshals, Hanstholm, Thyborøn and Skagen) as the total landings. Species for non-human consumption are primarily landed in Skagen, Thyborøn and Hanstholm. Herring is primarily landed in Hirtshals and Skagen, and mackerel is primarily landed in Hirtshals. This distribution is mostly due to the proximity to processing facilities in Skagen, Hanstholm and Thyborøn for the species for non-human consumption. For herring and mackerel, it is the facilities in Skagen, Aalbæk and Sæby that attract landings to Skagen and Hirtshals.

Table 4.3 illustrates the importance of landings from the UK EEZ from Danish vessels compared to the total landings in the four ports. The importance of Danish landings from the UK EEZ is highest in Hirtshals, where 42% of all landings come from the UK EEZ. For the most important landings (mackerel and herring, marked in bold), Hirtshals is highly dependent on the UK-EEZ landings, since 50% of landed mackerel and 58% of landed herring come from the UK EEZ.

Table 4.3: Relative importance of landing volume from the UK EEZ by Danish vessels of all landings (Danish and foreign) in the four ports, %, average 2011–2015.

Port	Non-human consumption (%)	Mackerel (%)	Herring (%)	Other species (%)	Total
Hirtshals	29.4	**49.6**	**57.9**	0.1	42.1
Hanstholm	**27.9**	-	28.8	2.8	20.6
Thyborøn	**37.2**	-	63.3	2.2	34.4
Skagen	**23.0**	10.9	**30.1**	0.0	23.7

4.2.3 Landing value

Looking at the value of landings shows a slightly different profile of the ports in terms of specialisation in species – simply because the "other fish" category includes the high-value, demersal species for human consumption. For Hirtshals and Thyborøn, "other fish" make up just over 40% of the total landing value (average for 2011–2015). In Skagen, the number is 20%, and in Hanstholm the "other fish" category makes up 75% (or DKK 520 million), which highlights Hanstholm's status as the main port for fish for demersal

species, for direct human consumption; however, 25% of the landing value still comes from species for non-human consumption.

Landings of species for non-human consumption have high value in Thyborøn and Skagen. Despite a DKK 250 million value of other species, this makes Thyborøn the most dependent on species for non-human consumption with DKK 343 million annually, almost 60% of the total average landing value. Skagen has a landing value of DKK 304 million for species for non-human consumption, an important port for such species, but the primary value comes from landings of herring, DKK 377 million. This makes Skagen the most important port for herring. Finally, Hirtshals is the main port for mackerel landings and the second for herring; however, "other species" still represent the highest landing value of the four categories.

Table 4.4: Value of all (Danish and foreign) landing in the four ports, DKK 1,000, average 2011–2015. Most important species in the port are marked in bold. Source: Danish AgriFish Agency, Dynamic landing statistics.

Port	Non-human consumption	Mackerel	Herring	Other species	Total
Hirtshals	8,137	**187,408**	**96,966**	**198,136**	490,648
Hanstholm	**173,310**	93	1,668	**519,871**	694,941
Thyborøn	**343,419**	26	2,797	251,044	597,287
Skagen	**303,891**	1,352	**376,677**	157,986	839,905

Looking at the landings from the UK EEZ by Danish vessels in Denmark (Table 4.5), this is also concentrated in the four ports when considering the value. It should be noticed that 7% of the value of demersal (other) fish was landed in three ports not in focus here. Interviews in the ports indicate that the catches of demersal fish in the UK EEZ and subsequent landings in Danish ports may be higher today than the 2011–2015 average. This might be a consequence of technological development in the demersal fleet of larger and faster vessels.

Table 4.5: Landings from the UK EEZ by Danish vessels. Average 2011–2015, value DKK 1,000. Most important species in the port are marked in bold. Source: The Danish AgriFish Agency vessel register, logbook and sales notes register.

Port	Non-human consumption	Mackerel	Herring	Other species	Total
Hirtshals	2,188	**98,066**	**48,011**	199	148,465
Hanstholm	**46,613**	39	565	**17,348**	64,564
Thyborøn	**129,820**	57	2,485	6,262	138,624
Skagen	**68,261**	311	**113,773**	44	182,389
All other ports in Denmark	38	1	5	2,031	2,075
Total	246,920	98,473	164,839	25,885	536,117

When measured in value, the pattern of the importance of landings from the UK EEZ only changes slightly as compared to landings in volumes. It is however noteworthy that the value of "other species" in Hanstholm is relatively high: DKK 17 million. This is though only a marginal value (3.3%) of the total landings of "other species" in Hanstholm (Table 4.6).

The relative importance of Danish UK-EEZ landings of all landings in the four ports points to the same species and ports. Hirtshals' dependency on Danish landings from the UK EEZ is 52% for mackerel and 50% for herring. The Danish landings from the UK EEZ of species for non-human consumption are of minimal

influence at nearly DKK 2.2 million out of the ca. 148.5 million DKK of Danish landings, however with a relative value of 27% out of the total catches of non-human consumption species. For Hanstholm, only landings of species for non-human consumption are significant, with ca. DKK 46.6 million corresponding to 27% of the total landing value of these species from the UK EEZ. The landing value of demersal (other) species from the UK EEZ by Danish vessels is DKK 17 million, which is only 3.3% of the total demersal landings and is regarded to be marginal. Thyborøn receives 38% of its species for non-human consumption from Danish vessels caught in the UK EEZ. Finally, for Skagen, 23% of the total landings of species for non-human consumption and 30% of herring landings come from the UK EEZ by Danish vessels.

Table 4.6: Relative importance of Danish landings from the UK EEZ of all (Danish and foreign) in the four ports, % of value, average 2011–2015. **Bold:** important species – high volume and of relative importance, *italic:* low volume, therefore not of importance for the port and community. Source: Own calculation, based on Table 4.4 and Table 4.5.

	Non-human consumption, (%)	Mackerel, %	Herring, %	Other species, %	Total, %
Hirtshals	*26.9*	**52.3**	**49.5**	0.1	30.3
Hanstholm	**26.9**	*41.8*	*33.8*	3.3	9.3
Thyborøn	**37.8**	-	*88.8*	2.5	23.2
Skagen	**22.5**	*23.0*	**30.2**	0.0	21.7

4.2.4 Conclusions on the profiles of the ports

Hirtshals is specialised in herring and mackerel, with 75% of the landing volume. However, the high value of demersal species (other species) reduces the importance of herring and mackerel to 55% of the total landing value. When compared to the other communities, Hirtshals receives the largest proportion of the total landings from the UK EEZ (30.3%) in value and could therefore be said to be most dependent on landings from the UK EEZ.

Hanstholm is specialised in species for non-human consumption and other (primarily demersal) species in volume. In value, Hanstholm is highly specialised in other, demersal species, with 75% of the landing value, and the importance of species for non-human consumption is 25% of the total landings value. In value, Hanstholm receives the smallest proportion of its total landings from the UK EEZ (9.3%) in comparison to the other communities.

Thyborøn is specialised in the industrial species, representing 90% of the landed volume and 60% of the value, which is also the highest among the four communities.

Finally, **Skagen** is specialised in species for non-human consumption and herring. These species represent 90% of the volume and 80% of the landing value. Skagen receives both the highest value and volume of total landings of the four communities.

4.2.5 The influence of other EU vessels' landings caught in the UK EEZ

One of the limitations in the scope of this report is the focus on Danish fishing vessels, with the risk of overlooking the potential influence of other EU vessels in the two scenarios. While landings from foreign vessels do have an influence on the economy of the four communities, the exclusion of these landings from the scope of the assessment is justified by the proportionality between UK-EEZ landings by Danish vessels compared to landings of other EU fishing nations, as presented below.

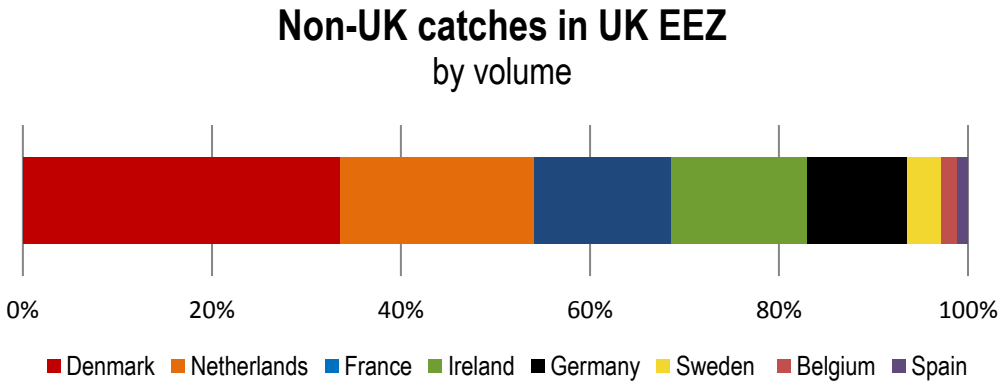

Figure 4.8: Landings from non-UK EU vessels fished in the UK EEZ. In weight distribution. Source: own model based on Napier, 2016.

Denmark is the largest non-UK fleet currently fishing in UK waters in terms of volume, with 34% of non-UK catches. When divided between fishing for consumption and processing, it is however evident that Denmark is by far the most significant player when it comes to fish for non-human consumption, with 77% of the overall landings caught by non-UK vessels in UK waters (new economic Foundation, 2017, and Napier, 2016).

Table 4.7: The influence of foreign landings from the North Sea and British waters (i.e., ICES areas VI, VII, IVA-C, IVN, IVL, IVR and mussel areas in the North Sea) in tonnes and percentage of total landings in port. Source: Danish AgriFish Agency, Dynamic landing statistics.

	Vessel nation									
	The Netherlands		Ireland		France		Sweden		Germany	
	Average from 2005–2017 (1,000 DKK)	% of annual landings in port	Average from 2005–2017 (1000 DKK)	% of annual landings in port	Average from 2007–2017 (tonnes)	% of annual landings in port	Average from 2005–2017 (tonnes)	% of annual landings in port	Average from 2005–2017 (tonnes)	% of annual landings in port
Skagen	-	-	13,464	1.6	-	-	57,066	6.79	5,127	0.61
Hirtshals	30.7	0.006	-	-	-	-	3,346	0.68	254	0.05
Hanstholm	1,412	0.20	207.5	0.03	6,162	0.89	8,590	1.23	25,043	3.60
Thyborøn	4,712	0.79	8.09	0.001	-	-	2,212	0.37	15,731	2.63
Total	6,154.5	1	13,681	1.63	6,162	0.89	71,214	9	46,155	6.89

The second largest non-UK nation in terms of landings from the UK EEZ is the Netherlands, which, amongst the four ports, has most landings in Thyborøn. Here, Dutch vessels land fish of an average value of ca. DKK 7.7 million/year, most probably plaice and other flatfish for export to the Netherlands. With the total value of annual landings in Thyborøn of ca. DKK 597 million on average (Table. 4.4.), the Dutch landings only make up 0.79% of these, and the influence of Dutch landings are therefore considered insignificant in relation to the present assessment. Skagen has no recorded landings from Dutch vessels during the last 12 years, and Hanstholm received landings of ca. DKK 1.4 million, although only with landings in two of the last six years (in 2014 and 2015).

France and Ireland both catch the third largest volumes of fish caught in the UK EEZ (see Figure 4.8) of which the four ports receive landings of respectively ca. DKK 6,2 million/year (entirely to Hanstholm) and

ca. 13.7 million/year (primarily to Skagen). These landings do not entirely come from the UK EEZ. Having in mind the ratio to the Danish and total landings in these ports, these landings are not considered to have a significant impact on the result of this report, which, along with the lack of data on the exact UK-EEZ landings amount, explains the exclusion of said landings.

Sweden is a minor taker of fish from UK waters, with only 4.55% of the volume (as illustrated in Figure 4.8). In the four Danish ports, 9% of the landed value were, over the last 12 years, landed by Swedish vessels. During this period, Sweden has landed an average value of ca. DKK 57 million/year in Skagen, which by far receives the highest landed value from Sweden of the four ports. However, only an unknown part of the ca. DKK 71.2 million/year landed by Swedish vessels in the four ports came from the UK EEZ. For Hanstholm (the second largest receiver of Swedish landings from the UK EEZ), the value of Swedish landings is an average of ca. DKK 8.6 million/year compared to the ca. DKK 64.6 million/year of landed fish from the UK EEZ by Danish vessels (Table 4.5.). Hanstholm received landings from German vessels of ca. DKK 25 million/year in average during the last 12 years, making up 3.6% of the total landings. Second to Hanstholm, Thyborøn received the highest value of German landings, corresponding to 2.63% of their total landings. The overall impact of Swedish and German landings are, based on the presented figures, considered to be insignificant.

5 ANALYSIS OF THE SOCIO-ECONOMIC CONSEQUENCES OF BREXIT

The following two sections present the two central assessments of the report. The first assessment focuses on the potential economic and employment consequences of the two scenarios. The second section considers the consequences for the four communities. This is done through an evaluation of how the communities depend on Danish landings from the UK EEZ and their resilience towards a potential recession. The two sections are followed by an evaluation of other potential effects and trends that could influence the outcome of Brexit for the four fishing communities.

5.1 Economic and employment consequences

This section presents the analysis of economic and employment consequences of Brexit based on two scenarios. The methods for operationalisation of the scenarios and calculations are briefly described in the text and further elaborated in Appendix 8.2. The operationalisation of the scenarios is firstly elaborated and is then followed by calculations of economic and employment consequences of two scenarios.

5.1.1 Operationalisation of scenarios

As mentioned in the introduction, two scenarios were formulated by the ministry in March 2017, both based on the assumption that the UK EEZ will be closed for Danish vessels.

> ***Scenario 1:*** *Quota rights are maintained and will be caught outside the UK EEZ. No changes in landings in Danish ports.*
>
> ***Scenario 2:*** *Catches so far fished in the UK EEZ cannot be caught elsewhere and are lost for the Danish vessels. Landings in Denmark are reduced by 100% of what has so far been landed by Danish vessels from the UK EEZ.*

The scenarios are analytical and are not intended to be "realistic" in a way that they can be used to predict a real outcome of the Brexit process. It is at present impossible to predict the actual outcome of the Brexit process and the subsequent complexity in terms of direct and indirect impacts on the Danish fishing sector and the local communities. The scenarios should rather be seen as best- and worst-case scenarios, illustrating the width of possible consequences of Brexit for the fishing communities.

It is important to stress that the assessment is focused on the *immediate* consequences for the four main ports in Denmark as a result of the two scenarios. This means that *dynamic effects* at sea (displacement of fishing activities, change of flagging, etc.) or on land (alternative sourcing for the industry, alternative employment opportunities, etc.) are NOT taken into consideration in the calculation of employment and economic losses. The scenarios have been operationalised as follows:

Scenario 1:
The maintained volume of landings means that the processing industry in Denmark is not affected.

The vessels that have so far fished in the UK EEZ are affected by having to catch the fish outside the UK EEZ. The specific actions taken by the vessels and the effects for the vessels are complex, as described in Appendix 8.2, but remains otherwise outside the scope of this report. Therefore, the operationalisation and calculation is based on simplified assumptions. It is assumed that the landing value of the current UK EEZ catches is reduced reflecting that some species can only be caught in a lower quality and therefore lower landing value and to a higher cost (lower CPUE). Following this, the spending for variable costs for the catches currently fished in the UK EEZ will be reduced by 50 % of the current landing value. This will result

in reduced turnover in the sectors providing services for the variable costs (wages for labour, fuel, landing sale and distribution and finally maintenance) according to the cost distribution in the accounts for the ≥40 m trawlers. Calculations of employment effects (loss of jobs) in the communities are based on the turnover/job relation in account statistics for selected sectors (Statistics Denmark REGN1 and FIREGN2). In the allocation of the economic and job effects, the effects are allocated to the home port, although the vessels may not necessarily use labour or services from the home port.

Scenario 2:
This scenario includes two elements: the vessels reduce spending for variable costs (as in scenario 1) and loss of landings in the ports, and thus a loss of resources for the industry.

The first element links to scenario 1, with the difference being that the volumes so far caught in the UK EEZ cannot be caught in the remaining EU waters. Therefore, 100% of the value of landings from the UK EEZ are lost. This is assumed reflected in reduction in vessels investments in variable costs at the same level as the landing value, and thereby leading to reduction in turnover for the service providers in the home port. Likewise, the employment effects will double compared to scenario 1.

The second element is based on data on landings from UK-EEZ waters by Danish vessels. All of these landings are lost for the processing industry. As mentioned in the previous section, the landings caught in UK waters by other nations' vessels are very limited. The loss of fish resources is mainly within three species/groups: species for non-human consumption, mackerel and herring, which all are processed in highly concentrated segments of the processing industry. In practice, the effects can almost entirely be located in five companies, two in fishmeal and oil, two in herring and one in mackerel. The employment effects are based on an assumption of direct proportionality between the loss in share of fish resources for processing and share of jobs. The assumptions behind scenario 2 is further developed in Appendix 8.2

5.1.2 Scenario 1 – Economic and employment effects

In 2016, 35 vessels caught 15% or more of their total landing value in the UK EEZ, and these 35 vessels accounted for 98% of all Danish catches in the UK EEZ. Thus, the following analysis focuses on loss of gross profit, and the resulting reduction of variable costs for those 35 vessels. The UK-EEZ catches by vessel are estimated based on an assumption of an average share of UK-EEZ catches for all, divided by species (Table 5.1). Based on this, the volume and value of landings from the UK EEZ for each vessel is calculated, reflecting differences in catch composition with regard to species and catch areas.

Table 5.1: Thirty-five vessels with +15% of landings value in UK EEZ: total landing value, value of UK-EEZ catches and relative UK-EEZ share of all catches, 2016. Source: The Danish AgriFish Agency vessel register, logbook and sales notes register.

	Total landing value, DKK 1,000	UK-EEZ value, DKK 1,000	UK of total, %
Flatfish	17,987	5,343	29.7%
Nephrops	1,775	127	7.2%
Industrial species	413,486	145,236	35.1%
Mackerel	295,374	257,266	87.1%
Shrimp	-	-	-
Herring	624,515	494,697	79.2%
Cod	177,861	79,389	44.6%
Other species	8,368	195	2.3%
Total	1,539,368	982,253	63.8%

A few of the 35 vessels were registered with Christiansø and Esbjerg as home ports. Based on interviews in the ports, it was revealed that they in fact were operating out of Thyborøn or Skagen. In the calculations, these vessels are considered as having Thyborøn and Skagen as home ports. Based on this, the total value of catches from the UK-EEZ area is calculated based on home port (+ de facto home ports).

Table 5.2: Value of landings from the UK EEZ for vessels per home port (+ de facto home port), 2016. Source: Own calculations based on the Danish AgriFish Agency vessel register, logbook and sales notes register.

Home port	UK-EEZ value total (million DKK)	50% of UK-EEZ value (million DKK)	Vessels' relative UK dependency for total catch value, %
Hirtshals	432.4	216.2	73.1
Hanstholm	49.1	24.6	43.1
Thyborøn	105.1	60.7	41.4
Skagen	283.0	189.6	70.1

The short-term effects of loss of gross value for the vessels are assumed to lead to reductions in the variable costs by 50 % of the landing value of the current UK EEZ catches. The reduction in variable costs is assumed to follow the normal allocation according to the account statistics of the ≥40 m trawlers: wages (41%), fuel (34%), landing, sale and distribution (6%) and maintenance (19%) (Statistics Denmark FIREGN2). This will reduce turnover in companies within the different sectors.

Table 5.3: Loss of income/turnover in sectors under scenario 1. Based on Table 5.2 and the distribution of variable costs for ≥40 m vessels, by home port, 2016 data, million DKK. Source: Statistics Denmark FIREGN2.

Home port	50% of the UK-EEZ value (million DKK)	Wages (million DKK)	Fuel (million DKK)	Landing, sale, distribution (million DKK)	Maintenance (million DKK)
Hirtshals	216.2	88.6	73.5	13.0	41.1
Hanstholm	24.6	10.1	8.4	1.5	4.7
Thyborøn	60.7	24.9	20.6	3.6	11.5
Skagen	189.6	77.7	64.5	11.4	36.0

The loss in turnover for employees/companies is assumed to lead to a reduction of jobs (e.g. not leading to an immediate reduction in accepted wage level for the fishers, or for the home port based service providers in reduction in other costs or profit). The conversion of turnover to jobs is based on the relation between turnover and number of employees in the relevant sectors. The conversion rates are calculated as: wages: 1.1 million DKK/job;[2] fuel: 10 million DKK/job; landing, sale and distribution: 1.6 million DKK/job; and maintenance: 1.8 million DKK/job (Statistics Denmark, Accounts statistics by industry and Account statistics for fishery by vessel length) – see Appendix 8.2 for a discussion of the conditions.

[2] Note the discussion in Appendix 8.2 claiming that the immediate response to less wage payment is most likely reduction of the salary for the fishermen rather than laying them off. The number of lost jobs may therefore be overestimated.

Table 5.4: Loss of jobs in sectors under scenario 1. Based on Table 5.3 and conversion factors by sectors, 2016 data. Million DKK and number of full-time equivalent jobs. Source: Own calculations based on Statistics Denmark REGN1 and FIREGN2.

Home port	Total (million DKK)	Wages, (no.)	Fuel, (no.)	Landing, sale, distribution, (no.)	Maintenance, (no.)	Total, (no.)
Hirtshals	216.2	81	7	6	26	120
Hanstholm	24.6	9	1	1	3	14
Thyborøn	60.7	23	2	2	7	34
Skagen	189.6	71	6	5	23	105
The region	491.0	183	17	14	58	272

Based on the calculation of scenario 1, losing 50% of the value of what is currently caught in the UK EEZ would result in a loss of investment in variable costs of DKK 491 million for the whole fleet. The largest proportion of this is for vessels with home ports in Hirtshals and Skagen (losses of DKK 216.2 million and DKK 189.6 million, respectively). A smaller amount would be lost for the vessels with their home port in Thyborøn (DKK 60.7 million) and a relatively small amount for vessels with their home port in Hanstholm (DKK 24.6 million).

It is assumed that reduced variable costs for the vessels will be distributed as less wages for the crew members and reduces investment in other variable costs. This would lead to laying off crew members and in the sectors providing services for the vessels. This is calculated to result in a loss of 272 jobs on a regional level. Of these jobs, 67% are within the fisheries[3] and the rest are in companies providing services. The losses of jobs are calculated at port/community level, but as the vessels are highly mobile, the local allocation of job losses is debatable. It is more likely that the effects for the individual vessel will spread to several ports and communities. This means that a regional estimate of employment effects better reflects the actual consequences than estimates at a community level.

5.1.3 Scenario 2 – Economic and employment effects

Scenario 2 takes its point of departure from scenario 1. The same 35 vessels and their home ports are in focus for the first part of the scenario – loss of turnover and gross profit for the vessels and the effects in the home ports (or in the region). The only difference is that the loss of income is 100% of the value currently fished in the UK EEZ. Therefore, consequences in the form of loss of turnover in land and the job effects will double compared to scenario 1.

Table 5.5: Value of UK-EEZ landings for vessels in home ports (+ de facto home port), 2016. Source: Own calculations based on the Danish AgriFish Agency vessel register, logbook and sales notes register. Source: Statistics Denmark FIREGN2.

Home port	UK EEZ value total (million DKK)	Vessels' relative UK dependency of total catch value, %
Hirtshals	432.4	73.1
Hanstholm	49.1	43.1
Thyborøn	105.1	41.4
Skagen	283.0	70.1

[3] Again, note that the most likely practical effect of reduced wages would be lower payment to the fishermen, rahter than laying off the fishermen, as discussed in section 8.2

Table 5.6: Loss of income/turnover in sectors under scenario 2. Based on Table 5.5 and the distribution of variable costs for ≥40 m vessels, by home port, 2016, million DKK.

Home port	UK-EEZ value (million DKK)	Wages (million DKK)	Fuel (million DKK)	Landing, sale, distribution (million DKK)	Maintenance (million DKK)
Hirtshals	432	177	147	26	82
Hanstholm	49	20	17	3	9
Thyborøn	121	50	41	7	23
Skagen	379	155	129	23	72

Table 5.7: Loss of jobs in sectors (excl. processing) under scenario 2. Based on Table 5.6 and conversion factors by sectors, by port, 2016, million DKK and number of full-time equivalent jobs. Source: Own calculations based on Statistics Denmark REGN1 and FIREGN2.

Home port	Total (million DKK)	Wages, (no.)	Fuel, (no.)	landing, sale, distribution, (no.)	Maintenance, (no.)	Regional total, (no.)
Hirtshals	432.4	161	15	12	51	240
Hanstholm	49.1	18	2	1	6	27
Thyborøn	121.4	45	4	3	14	67
Skagen	379.1	141	13	11	45	210
The region	982.0	366	33	28	117	544

The second element of scenario 2 considers the consequences of the loss of fish resources for the processing industry. In the scenario, all of the landings from the UK EEZ are lost.

According to interviews, the landings from the UK EEZ mainly go to five larger processors of herring, mackerel and fishmeal and oil. In spite of several possible companies processing other species for human consumption, the volume is so marginal that this is not further examined and taken into consideration here.

The five larger companies lose considerable shares of the total fish resources for processing under scenario 2. It is assumed that the relative loss of jobs in relation to the total current jobs is proportional to the relative loss of raw materials. Based on employment data from account registrations, the number of jobs lost in case of scenario 2 is calculated. The specific calculations are not demonstrated due to discretion. The method is further elaborated in Appendix 8.22.

Based on the above calculations, the direct loss of jobs in the processing industry would be approximately 300. The assumption of direct proportionality between the share of loss of fish resources and the share of loss of jobs may not be realistic. To some degree, processing activities can be reduced proportionally, but at some point the profitability of the remaining production might be questionable. The effects of loss of fish resources might therefore be stronger than calculated if one or more companies are forced to take radical steps because the remaining production is no longer profitable.

Based on the calculation for scenario 2, losing all current catches in the UK EEZ would result in losses of income for the whole fleet of DKK 982 million. The largest loss is expected for the fleets with home ports in

Hirtshals (DKK 432.4 million) and Skagen (DKK 379.1 million) and smaller losses are expected for the vessels with their home port in Thyborøn (DKK 121.4 million) and Hanstholm (DKK 50 million).

It is assumed that the economic loss for the vessels will be distributed as less payment to crew members and reduced investment in other variable costs. This would lead to layoffs of crew members and in the sectors providing services for the vessels. This is calculated to result in a loss of 544 jobs in the region. Of these jobs, 67% are within the fisheries, with the rest being in companies providing services. The job losses are calculated at the community level, but as the vessels are highly mobile, the specific allocation of job loss is debatable. It is more likely that the effects for the individual vessel will spread to several ports and communities. This means that a regional total of the job effects better reflects the actual consequences than data at the community level.

The loss of catches in scenario 2 leads to a loss of all landings from the UK EEZ. This will at first primarily affect five large processing companies in northern Jutland. The loss of jobs resulting from loss of raw materials for processing is assessed to be 300 jobs for the companies, as can be seen in the Table 5.9, below.

In scenario 2, the total loss of jobs for the vessels, service companies, ports and processing companies would be 844 jobs in northern Jutland. The calculations for these estimates of job losses are presented in Appendix 8.2.

5.1.4 Conclusions on economic and employment consequences of Brexit scenarios

In conclusion to the assessment of the two scenarios presented above, the overall findings are presented and clarified in Table 5.8.

The two scenarios both assume that the UK will close their EEZ for Danish vessels. In scenario 1, the current quotas are maintained but the value of the landings of what is fished in the UK EEZ is only 50% because it has to be fished elsewhere. Nevertheless, the landings are assumed not to change compared to the current situation. In scenario 2, the Danish fleet also lose fishing rights for what has until now been fished in the UK EEZ. This also means that all Danish landings from this area are lost for the Danish processing industry.

Based on the two scenarios, the direct effects were calculated in terms of economic losses of the value of landings for the vessels as DKK 491 million and DKK 982 million for scenario 1 and 2, respectively. This loss of jobs in different sectors at the regional level was assessed to be 272 and 844 jobs (full-time equivalents) for scenario 1 and 2, respectively, as summarised in Table 5.8.

Table 5.8: The calculated direct loss of income for vessels and no. of jobs lost (full-time equivalents) under scenario 1 and 2 – all at the regional level.

	Total loss of income (million DKK)	**Fisher-men** (no)	**Oil industry** (no)	**landing, sale, distri-bution** (no)	**Mainte-nance** (no)	**Processing** (no)	**Total loss of jobs** (no)
Scenario 1	491,0	183	17	14	58	0	272
Scenario 2	982,0	366	33	28	117	300	844

These estimates only include the direct consequences; the spread of effects in the local communities is not taken into consideration.

The local and regional spread of effects depends on the structure of local value chains and labour markets. This means to which degree those laid off as a direct consequence are local or from regions, and the secondary and tertiary effects are local, regional or broader.

In some reports, a rule of thumb mentioned is 3–4 jobs on land for every job at sea (Oceana, 2017, or Teknologisk Institut and IFM, 2008). Based on three jobs in land per job at sea, the total loss of jobs would be up to 1,500 under scenario 2.

The catchment area analyses (in Danish: oplandsanalyser) on the ports, based on the CTU regional economic model (Center for Regional og Turismeforskning and SDU, 2017a, 2017b; Madsen et al., 2017), shows that the indirect jobs generated by the ports is up to 1.5 times the jobs generated directly by the ports. Given that all the jobs calculated here are considered as direct, port-related jobs, the total effect of scenario 2 would be a loss of 2,100 jobs.

5.2 Overall influence from decreasing fishing activities in the four communities

The consequences of Brexit are, as indicated above, not limited to the fishing industry and related industries. The effects of scenario 1 and 2 of this report will not only lead to consequences in terms of jobs lost within fishing-related industries but will inevitably spread out and affect the four communities in ways that are challenging to predict.

The history and development strategies of the four communities have over time resulted in four communities with different capacities and opportunities to resist potential negative developments within the fishing industry. The communities are not equally dependent on the fishing industry and there are likewise different influential pressures in the four communities that affect their resilience. There are however some socio-economic and socio-cultural effects that could influence all four communities. In several interviews, concerns were raised about the influence of a potential economic loss in the fishing industry on the overall income of the municipality and what consequences this could bring. Also, the influence on end prices and the resulting effects on Danish food culture were raised as a potential problem.

5.2.1 Dependency

The dependency of the four communities on landings from the UK EEZ has in this report been determined by the proportion of Danish landings from the UK EEZ out of the total landings as well as the overall influence of landings compared to other port activities and the influence on community level. The dependency on landings from the UK EEZ can be assessed by three different levels of dependency (i.e., the fishing industry, the port and the community). These three levels are represented in the three elements in the equation below. The first element (1) represents the fishing industry's dependency on landings from the UK EEZ. The second element (2) represents the port's dependency on the fishing industry. The third and final element (3) represents the community's dependency on port activities. In combination (illustrated by multiplication), these elements indicate the dependency of the community on landings from the UK EEZ. For further elaboration on the application of this equation, please refer to Appendix 8.3.

$$Dependency = \underbrace{\frac{Landings\ from\ UK\ EEZ\ (Danish)}{Total\ landings}}_{(1)} \times \underbrace{\frac{Total\ landings}{Gross\ value\ added\ port}}_{(2)} \times \underbrace{\frac{Employees\ at\ port}{Inhabitants}}_{(3)}$$

Figure 5.1: The dependency equation.

The equation has been used in a comparative analysis of the four communities. Thus, the calculated results of the three elements in the equation have been used as a comparative measure for the four communities and are thus not intended to be viewed in isolation. In addition, averages of other Danish fishing communities were calculated for elements (2) and (3) in order to compare the four communities to other Danish fishing communities. For the third element, it should be noted that the influence of commuting is not calculated; thus, if the third element is high, this could be an indication of a high level of commuting to this community. The results can be seen in Table 5.9, below.

Table 5.9: The calculated elements of the equation. The results have been ranked low, medium and high based on a comparison of the four communities within each category and the national average for the second and third element.

Community	(1) Fisheries dependency on UK-EEZ landings	(2) Port dependency on fisheries	(3) Community dependency on the port
Skagen	medium	high	medium
Hirtshals	high	low/medium	high
Hanstholm	low	high	high
Thyborøn	medium	medium/high	high

For **Skagen,** the landed value of fish from the UK EEZ has been medium when compared to the other communities. The importance of the landings from the UK EEZ for the fishing activities in Skagen should however not be neglected, since the absolute value and volume are high. Fishing is still a crucial element of the port activities, being the largest pelagic port in the country, which can be seen by the second element (2), which was assessed to be high. However, the growing number of activities in cruise ships does result in a minor decrease in dependency on fishing activities. Also, related to this trend, the community in general has an influential level of tourism activities and is the largest of the four communities in terms of numbers of inhabitants, which is why the dependency for the third element (3) was assessed to be medium, the lowest of the four communities. However, this should not be seen as an indication for the port not being influential in Skagen. Respondents have indicated that the port is an integrated and paramount element of the community, including its activities. Skagen experiences less commuting to the community than the rest of the four communities, thus the impacts on the fishing industry and fishing-related industries should be expected to be more local than regional. The dependency is therefore more likely to have local socio-cultural consequences, since the effects of Brexit would be less spread out than in the case of the other communities.

While **Hirtshals** has proportionally the highest dependency (0.30) on landings from the UK EEZ among the four communities (1), Hirtshals receives the smallest value and volume of landings from the UK EEZ. The dependency is also not as severe when compared to the overall economic influence of the port (2), which was calculated to be low/medium. This is most likely because the fishing industry is only responsible for a minor part of the income of the port, since the port of Hirtshals has many activities (e.g., ferry activities and shipping). The dependency on the port for the community as a whole (3) was calculated to be high, which could be an indication of a high level of inbound commuting. Also, a significant part of value creation and jobs related to the fishing industry in Hirtshals is situated outside of Hirtshals in the processing factories in

Sæby and Aalbæk. It should therefore be expected that socio-economic consequences of a decline in landings due to Brexit will to some extent be shared between the communities of Hirtshals, Sæby and Aalbæk as well as the adjoining areas. The dependency of Hirtshals on UK-EEZ landings should therefore not be seen entirely as being locally linked to Hirtshals but rather that it is regionally spread out.

Thyborøn has a medium dependency on fish from the UK EEZ (1) relative to the other communities; however, it has the largest volume of landings, which is due to a high amount of landings of species for non-human consumption. In terms of the economic influence or the port in general, the dependency was calculated to be medium/high (2). With the exception of the nearby chemical factory, Thyborøn does not have a substantial number of alternative jobs and sources of value creation unrelated to the port. The port is therefore paramount to the community and the third element is thus also high (3). The overall dependency of Thyborøn on the Danish landings from the UK EEZ is therefore considered to be high.

Hanstholm has the lowest dependency on landings on fish from the UK EEZ of the four communities (1), despite the actual volume of 28,192 t/year being higher than the volume landed in Hirtshals. The influence of total landings compared to the gross value added from all port activities is seen as fairly significant and was calculated to be high, while the Port of Hanstholm is the largest in the country in terms of landed fish for direct human consumption (2). The dependency on the port at the community level is seen as relatively high, since alternative working places in Hanstholm are limited. As with Hirtshals, the dependency should be seen as regionally anchored, since Hanstholm also experiences net inbound commuting.

5.2.2 Resilience

The resilience of the communities has been assessed based on the communities' population size, other activities in the community that could compensate for any decline in fishing-related activities and statements from respondents. All four of the communities are dealing with decreasing populations. This has already challenged the resilience of the four communities. With an additional negative influence from the fishing industry, this could put further pressure on the resilience of the four communities and lead to further population decline.

Resilience and dependency are interlinked concepts in the way that both vary according to the variety and extent of other non-fishing-related activities taking place in the community. Thus, if a community is highly dependent on fishery, the community probably shows low resilience and vice versa.

The resilience of the four communities is influenced by an increasingly globalised market for the companies that supply the fishing industry with services and ship components. These companies have increasingly widened their markets to neighbouring countries and global markets. This increases the resilience of such companies and might contribute to secure jobs in the four communities.

Another element that strengthens the resilience is the fact that the fishing industries of the four communities continuously experience challenges and structural changes, which with time have resulted in an independent, adaptable and flexible industry. This indicates a high resilience. However, when it comes to the resilience of the communities as a whole, the resilience is also affected by other factors such as decreasing populations.

Skagen has the largest population of the four communities, albeit with the largest decline during recent decades. The community has a thriving tourism industry that is still growing, and this could to some extent compensate for loss of jobs and value creation in Skagen if the fishery sector should experience a decline. However, it is not considered by the respondents that the increasing cruise ship activities can in any notable way compensate for a recession in the fishing industry. It was also emphasised by the respondents

how the fishing activities are key to attracting visitors to Skagen, and thus a recession in the fishing industry could over time have a negative influence on the number of visitors. One view of the respondents was that the fishing industry is paramount to the permanent residents of Skagen. If the fishing activities stopped altogether, it was expected that Skagen would transform into being only a holiday destination and not a place for permanent residency. Although the scenarios of this report only assume a 21.7% decline in landed value in Skagen at worst and not a total halt, this perception of the dependency between fishing activities and the residents of Skagen emphasises the interrelationship between the fishing activities and the continuation of Skagen and indicates a low resilience in case of a recession. The seasonal fluctuations in customers for the local businesses would, all things being equal, be worsened with a recession in the year-round fishing industry. Since the tourism industry in Skagen is growing due to the increase in the number of cruise ships, one could argue that this increase in customers could compensate for a potential decline in jobs and reduced income in the fishing industry. However, while this to some extent could be the case, the increased annual fluctuations and loss of income from permanent residents could challenge the continuation of the community as it is today.

Hirtshals also has a decreasing population, although with a lower rate than Skagen. This may influence the resilience negatively. However, Hirtshals offers other activities not dependent on fishing activities such as the Science Park and Oceanarium, along with the ferry activities mentioned in section 3. This makes Hirtshals more resilient, although it is expected that the direct compensation for any loss of jobs in the fishing sector would be low. In Hirtshals, respondents are concerned not only with the direct effects of a recession in the fishing industry and related industries but also the effects that the reduced income could have on the financial state of the municipality. A reduced income for the municipality would in return spread out to areas not directly linked to the fishing activities. Another issue would be the potential impact of a recession on investments in future developments. If plans for development in the fisheries or fishing-related industries are dropped due to a reduction in fishing activities, this could have long-term consequences for the sustainability of Hirtshals, economically as well as demographically, by accelerating the declining number of inhabitants.

Due to the dependency on the fishing industry of the harbour, **Hanstholm** is considered to be relatively fragile in relation to changes within this industry. A significant loss of jobs within the fishing industry would spread out in society to activities related to this industry (blacksmiths, carpenters, electricians, masons, etc.). The options for alternative jobs are considered minimal, since alternative areas for work (such as commerce in the community and the public sector) would also experience a decline in demand and a decreasing income for the municipality. Hanstholm also has the second smallest population, which could indicate a lower resilience in terms of the survival of the community.

Thyborøn, being the smallest of the four communities, is also highly dependent on alternative jobs and activities in the event of strong consequences of Brexit as in scenario 2. Alternative working places are however few, since many jobs are, if not directly, indirectly connected to fishing activities. One larger job hub is the Cheminova factory, but it is not considered realistic that this company can take in all fishermen who potentially could become unemployed due to Brexit. Other activities, such as museums and parks mentioned in section 3.4, are mostly ocean-oriented tourist attractions, which may be negatively influenced if the fishery of Thyborøn decreases. This, together with the population size, makes the resilience of Thyborøn relatively low.

5.2.3 Conclusion on potential effects for the communities

Based on the assessments of the dependency and resilience of the four communities, it becomes evident how the four communities are affected differently if Brexit leads to a recession for the Danish fishing

industry. One example is the geographic spread of effects, where negative effects for the fishing activities, especially connected to Hirtshals and Hanstholm, are expected to be regionally spread out. For all of the four communities, recessions are expected to influence the municipalities economically and thereby lead to regional effects.

From the assessment of the four communities' dependency on landings from the UK EEZ, while they were all judged to be medium to highly dependent for at least two of the three elements analysed, there are differences in the pattern of dependency. For example, Hanstholm has a significant part of their landed value coming from species for human consumption from non-UK waters, and thus the first element was calculated to be low. The port of Hirtshals has high gross value added from other non-fishing-related industries, such as ferries and shipping, and was therefore calculated to have low/medium dependency on the fishery at the port level. In general, the four communities are all significantly dependent on Danish landings from the UK EEZ, either because these landings make up a large part of the total landings or because the fishery is highly important for the port and community, and a small change could have significant consequences.

In terms of resilience, the fishing industry is seen as a highly resilient industry due to the experiences it has in adapting to new structural changes, annual fluctuations in quotas, etc. The overall resilience is however seen as being low for all four communities due to decreasing population sizes and a minimal amount of alternative employment opportunities.

Based on the assessments presented, potential effects of Brexit are therefore expected to be locally severe in Skagen and Thyborøn, while the effects connected to the fishing industry in Hirtshals and Hanstholm should be expected to be more geographically spread out. Reduction of the fishing industry in the communities would influence the identity of the fishing communities. As an example, the local fish festivals, which can be seen as a manifestation of the identities, could be at risk, e.g. by reduced financial support from the fishing industry. This could further weaken the four communities' connection to their history as fishing communities.

6 TRENDS AND FURTHER PERSPECTIVES ON BREXIT CONSEQUENCES

The process of interviewing revealed aspects and possible consequences of Brexit outside the scope of this analysis focussing on possible short-term consequences for the four ports and communities. These aspects supplement the findings in the analysis. The aspects mentioned by the respondents regards risk of spread of the consequences to other parts of the fisheries than the part deriving from the UK EEZ. Also discussed during the interviews were potential activities of the industry that could counteract the effects of Brexit.

6.1 Spread effects in the fishing industry

The data used in the report documents that the consequences of the Brexit scenarios are almost entirely related to the large pelagic vessels. The interviews revealed however that the consequences could also spread to other parts of the fishing industry.

Respondents in the ports pointed to a trend in increased demersal fishing for species for human-consumption in the UK EEZ over recent years. The total catches are at a low level, but data confirm this increasing trend from 2011 to 2015. If this trend were to continue, the importance of "other species for human consumption" might be underestimated in this report. The trend might partly be explained by the technological development and investment in larger and better equipped vessels, which increases the opportunities for the middle-sized vessels to travel further and faster in order to reach the best fishing ground (such as the fishing ground Fladen in the UK EEZ). The effects of a closure of the UK EEZ might therefore affect a broader range of vessels with a more mixed catch pattern. Following this, the next links in the value chain, which includes parts of the Danish processing industry, might also be impacted to a higher degree than what has been in focus in this report.

In a more indirect manner, exclusion of the large vessels from the UK EEZ might affect other parts of the fishing industry, which was expressed especially by fishermen during interviews. The exclusion of the large vessels could start a displacement process involving many other vessels. To compensate for lost fishing opportunities in the UK EEZ, the large vessels would occupy fishing grounds until now used by the larger demersal vessels. This process could spread even to the coastal fisheries. This could lead to instability in existing fishing routines and preferred fishing grounds and areas, which would influence income and landings for all Danish vessels, probably mainly in the North Sea and Skagerrak, with spread effects further on in the value chain.

The sectors servicing the fisheries have often already managed to differentiate the markets to other sectors in the area or to non-Danish customers in the fisheries sector, which in this report is seen as an increasing factor for the resilience of the communities. The increased service, maintenance or constructions for English or Scottish fishermen create a new dependency on this market. The possible change in exchange rate following Brexit is a possible (and in this relation unexpected) negative spread effect of Brexit, which could have severe consequences for some companies and thereby affect the communities in general.

6.2 Counteracting activities in the industry

The fishing industry is used to operate in a fluctuating environment, not least because of natural and quota-induced fluctuations in fish resources for processing. Some counteracting activities could therefore be foreseen. These could affect the entire fishing industry and the communities as well.

The fishermen predicted that a closure of the UK EEZ would lead to a change in the fishing areas where they are able to catch the quota – as mentioned above. They were aware that the Brexit process could also question or change the fishing opportunities in the Norwegian EEZ, or at least change the power relations

in negotiations of fishing rights in the North Sea. This could limit their flexibility in compensation for lost fishing grounds in the UK EEZ.

The processing industry, which is only affected under scenario 2, has previously proven able to attract alternative fish resources when the traditional resource was reduced. A likely action from the processing industry to counteract reduced landings from Danish vessels is to try to attract alternative landings. This could be fish that are landed elsewhere today or it could be the "same" fish resources from the UK EEZ but caught by vessels under another flag if Brexit re-allocates the rights to fish the resource to vessels under the UK flag. In this case, the industry would try to counteract changed fishing rights by attracting the resources by offering the best price in the market for the landings. The main concern would be whether the catches from the UK EEZ would be restricted by landing obligations to protect or establish competing UK industries. In the case of restrictions on where the fish is landed, a possible reaction could be investments in processing plants within the areas where the fish can be landed (here the UK). These kinds of steps can be seen in the EU (Denmark)–Norway relation, where Norwegian herring processors invest in processing in Denmark to avoid the duty on processed products from Norway (an EEA country) to EU.

As alternative sourcing, aquaculture is not likely to compensate for the potentially lost landings from the UK EEZ. This is mainly because the main part of the UK-EEZ catches are relative low-value species such as herring and mackerel or species for non-human consumption, which are often reduced to feed for aquaculture.

7 CONCLUSIONS

For the two scenarios of a 50% loss in value of landings and 100% loss of landings, the potential losses of jobs were calculated. The consequences of **scenario 1** are expected to affect the fishermen and ship owners as well as service providers. Under the assumption that loss of landing value leads directly to job reductions, the expected direct loss of jobs was calculated to be 272 jobs at the regional level, while the indirect effects were not assessed. The vessels operate regionally, but based on their home ports this would be distributed as 105 for Skagen, 120 for Hirtshals, 14 for Hanstholm and 33 for Thyborøn. These numbers are job equivalencies and might be reduced to some extent by salary reductions. A 50% loss of landings value in scenario 1 is also likely to have effects further down the value chain, where fish of lower quality could result in a reduction of sales value; however, only the direct potential job losses following a lower value of landings have been calculated in this assessment.

In **scenario 2**, the 100% loss of UK-EEZ landings is expected to affect fishermen, vessel owners and service providers as well as the processing industry due to a loss of landings and therefore resources for processing. The expected direct loss of jobs from a lack of income in the fishing industry was calculated to be 544 jobs at the regional level if reduced salaries are not used to mitigate the effects. Based on the vessel home ports, this would be distributed as 210 for Skagen, 240 for Hirtshals, 27 for Hanstholm and 67 for Thyborøn. The calculated loss of jobs in the processing industry at the regional level would be 300, leading to a direct loss of 844 jobs at the regional level. This does not include job losses from indirect effects on communities, municipalities and the region, which would spread to many other sectors.

Table 7.1: The calculated direct loss of income (turnover) for vessels and induced loss of turnover for service providers, regional level.

	Total loss of income (turnover) in the fishing industry and for service providers (million DKK)
Scenario 1	491,0
Scenario 2	982,0

Table 7.2: The calculated direct loss of income for vessels and number of jobs (FTEs) under scenario 1 and 2 – all at the regional level.

	Fishermen	**Oil industry**	**landing, sale, distribution**	**Maintenance**	**Processing**	**Total loss of jobs**
Scenario 1	183	17	14	58	0	272
Scenario 2	366	33	28	117	300	844

Spreading effects were not included in the assessment. Using a rule of thumb of one job at sea generating three on land would lead to a loss of up to 1,500 jobs in scenario 2. Based on the catchment area analysis (Center for Regional- og Turismeforskning 2017a and b), calculation of direct and indirect job generation of port activities would lead to up to 2,100 jobs lost under scenario 2.

Further potential effects on the fishing industry

The Danish catches and landings of fish from the UK EEZ mainly consist of pelagic species caught by a limited number of vessels (35 in 2016). Over the last two years, there seems to have been a small but growing trend for demersal vessels to fish within the UK EEZ. This trend is supported by the development of

modern, larger demersal vessels that are equipped to be able to fish further away from landing ports. A Brexit-related closure of the UK EEZ might therefore affect the demersal fisheries to a greater extent than could be anticipated based on the historical data and could hamper the current trend in demersal fisheries.

The demersal fisheries and vessels are also potentially affected through the displacement of the largest vessels (pelagic vessels primarily), especially under scenario 1. Several respondents of the demersal fleet feared a reallocation of fishing activities from the UK EEZ to areas where other vessels usually fish. This could start a chain reaction that could eventually affect fishing activities in coastal areas by increasing the competition for the fish resources.

The four ports and many service industries seem to be relatively robust, as most of the ports (as economic entities) have diversified to rely not only on fisheries-related activities but also on goods and passenger transportation, tourism, etc. Likewise, many of the service companies are servicing foreign vessels in the port or as operators in the larger North Sea region or globally. In spite of this, it is possible that the diversification of activities and groups of customers is dependent on the existence of a stable "home market". In addition, there are indications that the uncertainty of the outcome of Brexit negotiations has led to a cancellation or, in best case, a postponing of investments in vessels and infrastructure. It could be considered whether a severe reduction of investments in the long term would raise questions about the attractiveness of the ports and service companies for foreign vessels.

For the processing industry, the assumption that the activities will be reduced proportionally to the potential reduction of fish resources for processing might not be realistic. To some degree, processing activities can be reduced proportionally, but if the reduction in available raw materials reaches a certain (but unknown) level, the profitability of the remaining production might be questioned. The effects of the loss of fish resources might therefore be greater than calculated if one or more companies are forced to take radical steps if the remaining production is no longer profitable.

Effects for the communities

How the calculated loss of jobs and value creation could affect the local communities is determined by the dependency of the four communities on the fishing activities and the resilience of the communities. Also, it depends on how connected the communities are to the surrounding areas in terms of the geographical spread of effects. The assessment indicated that effects of Brexit are expected to be more locally anchored in Skagen and Thyborøn, whereas the effects for Hirtshals and Hanstholm can be more regionally spread out. This could mean that effects will have a greater influence on the local culture and identity of Skagen and Thyborøn both in terms of jobs lost and loss of fishing activities (the latter in the event of scenario 2), which could hamper the connection to, and economic support of, the fishing industry for the communities. The effects in Hirtshals and Hanstholm should to a greater extent be seen in a regional perspective, albeit the communities are also likely to be affected by a loss of jobs and fishing activities, which could influence the cultural activities around the fishing industry.

Also, the resilience of the four communities is influential on the effects of Brexit. They have all experienced a decreasing number of inhabitants over recent decades, which puts pressure on the remaining job hubs. The resilience of the four communities is highly dependent on the variety and number of alternative workings places for the fishermen and employees in the fishing industry who might lose their jobs as a result of Brexit. Unfortunately, there are no industries with the same level of activities and number of jobs as the fishing industry in the four communities, although a small number of jobs might be available. The resilience is also influenced by alternative value creation such as an increased income from tourism or other non-fishing-related activities at the ports. This is especially the case in Skagen, where estimates for

cruise ship passengers are increasing. While this could increase the resilience economically, it is not considered to be a realistic alternative for the unemployed. This could therefore sustain the community but not necessarily its inhabitants and identity, while it would transform from being a community where people live to a community where people primarily visit. In the other communities, ports have increasingly diversified their activities and industries have turned more and more towards the global market. This could help secure jobs in fishing-related industries; however, it might not offer alternative jobs for the potential unemployed.

A loss of jobs and value creation in the fishing industry and fishing-related industries are expected to affect the entire community both in terms of other sectors, such as commerce, and the potential impact on the way in which everyday life is lived in the communities. A tangible symbol of the identity as fishing communities could be the cultural activities such as the fish festivals in Hirtshals and Thyborøn, which is supported economically and by attendance of the fishing industry. Should Brexit result in a loss of jobs and income for the fishing industry, the effects will not only be limited to the jobs lost but will also likely be seen through a change of community cultures and identities that are unique to other Danish communities. The consequences of a Brexit that results in a reduction of Danish catches in the UK EEZ is therefore not only a local and regional loss but a national loss, since Skagen, Hirtshals, Hanstholm and Thyborøn offer unique cultures and are central representatives in the past and present connection between Denmark and the sea.

8 APPENDICES

8.1 Respondents

The following persons have been interviewed personally or by telephone as input for the report:

Communities	Contacts	Institution
Hirtshals	Mette Jensen	Hirtshals' Fish Festival
	Niels Kristian Nielsen (Chairman of the Board)	Hirtshals Fishermen's Association (Hirtshals Fiskeriforening)
	Jan Woller (Vice Chairman of the Board)	
	Jens Kirketorp Jensen (CEO)	The Port of Hirtshals
Hanstholm	Knud Holch Andersen	Local History Archive for the Municipality of Thisted
	Niels Clemensen (CEO)	The Port of Hanstholm
	Martin Bjerre (Head of Administration)	
	Rasmus Buchardt Sørensen (Business Developer)	
Skagen	Hans Nielsen (Secretary)	Local History Archive of Skagen
	Leif Løkke (Sales Manager)	Cosmos Trawl
	Johannes Palsson (CEO)	FF Skagen
	Lars Leer (Head of Finance)	
	Jens Borup (Chairman of the Board)	
	Ole Holm (CEO)	Nielsens Fiskeeksport
	Carl Jesper Hermansen (Chairman of the Board)	Skagen Fishermen's Association (Skagen Fiskeriforening)
	Christian Espersen (Export and Marketing Director)	Skagerak Group Ltd.
Thyborøn	Heidi Ebey Grønkjær (Project Leader)	Konsumfisk and the Fish Days in Thyborøn
	Christian Møller	Local History Archive Thyborøn-Harboøre-Engbjerg
	Niels Olav Vinther Jensen (Owner and CEO)	Kynde & Toft
	Kurt Madsen (Chairman of the Board)	Thyborøn Havns Fishermen's Association (Thyborøn Havns Fiskeriforening)
	Jesper Holt Jensen (CEO)	The Port of Thyborøn
	Peter Jensen (CEO)	TripleNine
Other	Kurt Kiil (CFO), information about the project	Sæby Fiske-industri
	Esben Sverdrup-Jensen (CEO)	DPPO, Danish Pelagic Producer Organisation
	Lise Jørgensen (Owner)	HG 333 Isafold

8.2 Extended description of assumptions and operationalisation of scenarios and calculations

The following explains the assumptions behind the operationalisation of the scenarios and the reservations regarding how the scenarios and industry reaction would be in reality. Then, the assumptions behind the calculations of impact on communities are expanded.

The basic scenarios agreed on with the AgriFish Agency were based on the assumption that the UK EEZ will be closed for Danish vessels and were formulated as such:

> ***Scenario 1:*** *Quota rights are maintained and will be caught outside the UK EEZ. No changes in landings in Danish ports.*
>
> ***Scenario 2:*** *Fish so far caught in the UK EEZ cannot be fished elsewhere. Landings in Denmark are reduced by 100% of what has so far been landed by Danish vessels from the UK EEZ.*

This allows for operationalising different aspects of the scenarios.

- Vessels retaining the quota but losing the fishing grounds of UK-EEZ – how would they react, what would the economic affects be, and how would this affect the communities?
- When the loss of income for the vessels is transferred to the communities, how is the loss of income converted to loss of jobs?
- How is the loss of landings, and thereby loss of fish resources for the fish processing industry, distributed and how will this influence the number of jobs in the processing industry?

8.2.1 Calculating the loss of landing value for the vessels and allocation to land-based sectors in the scenarios

Under scenario 1, the vessels will fish their quotas outside the UK EEZ. In scenario 2, this is not possibly and the catches are lost. Scenario 1 in particular presents relatively complex reaction processes for the vessels, which is actually outside the scope of this report. Here, we briefly discuss the possible consequences, which concludes that we use a set of quite simple assumptions for the further calculations of consequences for the communities.

For vessels normally fishing within the UK EEZ, some of this catch in reality cannot be taken outside the UK EEZ (e.g., sand eel, which is mainly fished in the UK part of Doggerbank). Other species *can* be fished outside the UK EEZ, but at a cost. The quality of the fish might be lower (if the fish is in another stage of the life circle, smaller or with a lower fat content), and/or the cost of catching might be higher (a lower CPUE, catch per unit effort), because the vessel have to spend more time to find and catch the same volumes. In reality, the vessel owner would have to give up catching parts of their quota (e.g., sand eel in the UK EEZ) and could decide not to catch the part of the quota with a too low CPUE. The situation in scenario 1, more or less equalises the scenario 4 in the report made by IFRO at Copenhagen University (Andersen et al 2017). This concludes that the landing value for current UK EEZ landings is reduced by 78 % and the gross profit by 80 % compared to the 0-scenario (non or pre-Brexit scenario) (based on Andersen et al 2017, table III.5). It is however clear, that the capacity freed by this process (days at sea) could be used for fishing alternative species or places (e.g., non-quota species), which would counteract the effect described above.

In this context the focus is on the consequences for the communities, rather than the vessels. It is not clear how the loss of gross profit for the vessels would be allocated between the ship owner (as reduction of profit for the owner) and reduction in the variable costs (as the fixed costs cannot be reduced in the short

term). The effect of reduced profit for the owner is out of the scope of this analysis, while the reduction in variable costs is assumed to be transferred as reduced turnover for those providing the services behind the variable costs. The variable costs are wages, fuel, landing services (landing, sale and distribution) and maintenance. In the real world, the cost of fuel and maintenance depends on the number of days at sea, while landing costs and wages depends on the turnover. This means that the variable costs for fuel and possible maintenance would increase if more time and effort were spent on catching the quota, while wages and landing costs would decrease with a lower turnover. Which strategy the vessels would chose is unknown, and we therefore cannot predict how the trends in the variable costs would be.

Given the complexity of the allocation of the loss of profit (loss of turnover and higher costs), and the complexity in the development of the variable costs the calculations for operationalisation of scenario 1 are based on a simple operationalisation:

- The reduction in gross profit leads to a 50 % reduction in the variable costs categories, though only for cost related to the catches normally caught in the UK EEZ.
- The loss of spending on variable costs are distributed with the same share of each type of variable cost, according to the account data for the ≥40 m trawlers (Statistics Denmark FIREGN2): wages 41%, fuel 34%, landing costs (including transportation) 6% and maintenance 19%.
    - This means that the owner's share (reduction of profit) is not taken into consideration in the calculations, as we cannot address the consequences of this in terms of jobs – either regionally or in the communities.

Based on the discussion of the "real" effects for the vessels above, where some species cannot be fished, while other can be fished at higher cost and/or in another quality, clearly questions the assumption of an unchanged landing pattern. Nevertheless, this assumption is maintained in scenario 1, partly because the vessels *can* take counteractive steps.

8.2.2 Allocation of lost landing value to reduced turnover for sectors at the home port

In both scenarios, the reduced spending on variable costs for the vessels is allocated to the home port of the vessel, assuming that the reduced spending is allocated to the respective home port resulting in reduced turnover in the respective industries (including fishermen in form of wages).

The allocation of reduced activities to only the home port is a rough assumption of various reasons. The crew is not necessarily living in the home port community. The vessels land where prices are best and where the market is (especially for direct landings). This is often not the home port. This means that bunkering fuel, landing costs and maintenance might be in the landing port rather than the home port. Large maintenance is also often directed to the yards with capacity for the vessel rather than the home port. Interviews have revealed that the behaviour of the service operators is also regional, sometimes traveling to other ports to provide services to the vessels they are used to service. They are also partly working on a regional level rather than purely at a local level. The job effects of the two scenarios is therefore indicative for the local community but should rather be seen aggregated as regional effects. The effects of the loss of jobs is calculated for the region because of the low number of processing industries.

8.2.3 Modelling the economic and employment consequences of the scenarios

The economic and employment consequences of the two scenarios are based on simple modelling of the immediate effects. This means that *no dynamic effects* are taken into consideration; the steps from the industries and communities to counteract the immediate effects and the derived local and regional effects of loss of income and jobs for fishermen or service providers.

The calculations of employment effects (loss of jobs) is based on the assumption that the loss of gross profit for the vessels is directly transferred to reduced variable costs – which is mirrored in reduced turnover in the sectors providing services behind the variable costs.

The calculated loss of turnover for the service providers, including labour (e.g., wages), is converted to jobs based on the turnover/employee relation in general account statistics for the selected sector in Statistics Denmark (REGN1 and FIREGN2).[4] In reality, this would not be the immediate reaction, as the companies might take steps to reduce payed overtime (which, according to interviews, are high at the moment) or profit. Likewise, there would be a time shift in the reduction of labour in order to maintain the specialised labour force. Nevertheless, in just the medium term, the companies would need to reduce labour to fit the actual turnover.

Wages: The loss of wage income is converted to jobs based on the average salary/working day for the ≥40 m vessels and the 24–39.9 m industry trawlers according to the vessel accounts (FIREGN2). The data is weighted with 5 vessels in the group 24–39.9 m and 30 in the ≥40 m groups. The average annual salary is based on the total cost of salaries divided by 180 working days/year – for 2015 this was DKK 1.1 million. Most fishermen are payed by shares of the value of the catch. In practice, the first consequence would be lower income shared between all crew members or more days at sea to earn the same salary rather than laying off individuals. Still, we expect one full-time employee per loss of DKK 1.1 million in income.

Fuel: There is no data available for the relation between turnover and number of jobs in the oil industry. It is assumed that the main part of the cost of oil is for the commodity and taxes. The latter reduces state income; the first influences jobs in the oil business in general. The direct number of jobs related to bunkering of fuel is therefore assessed to be DKK 10 million/job.

Landing, sale, distribution: This covers income for the port and transport industries. Based on accounts for 49003: Freight transport by road and via pipeline, 52000: Support activities for transportation (e.g., cooling stores) and 82000: Other business service activities (packaging), the average turnover/job is DKK 1.6 million.

Maintenance: This sector consists of several industries. Based on accounts for 30000: Manufacture of ships and other transport equipment, 33000: Repair and installation of machinery and equipment and 43002: Building completion and finishing (painters etc.), the average turnover/job is DKK 1.8 million.

8.2.4 Effects of loss of fish resources for processing industries (scenario 2 only)

The assessment of the loss of landings in the ports is based on an average of volumes of landings 2011–2015 of fish caught in the UK EEZ by Danish vessels. The landings are grouped as species for non-human consumption, herring, mackerel and all other species, which is the demersal species all for human consumption.

The other species are mainly landed in Hanstholm. The volumes of these species are relatively low (less than 3% of the total landing volume in Hanstholm). Therefore, the companies that would be affected by losing the other species are not followed and taken into consideration.

The main landings are herring, mackerel and species for reduction (as seen in total in Table 8.1). Mackerel is mainly landed in Hirtshals for one large processor. Herring is landed in Hirtshals and Skagen, in general for one of the two large herring processors and, finally, species for reduction is landed in Thyborøn, Hanstholm

[4] The relevant industries (of 102 industries) were identified based on the industry registration of companies in the ports. The aggregated accounts for these branches has been used for assessing turnover/man-year.

and Skagen for the local fishmeal and oil processors. Based on interviews, these five companies are identified as the companies at risk of losing fish resources in scenario 2.

Table 8.1: Landings from the UK EEZ, Danish vessels. Average 2011–2015, tonnes. Source: The Danish AgriFish Agency vessel register, logbook and sales notes register.

Port	Industry species	Mackerel	Herring	Other species	Total
Hirtshals	1,350	10,674	12,459	7	24,490
Hanstholm	26,905	6	179	1,101	28,192
Thyborøn	74,611	9	700	399	75,719
Skagen	39,020	23	29,091	8	68,142
All other ports in Denmark	18	0	1	75	94
Total	**141,904**	**10,712**	**42,430**	**1,590**	**196,637**

It is assumed that the loss of jobs is directly proportional to the loss of fish resources for processing. Based on interviews, we assume that the companies (in herring and mackerel) get all their resources from Skagen and Hirtshals. The relative loss of raw materials for processing is assessed to equalise the loss of UK-EEZ landings in these ports. For industrial species, the same assumption is made, only with the extra loss of trimmings from herring (50% of the volume of herring). Trimming from mackerel is not included here, which tend to underestimate the importance of the UK-EEZ resource, which might be offset by not including sources from other ports delivered by truck. This assumption is compared to the more precise data on sourcing for the herring industries, which roughly confirm the assumption.

Table 8.2: Relative importance of landing volume from the UK EEZ by Danish vessels of all landings (Danish and foreign) in the four ports, %, average 2011–2015.

Port	Industry	Mackerel	Herring	Other species	Total
Hirtshals	29.4	**49.6**	**57.9**	0.1	42.1
Hanstholm	**27.9**	-	28.8	2.8	20.6
Thyborøn	**37.2**	-	63.3	2.2	34.4
Skagen	**23.0**	10.9	**30.1**	0.0	23.7

The relative loss of fish resources for processing (based on Table 8.2) is expected to result in a loss of jobs with the same relative share (direct proportionality). Based on employment data from account registrations for the Danish Business Authority (here provided by Bisnode), the number of jobs lost in the event of a lack of all UK-EEZ landings from Danish vessels are calculated. The specific calculations are not demonstrated due to discretion.

8.3 Dependency model

For the assessment of how the four communities are dependent on the Danish landings from UK EEZ, a model was constructed. The model is represented by the equation below, which is made of three elements: one for the importance of Danish landings from the UK EEZ for the fishing industry, one for the importance of the fishing industry for the general production of the harbour and one for the importance of the harbour for the community as a whole. By combining these three elements, an indicator is created that represents the importance of Danish UK-EEZ landings for the community, and thus the dependency of the community on these landings.

$$Dependency = \underbrace{\frac{Landings\ from\ UK\ EEZ\ (Danish)}{Total\ landings}}_{(1)} \times \underbrace{\frac{Total\ landings}{Gross\ value\ added\ port}}_{(2)} \times \underbrace{\frac{Employees\ at\ port}{Inhabitamts}}_{(3)}$$

Figure 8.1: The dependency equation.

The applied data for this calculation was selected based on availability and representability. In the selection process, it was prioritised to find data that in the best possible way represented the intended purpose, namely that element 2 (total landings/gross value added for the port) represents the importance of the fishery in the general economic production of the port and that element 3 (employees at port/inhabitants) represents the importance of the port for the community in general.

The latter was particularly challenging, because employees at port are not only constituted by inhabitants of the community in focus but also commuters from the adjoining region. This element (3) is thus also an indicator of commuting (i.e., if the element is high, it is likely that the community attracts a high number of employees from outside the community). One example for this is how Hanstholm has approximately 1,600 employees at the port, which is 74% of the 2,154 inhabitants of Hanstholm, indicating that Hanstholm has a high level of inbound commuting.

Table 8.3, below, contains the data that was used to calculate the three elements for the four communities. Other Danish fishing ports were added for the assessment of whether the calculated outcome for the four communities was high, medium or low for elements 2 and 3. They were not included in the assessment of the first element (1), since the other Danish fishing ports do not receive landings from the UK EEZ.

Table 8.3: The four case communities and other Danish fishing communities and data corresponding to the equation above. Source: Harbour assessments from Danish Harbours and Danish Statistics as well as the Agency for Agriculture.

	DK landings from UK EEZ million DKK	Total landings million DKK	Gross value added, port million DKK	Employees port	Inhabitants
Skagen	182	840	780	1,907	8,088
Hirtshals	148	491	1,555	2,245	5,880
Thyborøn	138	597	848	1,039	2,069
Hanstholm	64	695	619.6	1,600	2,154
Hundested	0	11	170	304	8,832
Rønne	0	18.3	943.7	1,421	13,924
Nexø	0	86.9	116.7	293	3,732
Køge	0	11	1,958.6	2,471	34,937
Korsør	0	2	702	1,738	14,439
Bønnerup	0	28	49.7	105	855
Lemvig	0	-	265	349	7,195
Nykøbing Mors	0	-	199.5	354	9,172

Based on the data above, the three elements were then calculated and an average was calculated for elements 2 and 3. This outcome was then applied in the final distinction of whether the result, and thus the dependency, was high, medium or low. The distinction was made comparatively by the use of the average and an even split in three parts of the overall range of data. For the first element (1), the comparison was done among the four case communities, whereas for elements 2 and 3 the comparison also included the average for Danish fishing communities. The comparison is only done within each column and not in-between columns, as the types of indicators vary from (1), (2) and (3).

Table 8.4: The three elements calculated from the data in the previous table and an average of the second and third element.

	(1) Fisheries dependency on UK-EEZ landings	**(2) Port dependency on fisheries**	**(3) Community dependency on the port**
Skagen	0.22	1.07	0.24
Hirtshals	0.30	0.31	0.38
Thyborøn	0.23	0.70	0.50
Hanstholm	0.09	1.12	0.74
Hundested	0	0.06	0.03
Rønne	0	0.02	0.00
Nexø	0	0.74	0.08
Køge	0	0.01	0.07
Korsør	0	0.00	0.12
Bønnerup	0	0.56	0.12
Lemvig	-	-	0.05
Nykøbing Mors	-	-	0.04
Average (incl. the four ports):		0.46	0.20

Table 8.5: The three elements of the four communities categorised as high, medium, and low, with the medium category covering a third of the overall range of the communities centred around the average.

	(1) Fisheries dependency on UK-EEZ landings	(2) Port dependency on fisheries	(3) Community dependency on the port
Skagen	0.216 (medium)	1.07 (high)	0.24 (medium)
Hirtshals	0.30 (high)	0.31 (low/medium)	0.38 (high)
Hanstholm	0.09 (low)	1.12 (high)	0.74 (high)
Thyborøn	0.23 (medium)	0.7 (medium/high)	0.5 (high)

The scale of low, medium and high is individual for each of the three elements ((1), (2) and (3)), and the numbers of elements in different columns should therefore not be compared. The comparative nature of the model should be taken into consideration if the results are used out of context. As an example, compared to the other communities, Hanstholm is low in dependency of landings from UK EEZ, although it in absolute terms might not be true and might not be felt so by the fishing industry of Hanstholm.

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